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**Southeastern Arizona Working Group
Master Project List
May 5, 2004**

Aravaipa Creek geohydrology review and need analysis

A. Background. Channel down-cutting and other changes in channel geomorphology along with continuing cumulative channelization, bank stabilization, road stabilization, and irrigation diversion projects appear to threaten the integrity of the Aravaipa Creek aquatic ecosystem. The issue regarding the effects of upstream groundwater pumping on the discharge of Aravaipa Creek continues to be of concern. The current level of data is inadequate to clearly determine the severity and trend of changes in the channel geomorphology and discharge. The information is inadequate to predict the long-term consequences of human alterations of the channel. We need this information to learn whether stabilization or reversion to the adverse changes in channel geomorphology and discharge would be appropriate. This information is vital in developing plans and assessing the direction for the protection of the stream and its fish fauna in relation to proposed actions for channelization, bank and road stabilization, irrigation diversion structures, and other forms of channel alteration. These tasks have recovery priorities of 1.

B. Statement of Work/Assistance: Identify, review and generate a summary report regarding the geohydrologic and geomorphologic information available about Aravaipa Creek. The report should contain information about conservation of that area and identify needs, if any, for additional studies to obtain missing information. An entity with appropriate expertise should perform the work in fluvial geomorphology.

Survey of water rights in native fish habitats in the Gila Basin and identification of possible protection and acquisition opportunities

A. Background. Tasks 1.9 in the spikedace and loach minnow recovery plans and tasks 1.2 and 1.3 of the Gila topminnow recovery plan call for identification of possible water rights acquisition or protection opportunities to ensure water flows in the habitats of these species. Although these tasks are priority 2, they are tasks that need to be conducted soon to take advantage of current opportunities and to provide the basis for planning for future actions.

B. Statement of Work/Assistance: An entity with appropriate expertise on water rights acquisition will prepare a report that identifies and ranks areas where water rights acquisition would benefit the spikedace and loach minnows. The experts will also identify where current and future opportunities may exist for the acquisition of those rights from prospective sellers.

The CAP opinion-related species are spinedace, loach minnow, Gila topminnow, and razorback sucker, although many other native species would benefit as well.

Assessment of Colorado squawfish and razorback sucker reintroduction programs in the Gila River basin.

A. Background: Colorado squawfish and razorback sucker were extirpated from the Gila River basin by the 1970s as a result of damming, dewatering, and introductions and establishment of non-native aquatic organisms. Efforts to reintroduce both species were begun in the early 1980s, but initial stockings were largely unsuccessful because of predation by non-native fishes on the relatively small, newly released natives. Later efforts are thought to have met with greater success, in part because size of stocked individuals was increased to remove much of the threat of predation. However, these later releases have not been statistically examined and few quantitative data exist upon which to assess survival of stocked natives, or to make informed management decisions about the future direction of the repatriation program. The objective of this action is to perform an up-to-date programmatic assessment by evaluating survival of repatriated Colorado squawfish and razorback sucker in the Gila, Salt and Verde rivers, and to determine whether such stockings can contribute to recovery efforts in these lower Colorado River basin streams. This action will supplement an existing but under-funded Section 6 program that provides resources to stock and monitor Colorado squawfish and razorback sucker into Salt River and Verde River.

B. Statement of work/assistance: All available, post-1990 Colorado squawfish and razorback sucker release data and monitoring results for the Gila River basin in Arizona, including capture-recapture information, will be statistically analyzed to determine survivorship of each species stocked into each stream. Based upon survival data, an estimate will then be determined of the intensity of future stocking that would be required to establish and maintain populations of each species. Data and results are to be presented in a written Final Report that will also assess overall success of historic stocking and make recommendations as to the role of the project in future recovery efforts for Colorado squawfish and razorback sucker in the Gila River basin.

Loach Minnow and Spinedace Declines in the Gila River Basin

A. Background: All known populations of loach minnow and spinedace are subject to annual or more frequent monitoring by a number of cooperating but independent entities. Participants generally prepare and distribute summary trip reports that provide information on dates and locations sampled, numbers of fish encountered, and habitat, but there has been no integration of the fish data to document status and trends (if any) on a range-wide basis. Although not subject to final analysis, recent monitoring of loach minnow and spinedace over the past decade in New Mexico streams suggests a general decline in both species in that area. It is critically important to conservation of these species to have reliable sampling data, but these data are most useful when they are placed into appropriate temporal and spatial contexts. There is a clear need to collate existing records and prepare a comprehensive document. A management

response in behalf of these species cannot be developed and implemented absent documentation of need.

B. Statement of Work/Assistance: This task will provide funds to New Mexico Department of Game and Fish to (1) analyze recent (post 1985) fish sampling data for all known populations of loach minnow and spikedace in Arizona and New Mexico, (2) document any spatial (local and regional) and temporal changes in distribution and abundance, and (3) identify likely explanations or causes for any observed changes. Activities of this nature are listed as priority 1 in final recovery plans for loach minnow and spikedace (respective step down outline sections 1.1 and 1.2). This work complements and expands upon Task 2 under this Intra-agency Agreement 1425-97-AA-32-00420 between Bureau of Reclamation and Fish and Wildlife Service to continue long-term monitoring of spikedace and loach minnow in New Mexico and long-term data analysis.

Key to Larval Native Fishes

A. Background: Little is known about the ecology and habitat requirements of Gila River fishes because many species were reduced in distribution and abundance prior to intensive research. Understanding factors that control the distribution and abundance of Gila River fishes is a requirement for conservation and restoration activities. A key information gap remains regarding ecology of sensitive early life history stages. Complete descriptions and illustrations of early life stages would contribute to a broader understanding of the ecology of Gila River fishes and facilitate more complete status assessments. This information is pertinent because of the continued decline in the distribution and abundance of endangered fishes in the Gila River basin, New Mexico.

B. Statement of Work/Assistance: Detailed morphological measurements, and descriptive accounts of developmental characteristics of all native Gila River Basin larval fishes (exclusive of salmonids) will be prepared, including comparisons with certain non-native species. A progress report that details specimen availability will be prepared 4 months from execution of the agreement. Annual progress reports will be submitted 12 and 24 months after project inception, and a final project report will be submitted no later than 36 months after project inception, and will consist of detailed species accounts that include descriptions, illustrations, and characteristics for identification of these species. A dichotomous key will be assembled.

Development of Propagation Techniques for Spikedace

A. Background: An essential element in the recovery plan for spikedace in the Gila River Basin is repatriation of the species to streams from where it has disappeared. Supplies of fish for this purpose are expected to come from a fish hatchery, but propagation techniques for spikedace have not yet been worked out. A more thorough understanding of the reproductive biology of this endemic Gila River cyprinid is a prerequisite for any recovery effort. Information

gained from a propagation study can be integrated with field studies to produce a comprehensive understanding of the autecology of this species. The integration of laboratory and field life history information will assist in a better understanding of this species population dynamics and the relationships of flow and water management practices on spikedace. Once propagation techniques are put into practice in a hatchery setting, repatriation attempts can move forward.

B. Statement of Work/Assistance: Dr. Steve Platania of the University of New Mexico will collect spikedace from the Gila River in New Mexico, transfer them to a laboratory, and develop techniques for hatchery propagation. An annual progress report will be produced 12 months from execution of an agreement, and a final report will be due 24 months from execution of an agreement.

Development of propagation techniques for loach minnow.

A. Background: Loach minnow is a fish species endemic to the Gila River basin of Arizona, New Mexico, and Mexico. It is federally listed as threatened because of reductions in population abundance and geographic range. Threats to the continued existence of loach minnow have not been alleviated and reductions in abundance and range continue. Hatchery propagation and repatriation of fish to suitable habitats are among alternatives available for management of imperiled native fishes. Currently only wild loach minnow are available to support such stockings because propagation techniques have not been fully developed for this species. Development of methods to successfully produce this fish in a hatchery environment may prove critical to its future survival and recovery.

B. Statement of Work/Assistance: The objectives of this grant are to (1) assemble and review published and gray literature dealing with husbandry and reproduction of loach minnow, (2) visit streams occupied by reproducing populations of loach minnow and attempt to observe courtship and spawning, determine habitat variables associated with spawning, and acquire live specimens, (3) through experimentation develop and document conditions required to hold and maintain loach minnow in artificial laboratory systems, (4) through experimentation develop and document conditions required to spawn loach minnow in artificial laboratory systems, (5) investigate efficacy of hormone induction of spawning if "natural" reproduction cannot be elicited, (6) develop and document conditions necessary for incubation, hatching, and normal growth of young loach minnow through the juvenile life stage, and (7) produce annual and final reports for review by Reclamation, Fish and Wildlife Service, and others that document all phases of project performance. The budget estimate for this task includes funds to equip the existing facility with commercially-available artificial streams, circular raceways, and aquaria as necessary to perform the intended research. The U.S. Fish and Wildlife Service will retain the rights to the disposition of all fishes held or propagated, as well as disposition of equipment in need of replacement or if the facility closes.

Gila topminnow stockings.

A. Background: A primary goal of the Gila topminnow recovery plan is to repatriate Gila topminnow into suitable sites throughout its historic range. This species has been extirpated from most of its historic range and much of the historic habitat is irrevocably destroyed or contaminated with nonnative aquatic species. However, small isolated habitats still exist that are believed to have the potential for successful repatriation efforts that, with long-term management, may allow this species to persist into the future and possibly achieve some level of recovery. The Gila topminnow stocking program has languished for over a decade due, in part, to lack of resources on the part of the management agencies. During that period, many sites have been identified as suitable for such repatriation efforts and some portion of those have already undergone all or part of the environmental compliance and other paperwork that is needed to allow stocking to occur.

B. Statement of Work/Assistance: Funds will be provided to an appropriate agency to cover costs of stocking of approximately 6, but no less than 4, sites with Gila topminnow that have already undergone environmental compliance. The sites are to be identified and may be on Federal, State, or private lands. Gila topminnow stocks used will be in accordance with the draft revised recovery plan for the species. Funds will be used for equipment, travel, and other costs associated with the stockings and with short-term monitoring of repatriated populations. Long-term monitoring of these repatriated populations could be accomplished by Arizona Game and Fish Department, using section 6 funding under the Endangered Species Act, if available. Some use of the funds for finalization of agency decision and other paperwork may occur.

Repatriation of native fishes into Redrock Canyon.

A. Background: Redrock Canyon, on the Coronado National Forest in Santa Cruz County, Arizona is one of only two remaining natural populations of Gila topminnow on public lands. It is the second largest of the remaining natural populations and the only one in which the entire watershed is in Federal management. As such, its protection and enhancement are critical to survival and recovery of Gila topminnow. Over the past two decades, two native fish species have been extirpated from Redrock Canyon above the natural waterfall located about two-thirds of the way from the top of the watershed to the confluence of Redrock Canyon with Sonoita Creek. Desert sucker was recorded below the falls in 1987 and then not again until 2001. Although desert sucker were not recorded above the falls during the initial surveys of the canyon in the 1970's, it is presumed to have originally occupied most of the canyon. Longfin dace were present above the falls until 1995, but have not been found there since that time, despite thorough sampling. They have remained present and common below the falls. Speckled dace have never been recorded from Redrock Canyon, however, Sonoita Creek below its confluence with Redrock Canyon supports one of only three known speckled dace populations remaining south of the Gila River. It is likely that speckled dace were once a part of the fish fauna of Redrock Canyon, but were extirpated due to the substantial human alterations of the watershed and stream during the past 150 years. During the past decade there have been significant efforts in Redrock Canyon to remove adverse impacts to Gila topminnow and to set the stage for increasing the distribution and size of its population there. As part of future efforts, it is considered important

to restore the other native fish species which once composed part of the Gila topminnow habitat.

B. Statement of Work/Assistance: Funding will be used to cover expenses of obtaining stock of desert sucker, longfin dace, and possibly speckled dace from lower Redrock Canyon or Sonoita Creek and of transporting and stocking those fish into appropriate areas of Redrock Canyon. Project initiation will follow completion of environmental compliance. Monitoring of fishes in Redrock Canyon is conducted on an annual basis since 1987 by Arizona Game and Fish Department (under ESA section 6 funding). Therefore, no additional monitoring is needed at this time.

Repatriation of native fishes into Arnett Creek.

A. Background: Arnett Creek, on the Tonto National Forest, Pinal County, Arizona, has been the subject of ongoing efforts to make it suitable for repatriation of native fishes. A barrier was constructed by the Forest Service, using Reclamation and other funds, and has since been improved to remedy some design weaknesses. Arnett Creek was renovated in 1997 to remove nonnative fish and surveys in summer 2001 found no nonnative fish present. Plans for the stream include repatriation of longfin dace, desert sucker, Gila chub, Gila topminnow, and possibly other native fish species. NEPA analysis has already been completed for this action.

B. Statement of Work/Assistance: Funding will be used to cover expenses of obtaining stocks of the species on the final list and of transporting and stocking those fish into Arnett Creek. Choice of stocks of Gila topminnow will be based on the draft revised recovery plan and those of other species will be based on any existing genetic information or on use of stocks from the most proximate population to Arnett Creek. If Gila topminnow are stocked, then monitoring becomes a responsibility of Arizona Game and Fish Department under their existing section 6 agreement. Otherwise, short-term monitoring funding may require additional CAP native fish recovery funding.

Miscellaneous minor expenses.

A. Background: During the past 5 years of implementation of the CAP native fish recovery and management against nonnative funds, it has become apparent that there is a need for a small amount of funding to be available for miscellaneous expenses that occur during the year. Some of these are small expenses for materials or services that are not specific to any one project, such as minor renovation equipment or supplies or technical background materials. Others are for small projects that need to occur immediately without waiting to be identified in the next year's intra-agency agreement modification or which are for such small amounts that it is impractical to include them as a separate task in a modification. Examples include taking advantage of opportunities for recovery actions where the opportunity will be lost if we wait until an agreement modification can occur, such as one-time windows of opportunity for small Gila topminnow repatriations or small projects for nonnative removal that need immediate action. It

would also be used to provide small amounts of money to assist in recovery or nonnative control projects by other entities, where there are equipment or supply needs and no available funding.

B. Statement of Work/Assistance: To provide for such needs, a small fund will be set aside under the native fish recovery fund. Expenditures of single items not exceeding \$2,500 may be made from this fund by the Service after e-mail approval from Reclamation's technical representative. Expenditures of over \$2,500 may be made after e-mail approval from Reclamation's contracting officer.

Genetic differentiation among Gila River basin chub populations.

A. Background. Three species of the minnow genus *Gila* currently occupy the Gila River basin of Arizona and New Mexico (a fourth species is extirpated). Gila chub (*Gila intermedia*) and headwater chub (*G. nigra*) are stream dwelling endemics of the basin, while roundtail chub (*G. robusta*) has a widespread distribution in larger streams throughout the Colorado River system. The three species typically are allopatric to one another. Recent studies indicate all three chubs have suffered substantial declines in abundance and restriction of geographic range. As a result of these changes and because of continuing threats, these fishes are under consideration for federal listing under the endangered species act.

One management strategy to enhance (or recover) these native fishes is to introduce or repatriate the species into suitable habitats where threats to survival and persistence are reduced or eliminated. However, before such management can be implemented it is critically important to characterize genetic differentiation among and between geographically isolated populations. This is to avoid inappropriate mixing of stocks and ensure that population level genetic variation is conserved. In this way each species or population retains the opportunity to evolve along as natural a trajectory as possible.

B. Statement of Work/Assistance. The purpose of this project is to provide funds to perform basic research into the population level genetic differentiation among and between geographically isolated stocks of Gila chub, headwater chub, and roundtail chub in the Gila River basin. While much already is known about the genetics of these fishes, relationships are complex and poorly understood, and information critical for management is missing.

Sample specimens from a large number (more than 40) of localities representing the geographic and morphological diversity within this complex will be used. Mitochondrial and nuclear DNA sequence variation from these samples will be utilized to quantify levels and patterns of genetic variation. This variation ultimately will be placed in taxonomic and geographic perspective, allowing an assessment of the various factors responsible for observed complexity. The ultimate goal is to identify distinctive units that can be targeted for management action, as appropriate.

Stock loach minnow and spokedace into Hot Springs Canyon.

A. Background: A high priority of the CAP Fund Transfer Program to conserve and recover native fishes of the Gila River basin is to replicate remaining populations of federally-threatened loach minnow and spokedace into suitable protected streams. Aravaipa Creek, a tributary to the lower San Pedro River, is host to sizeable populations of both species, and is thus a source for needed population replications. Hot Springs Canyon, a tributary to the middle San

Pedro River, retains a native fish assemblage of five species to the exclusion of non-native forms. Attributes of Hot Springs Canyon that help prevent invasions by non-natives include its isolation from the mainstem San Pedro River by 5+ miles of normally-dry streambed, and a long reach of ephemeral discharge of the San Pedro River at and upstream from its confluence with Hot Springs Canyon. Hot Springs Canyon is also being considered for emplacement of a fish barrier under tasks 4-32 and 4-33. Following compliance with appropriate environmental regulations, it is proposed that appropriate numbers of loach minnow and spikedace from Aravaipa Creek be captured and translocated to Hot Springs Canyon.

B. Statement of Work/Assistance: With assistance from Reclamation and in cooperation with the Arizona Game and Fish Department, funds will be provided to Fish and Wildlife Service to develop translocation protocols (including post-translocation monitoring needs), accomplish necessary environmental compliance, and undertake the actual translocations and monitoring. To the extent necessary, this task will consider funding of Arizona Game and Fish Department internal environmental compliance activities.

Identify fishless and native only streams.

A. Background. Fishery personnel have sampled and recorded the fauna of many Gila River basin streams in Arizona and New Mexico. Natives are extirpated from some places and most reaches have mixed faunas of native and non-native species. A few streams have intact native communities absent an introduced component, and some apparently were fishless, at least at time(s) of visitation. There also are some waters that have not recently, or in some cases ever, been sampled comprehensively.

Among the last three kinds of streams there may be some where suitable habitat is available for possible establishment or re-establishment of one or more native fish species, including threatened loach minnow and spikedace. Such sites may be especially amenable to native fish management because they may not require a barrier to protect the fauna or renovation to remove an unwanted non-native species or community.

B. Statement of Work/Assistance. The purpose of this project is to provide funds for a two-part, two-year study to identify and verify streams that are either fishless or occupied only by native species. This will be accomplished by (1) review of available data bases and published and agency collection records and interviews with knowledgeable professionals and lay persons to identify potential streams (fishless, native only, or unsampled) and (2) design and implement a field protocol to perform fish collections that verify fish occurrence in streams identified in part 1. Target watersheds include but are not limited to those of Tonto Creek and Agua Fria, upper Salt, and San Francisco rivers. Final site selection will be determined in cooperation with the CAP technical team.

Propagation techniques for chubs.

A. Background. The Gila River basin of Arizona and New Mexico is home to at least three species of chub (Cyprinidae): Gila (*Gila intermedia*), headwater (*G. nigra*) and roundtail (*G. robusta*). A fourth species, the federally listed bonytail (*G. elegans*) was extirpated long ago

and persists today only in two lower Colorado River mainstream reservoirs and in portions of the upper Colorado River basin. All Gila basin chubs are in decline and their geographic ranges are becoming restricted. As a result and because of continuing threats there have been proposals to list the “complex” as endangered. Roundtail chub is designated a sport fish in Arizona.

Range expansion and increased abundance are among the management goals for species like the Gila River chubs. In fact, attainment of such goals may obviate part of the biological justification for listing. There are a suite of alternative strategies to achieve population and range expansion including establishment or re-establishment into new habitats or into those from which a species has been eliminated. Implementation of such action requires a source population or stock. Wild stocks in some cases are not recommended to serve as sources because of their rarity or restricted distribution. One alternative in such instances is to secure captive brood stocks and develop successful protocols for holding, artificial propagation and rearing. These protocols then can support programs of introduction and/or reintroduction. Suitable techniques have been developed and implemented for bonytail, and less so for roundtail and the closely related humpback chub *Gila cypha*, but not otherwise for Gila River chubs.

B. Statement of Work/Assistance. The purpose of this project is to provide funds for a three-year, applied research study to develop practical methods to successfully hold, propagate and rear Gila, headwater and roundtail chub. Experimental hatchery stocks will be derived from wild populations whose numbers, range and dynamics are adequate to support removal of a nominal number of individuals. Holding methods will be developed and applied to ensure long-term survival in captivity of wild individuals and their future progeny. Artificial breeding experiments will use established methods that have been successful with congeners and closely related species. If such experiments are unsuccessful, then methods developed for other fishes or innovative approaches will be tested. After successful propagation methods are developed, a protocol will be developed to rear young fish under artificial conditions. Successful rearing implies acceptable levels of disease management and fish growth, condition and survivorship.

Helicopter support for Aravaipa Creek topminnow stockings.

A. Background: The Arizona Game and Fish Department and Bureau of Land Management have identified several sites within the Aravaipa Creek drainage of Arizona that they intend to stock with endangered Gila topminnow, *Poeciliopsis occidentalis*. These actions have potential to improve the conservation status of Gila topminnow within the Gila River basin. Many of the intended stocking sites are remote, however, and transporting live fish on the ground could result in unnecessary mortality. Helicopter support for fish transport could significantly increase the chances for success of these stockings.

B. Statement of work/assistance: Funds will be retained by Reclamation to cover hourly flight costs of a Reclamation helicopter in assisting transport of Gila topminnow to various stocking sites within the Aravaipa Creek drainage.

Acquisition of chemicals for stream renovations.

A. Background: As described under Task 4-42, chemical renovations of streams are necessary actions to assist with recovery of native fishes. The chemical most appropriate for renovation of small streams in the Gila River basin is antimycin A, manufactured by Aquabiotics Corporation of Bainbridge Island, Washington, under the trade name Fintrol. Detoxification of antimycin is typically accomplished with application of potassium permanganate, $KMnO_4$. Although relatively small amounts of these chemicals have been acquired by the CAP Fund Transfer Program under prior tasks, there is a need for much larger quantities to undertake stream renovations that have been proposed (e.g. Fossil Creek). The purpose of this task is to provide the Fish and Wildlife Service with funds to acquire antimycin A and potassium permanganate to meet these immediate needs.

B. Statement of Work/Assistance: Funds will be transferred to Fish and Wildlife Service under this agreement to acquire approximately 210 units of Fintrol and an appropriate amount of potassium permanganate for detoxification purposes. As the price of Fintrol is expected to increase on January 1, 2003, it is essential that it be purchased prior to that date. Costs for chemical purchases are being shared with Task 4-43.

Romero Creek and Paige Creek native fish renovation projects.

A. Background: The Coronado National Forest has been surveying perennial streams in southern Arizona, and has identified Romero Creek in the Santa Catalina Mountains (Santa Cruz drainage) and Paige Creek in the Rincon Mountains (San Pedro drainage) as candidate streams to remove non-native fishes and repatriate native fishes. In cooperation with the Arizona Game and Fish Department, National Environmental Policy Act planning is underway to renovate both systems in 2003 with antimycin A and/or rotenone, and later repatriate the proposed endangered Gila chub (*Gila intermedia*) and other native fish species as appropriate. This project will remove undesirable sources of green sunfish, yellow bullhead, and other non-native species from the San Pedro and Santa Cruz drainages, and will significantly enhance conservation and recovery efforts for Gila chub and other native fishes. The project addresses tasks 5.3 (implement habitat improvement) in both the loach minnow and spikedace recovery plans. A recovery plan for Gila chub has not yet been written, but replication of populations is a high priority in nearly all recovery plans.

B. Statement of Work/Assistance: Funds will be transferred to the Coronado National Forest to cover personnel expenses, supplies, and helicopter time needed to assist with renovations and repatriations. A written report documenting the successes and failures of the project will be submitted to Reclamation and the Fish and Wildlife Service.

Turkey Creek repatriations

A. Background: A priority of the CAP Fund Transfer Program to conserve native fishes of the Gila River basin is to replicate rare populations and repatriate extirpated ones into suitable, protected streams. Turkey Creek, tributary to O'Donnell Canyon (Babocomari River drainage) in southeastern Arizona, represents historical habitat for longfin dace *Agosia chrysogaster* (last found in 1993), Gila chub *Gila intermedia* (last encountered in 1989), and likely Sonora sucker

Catostomus insignis and desert sucker *Pantosteus clarki*, but there have been no recent collections of these native species and the stream is presumed fishless. The dace and suckers are declining range-wide but still relatively widespread and common, while Gila chub has been proposed for designation as an endangered species. O'Donnell Creek upstream from the Turkey Creek confluence was renovated in 2002 to remove green sunfish and restore its population of Gila chub, and an opportunity now exists to replicate that population into Turkey Creek. This opportunity is especially attractive because non-native fishes are absent from Turkey Creek and a native fish assemblage thus can be restored without threats of alien fishes. Attributes that help prevent reinvasions by non-natives include relative isolation from O'Donnell Creek and Babocomari River by many miles of normally dry streambed. Following a survey to confirm fishless status, evaluate potential for emplacement of a fish barrier, and compliance with appropriate environmental regulations, it is proposed that appropriate numbers of Gila chub be captured from O'Donnell Creek and translocated to Turkey Creek. It also is recommended that longfin dace, Sonora sucker, and desert sucker from suitable source populations be repatriated to the stream.

B. Statement of Work/Assistance: In cooperation with the Forest Service and other landowners, funds will be provided to the Arizona Game and Fish Department to survey Turkey Creek and verify its fishless status, develop a repatriation protocol (including post-translocation monitoring needs), accomplish necessary environmental compliance, and undertake the actual repatriation and monitoring. In cooperation with Reclamation, the potential need and site suitability for emplacement of a fish barrier will also be evaluated.

Post Canyon/Welch Spring repatriations

A. Background: A priority of the CAP Fund Transfer Program to conserve native fishes of the Gila River basin is to replicate rare populations and repatriate extirpated ones into suitable, protected streams. Post Canyon is a spatially intermittent tributary to O'Donnell Canyon (Babocomari River drainage) in southeastern Arizona. Due to lack of historical surveys, the only native fish recorded from Post Canyon is Gila chub *Gila intermedia*. However, downstream in O'Donnell Canyon, longfin dace *Agosia chrysogaster* and Sonora sucker *Catostomus insignis* were present until very recently. Several other native fishes, such as desert sucker *Pantosteus clarki*, and desert pupfish *Cyprinodon macularius* were historically found in the Babocomari River. The dace and suckers are declining range-wide, while the pupfish is listed as endangered, and Gila chub has been proposed for designation as an endangered species.

Upstream of the confluence of Post and Freeman Springs Canyons, a reach of perennial surface flow is associated with Welch Spring, an in-channel upwelling in Post Canyon. This perennial reach has no records of fish. A bedrock ledge about 1.6 km below Welch Spring forms a partial, and possibly complete, barrier to upstream fish movement. Above the ledge, the stream flows through a lush cienega of long, narrow, deep pools connected by small channels or marshy areas of poorly defined channel. This opportunity for native fish restoration is especially attractive because non-native fish are absent, allowing restoration of a native fish assemblage without threats of alien fish. O'Donnell Creek upstream from the Post Canyon confluence was renovated in 2002 to remove green sunfish and restore its population of Gila chub. Post Canyon in the Welch Spring reach offers an opportunity for replication of that chub population. Following a survey to confirm fishless status and compliance with appropriate environmental

regulations, it is proposed that appropriate numbers of Gila chub be captured from O'Donnell Creek and translocated to Post Canyon. It is also recommended that longfin dace, Sonora sucker, and desert sucker from suitable source populations be repatriated to the stream.

B. Statement of Work/Assistance: In cooperation with the Forest Service and other landowners, funds will be provided to Arizona Game and Fish Department to survey Post Canyon and verify its fishless status, develop a repatriation protocol (including post-translocation monitoring needs), accomplish necessary environmental compliance, and undertake the actual repatriation and monitoring.

Acquisition of fish transport equipment and materials.

A. Background: A priority of the CAP Fund Transfer Program to conserve native fishes of the Gila River basin is to replicate rare populations and repatriate extirpated ones into suitable, protected streams. These actions require transporting live fishes among points-of-capture, propagation/holding facilities, and receiving waters. Native fish replications/repatriations planned by the CAP Fund Transfer Program, Arizona Game and Fish Department, and Fish and Wildlife Service will require acquisition or upgrading of fish transport equipment and materials to enhance health and survival of translocated fishes. The purpose of this task is to acquire items such as fish hauling tanks, aeration systems, oxygen diffusers, prophylactics, water quality monitors, etc.

B. Statement of Work/Assistance: To minimize administrative costs associated with small-dollar purchases, Reclamation will retain funds for this task to acquire fish transport materials with a Government credit card. This equipment shall be made available for use by permitted agencies/individuals for approved translocations of native fishes. This project will address tasks 6.3 and 6.4 of the loach minnow and spikedace recovery plans, task 2.2 of the draft Gila topminnow revised recovery plan, and task 2.0 of the desert pupfish recovery plan.

Lower San Pedro River Preserve pond refuge.

A. Background: To mitigate impacts of operations of modified Roosevelt Dam on endangered southwestern willow flycatcher *Empidonax trailli extimus*, Reclamation provided funds to The Nature Conservancy (TNC) in 1996 to acquire an 820 acre parcel of riparian land along the lower San Pedro River near Dudleyville, AZ. Two groundwater-supplied ponds on that property (TNC's Lower San Pedro River Preserve) were rehabilitated for use as native fish and waterfowl habitat, and Reclamation since 2000 has used the larger pond (~3 surface acres) as a growout and refuge facility for razorback sucker *Xyrauchen texanus*. The large pond has further potential as a refuge for Gila chub *Gila intermedia*, and both ponds can be used similarly for desert pupfish *Cyprinodon macularius* and Gila topminnow *Poeciliopsis occidentalis*. The purpose of this project is to acquire and stock individuals of Gila chub, desert pupfish, and Gila topminnow into the refuge ponds.

B. Statement of Work/Assistance: This task will provide money to the Arizona Game and Fish Department to undertake necessary environmental compliance, and identify, acquire, and stock from appropriate sources Gila chub, desert pupfish, and Gila topminnow into ponds on the Lower San Pedro River Preserve. Gila chub will come from extant San Pedro River basin populations (e.g. Hot Springs Canyon), while suitable source stocks of pupfish and topminnow have not been specifically determined. Reclamation will conduct annual post-stocking monitoring of the repatriations. This project will address task 1.1 of the draft Gila topminnow revised recovery plan and task 2.0 of the desert pupfish recovery plan.

Pupfish genetics

A. Background: Desert pupfish *Cyprinodon macularius* and Quitobaquito pupfish *C. eremus* are endemic fishes of the lower Colorado River and Rio Sonoyta basins, respectively. These two pupfish were considered subspecies until their recent recognition as distinct species, and conservation needs of both forms are addressed in the Desert Pupfish Recovery Plan. The former was widespread and abundant at lower elevations while the latter species was more restricted in distribution in southern Arizona and northwestern Mexico. Wild populations of desert pupfish now are extirpated from the Gila River basin and Quitobaquito pupfish occurs in the United States only in one spring in southern Arizona. Establishment of refugium populations, restoration of wild populations, and exchange of genetic material among these respective populations are recommended strategies to recover these critically imperiled species. A quantitative protocol must be developed to implement the last of these actions, and development of such a protocol will require information on population genetic structure derived from surveys of both mitochondrial and microsatellite DNAs. However, only mtDNA data are presently available. This task will develop the additional molecular genetics data needed to establish a baseline of native diversity. This will allow assessment of the success of the refugium populations in maintaining diversity and establish the foundation for preparation of a protocol that integrates wild and refugium populations in an overall plan for genetics management of the two species.

B. Statement of Work/Assistance: The purposes of this project are to make funds available to (1) assess the genetic status of refugium and wild populations of desert pupfish and Quitobaquito pupfish using microsatellite DNA and (2) develop an applied management protocol to exchange genetic material among populations of each species and thus maintain their respective genetic variability. The project will integrate new and existing information so as to include all known wild and refugium populations of both species in the US and Mexico. This project will address task 4 of the desert pupfish recovery plan.

Post-repatriation evaluations

A. Background: High priorities of the CAP Fund Transfer Program to conserve and recover native fishes of the Gila River basin is to replicate remaining populations of federally listed species into suitable, protected streams and repatriate populations of listed and other native fishes into streams from which they have been extirpated. Toward these ends, the Program has identified a number of projects that incorporate replication or repatriation of native fish

populations. Each such project must be assessed to determine its success in achieving stated goals, identify positive and negative factors, and provide information that will benefit other, similar projects. The fundamental metric of success of a replication or repatriation project is population establishment, and this is confirmed by periodic, post-project sampling. In cases where a renovation has been performed to remove undesired, non-native species there is an additional expectation that these species are eliminated and will not appear in post-project samples.

B. Statement of Work/Assistance: With assistance from Reclamation and Fish and Wildlife Service and in cooperation with Arizona and New Mexico departments of Game and Fish and other appropriate agencies and non-governmental entities, funds will be provided to one or more contractors to perform post-project monitoring of streams into which native fish populations have been replicated or repatriated under auspices of the CAP Fund Transfer Program. Monitoring will be performed using standard fishery methods and equipment appropriate to the species and habitat being sampled. Sampling is recommended initially within one year of fish stocking, and periodically thereafter. The contractor(s) will be authorized by state and federal permits as required to make fish collections, and will obtain permission to access waters on private lands. Voucher specimens deposited into an accredited institutional collection and color photographs will be required to verify fish species identity. A narrative trip report with a tabulation of sampling results will be prepared for each sampling event. This task will periodically have additional funds added to it as new streams are repatriated and will require post-repatriation evaluations. This project will address task 5.0 of the desert pupfish recovery plan, task 3.1 of the draft Gila topminnow revised recovery plan and tasks 2.1 and 2.2 of the loach minnow and spikedace recovery plans.

Removal of Nonnative Fish from Down Under Tank in Redrock Canyon

A. Background. Redrock Canyon is a tributary of Sonoita Creek that supports a natural population of Gila topminnow. The Down Under Tank is a small stock pond that is located at the head of Redrock Canyon proper, on the Coronado National Forest. It contains several species of nonnative fish, including the mosquito fish. This funding would be used to chemically remove the species from Down Under Tank. Although other sources of nonnative fish remain in Redrock Canyon, removal of nonnative fish from Down Under Tank will reduce the pressure on downstream Gila topminnow populations from mosquito fish and other nonnative species. The CAP opinion-related species in the Gila topminnow and this project would fulfill part of recovery plan task 1.214, with a priority of 1.

B. Statement of Work/Assistance. This project will be accomplished cooperatively with the Arizona Game and Fish Department, U.S. Forest Service, and the FWS to chemically remove fish from Down Under Tank in Redrock Canyon. FWS will furnish a report that details the success/failure of the project.

Preliminary work for Baseline Study and Monitoring for Fish Diseases and Pathogens in Gila River Basin

A. Background. The BO focused on the effects to listed fish from the introduction and spread of nonnative fish species. It recognized the threat of other nonnative aquatic species, such as invertebrates, plants, parasites, and diseases, but lack of information precluded adequate evaluation of those threats. Monitoring would detect any introduction or spread of diseases or pathogens and probable incursion paths and mechanisms. This information would provide the basis for a program to protect listed fishes from this threat and to ameliorate existing problems with diseases and pathogens. It may also be important in future reintroduction efforts by identifying stocks with undesirable diseases or pathogens.

All native fish in the Gila River basin would benefit from this project, the CAP opinion related species are the spinedace, loach minnow, Gila topminnow and razorback sucker. This funding would partially implement recovery plan tasks 2 for spinedace and loach minnows (Spinedace Recovery Plan and Loach Minnow Recovery Plan), 1.0 for Gila topminnow, and Level III for razorback sucker in the draft "Colorado River: Lower Basin Fisheries Management Prospectus for Indigenous 'Big River' Fishes: Colorado Squawfish, Razorback Sucker, Bonytail, Humpback Chub" developed by the Fish and Wildlife Service. These tasks are all priority 1.

B. Statement of Work/Assistance. Provide funding for review of existing information on fish diseases and pathogens in the Gila River basin, including the CAP aqueduct. FWS will prepare a plan for a study that identify baseline conditions for fish diseases and pathogens within the Gila River basin. The preliminary phase would be one year and the baseline phase of the work would be a five-year study.

Feasibility of Piscicide Development for Control of Non-indigenous Fishes

A. Background. Effective treatments for eradication and control of nonnative fishes include chemical renovation of stream reaches (usually in concert with an emplacement of physical fish barriers). The stocking of desired species, and application follows this of species-specific piscicide in rare situations. Renovation is expensive, logistically difficult, typically limited to headwater situations, and may not achieve desired long-term results without retreatment. Application of species-specific piscicide has not been practiced in the southwest, presumably because piscicides have not yet been developed for the array of non-indigenous species problematic in the region. Other treatments (e.g., selective harvest, regulatory control) have rarely been effective in controlling nonnative fishes. Potential problems with development of species-specific (or family/order-specific) piscicides include costs associated with screening of chemicals and fishes, regulatory obstacles associated with application of chemicals to the environment, impacts to non-target organisms, and retreatment costs. Benefits of development of such piscicides include comprehensive treatment of target organisms without the necessity of restocking non-target species, potential to treat large areas (drainage). The possible elimination of the need for a physical barrier emplacement that may fragment populations and restrict gene flow. These benefits may outweigh negative considerations. The CAP opinion-related species are spinedace, loach minnow, Gila topminnow, and razorback suckers. This funding would not directly implement recovery plan tasks, but would contribute to future implementation of recovery plan tasks 1.7 for spinedace and loach minnow 1.214 for Gila topminnow, and Level III for razorback sucker. These tasks are priority 1.

B. Statement of Work/Assistance. A qualified contractor will be selected to conduct a study to determine the feasibility of developing species-specific, family-specific, or order-specific piscicides targeted at the most ubiquitous, locally-problematic species. These include rainbow trout, brown trout, brook trout, channel catfish, flathead catfish, bullheads, black basses, sunfishes, red shiner, common carp, and mosquito fish. The study deliverables will include a literature review of the history of piscicide development in North America, protocols and procedures involved with the development of piscicides, estimated research and development costs for chemical and fish screenings, a review of environmental concerns and regulations associated with use of piscicides, and in general a recommendation for the feasibility of pursuing development of new piscicides.

Improvement of grade control structures on Sonoita Creek.

A. Background: The upper Sonoita Creek drainage supports several of the few remaining natural populations of Gila topminnow, an endangered species potentially impacted by CAP-mediated fish transfers into the Gila River basin. Mosquito fish, a non-native species known to negatively impact topminnow populations, is extant in the lower Sonoita Creek drainage, but has not yet invaded upper Sonoita Creek. A normally dry channel between the upper and lower creek prevents upstream movements of non-native fish when it is not flowing, but is not an impediment to movements when flowing. A pair of rock grade control structures emplaced by the Fish and Wildlife Service in the dry reach may also hinder upstream movements, but physical improvement of the structures to function as complete fish barriers will provide added insurance against upstream transgressions.

B. Statement of Work/Assistance: Reclamation will inspect, evaluate, design and subcontract improvements to the grade control structures so that they function as fish barriers. A final report will be prepared and submitted that will detail the improvements made to the structures.

Acquisition of Ichthyocide and Detoxification Chemicals

A. Background. It is widely recognized that non-native fishes pose a serious threat to native species. Non-native fishes impact existing populations of native fishes, and also represent an impediment to establishment of new populations in habitats from which the natives have been extirpated. Habitat renovation to eliminate or reduce non-native fishes that may interfere with native species is a fundamental, priority 1 action in Recovery Plans for listed species, including four CAP opinion related fishes: loach minnow, spikedace, razorback sucker, and Gila topminnow. Chemical renovations typically are accomplished using either rotenone (an organic material derived from a South American plant) or antimycin (an antibiotic). Each of these chemicals has advantages and disadvantages, and selection of which substance to use is on a case-by-case basis. Both chemicals are available as liquid, sand, and brick formulations, each suitable to specific circumstances. Potassium permanganate can be used to detoxify both rotenone and antimycin to protect non-target fishes in areas that receive water from renovation areas. Chemical costs are high for antimycin and rotenone, their availability is not assured (for example, occasional extraordinary demand may deplete manufacturers' inventories), and quantities and formulation required vary as a function of water volume and site specific habitat

and water chemistry characteristics. It thus is prudent to accumulate an inventory or stockpile of chemicals to meet anticipated needs for renovations in behalf of imperiled species management and recovery.

B. Statement of Work/Assistance. The purpose of this task is to fund acquisition by the U.S. Fish and Wildlife Service of stream renovation chemicals that can be held in storage until needed. Ready availability of this material will eliminate the time required to place and fill an order, and thus allow managers to respond effectively in situations that require immediate action. These chemicals also may be used to assist in the implementation of other Task Agreements identified under the Central Arizona Project Funding Transfer. Chemicals to be acquired are (1) rotenone, (2) antimycin, and (3) potassium permanganate, in an active ingredient concentration ratio of 1:1:2. Rotenone and antimycin are to be in liquid, sand, and brick forms in an active ingredient concentration ratio of 2:1:1. The Service will prepare a Task Completion Report for the Central Arizona Project Funding Transfer Technical Team members that identifies the location, type, form, quantity, expiration date, and other relevant information for renovation chemicals acquired under this order, and provide contact information and standard protocol for obtaining use of this material.

Stock Tank Easements

A. Background: Stock tanks are a common surface feature in the desert Southwest. State agencies, in addition to private landholders, have stocked many of these tanks with nonnative fishes such as largemouth bass, bluegill and channel catfish. Loss of habitat and introduction of nonnative fishes are the most devastating factors in the decline of native fish populations. Active management of stock tanks may prove beneficial for native, aquatic species through removal of potential sources. Further, stock tanks can provide predator-free habitat for maintenance of native, aquatic species. Stock tank easements would give Arizona Game and Fish Department the right to manage fishes on private land either by the removal or addition of aquatic species. This action would provide protection to sensitive areas through the exclusion and/or management of nonnative fishes. This action will benefit native aquatic species by both providing nonnative-free refugia and reduce predation on sensitive life history stages by removing source populations of nonnatives.

B. Statement of Work/Assistance: The Arizona Game and Fish Department will develop language for this new easement, and attempt to negotiate and purchase easements from private landholders, initially concentrating in the San Raphael Valley and Coal Mine Canyon areas.

Investigation of crayfish control technology.

A. Background: Development of control technologies for specific non-native organisms that are a threat to the management and recovery of native species is recognized as a high priority. There are no indigenous crayfishes in the Colorado River system. However, introduced crayfishes are widespread and abundant throughout the Gila River basin of Arizona and New Mexico, where they co-occur with four CAP opinion related species: loach minnow, spikedace, Gila topminnow, and razorback sucker. The introduced crayfishes are among the non-native

animals implicated in impacts to populations of native fishes and amphibians. Chemical, biological, mechanical and other technologies to control crayfish, their efficiency, and general applicability to southwestern aquatic habitats are not widely known. Examples of areas that may have promise are Dimlan 25W and the crayfish fungal disease known as “burn spot.” Dimlan 25W is a chemical produced by Uniroyal, Inc., which apparently is selectively toxic to crustaceans (including crayfishes) but not to fishes and other aquatic biota. However, fishery scientists have not determined registered/intended uses, and its efficacy as a crayfish-specific toxin has not been demonstrated. Basic information is required to make a determination of the possible suitability of Dimlan 25W for use on introduced populations of crayfish. Another area is bio-control technology potentially utilizing the causative agent of “burn spot” disease of crayfish. This disease is widespread in Europe, and may result in host animal mortality, however, its’ possible role as a crayfish control mechanism has not been investigated.

B. Statement of Work/Assistance: This is primarily an information seeking and gathering project. The major task is to perform a comprehensive, library and computer-based literature review of actual and potential crayfish control technologies. Chemical, biological, mechanical and other control mechanisms are to be identified and described, and any information on state, federal or other rules (US and elsewhere), regulations, prohibitions, etc., should also be included. A report will be prepared that assesses the potential suitability of each control or eradication technology, including possible effects on non-target aquatic biota, assesses environmental safety of the control method, and recommend avenues for further investigation if appropriate.

Boyce-Thompson Renovation.

A. Background: The pond at Boyce-Thompson Arboretum, near Superior, has been a dependable site for maintaining refugia populations of both Gila topminnow and desert pupfish for 20 years. However, periodically, the pond is contaminated with nonnative species and has to be renovated. It was last renovated in 1983. At present, the only nonnative known from the pond is fathead minnow. Recent efforts to obtain a stock of 200-300 Gila topminnow from the pond found topminnow scarce. Pupfish were the most numerous species, with fathead minnow second and Gila topminnow a poor third. Desert pupfish in the pond are from Santa Clara Slough via Dexter National Fish Hatchery. Gila topminnow are a mixed stock of Monkey Spring, Bylas Springs, and possibly Cocio Wash (an extirpated population). Although it was previously thought this topminnow mixed stock was undesirable, recent genetic work indicates there may be unique genetic components in this population, possibly as a result of contributions from the Cocio Wash or unknown populations. Given the recent trend in topminnow and fathead populations, it is again necessary to renovate the pond to remove the nonnative fish.

B. Statement of Work/Assistance: The Arizona Game and Fish Department, in cooperation with Arizona State Parks, will renovate the pond at Boyce-Thompson Arboretum to remove all nonnative fish.

Transgenic fish feasibility study.

A. Background: The native fish fauna of the Gila River basin, indeed of the vast Colorado River system of western North America, is biologically imperiled. Many species

already are federally listed as threatened or endangered, and others have been recommended for listing by the Desert Fishes Recovery Team. Primary causes of this condition have been habitat degradation and water development, exacerbated by introductions and establishment of non-native biota. Non-native fishes that prey upon, compete with, or otherwise impact native species are implicated as the single most important deterrent to conservation and recovery of the native fauna. Relatively few practical and effective alternatives are available for dealing with non-native biota. Examples include chemical or other removal or depletion of undesirable exotics, construction of barriers to protect intact or repatriated faunas, and other control measures. These approaches are variously successful, even when carefully planned and effectively executed. All are logistically difficult and costly, and must account for effects on non-target biota. The status of the imperiled native fish fauna is one of continuing deterioration in spite of conservation efforts. New management tools and strategies are desperately needed if the fauna is to be saved from extirpation, or worse, extinction. A novel application of genetic engineering is among these potential new approaches.

B. Statement of work/assistance: This task will provide funds to a contractor to conduct a feasibility study of using a “Trojan gene” as a non-native fish bio-control mechanism. Recent research indicates that a transgene introduced into a natural population by a small number of transgenic donor fish can cause eventual local extinction of both the wild and introduced populations (Muir, W.M. and R.D. Howard. 1999. PNAS 96: 13853-13856). The effect was modeled using life history data of a small cyprinodontid fish, the Japanese medaka (*Oryzias latipes*). Deterministic equations predicted that the transgene would spread as a result of enhanced mating advantage of transgenic individuals, and that extinction would occur as a result of reduced offspring viability of both donor and receptor populations. The purpose of this study is to determine the actual feasibility of using transgenic fish carrying a “Trojan gene” to control populations of non-native fishes in isolated habitats. In the Gila River basin of Arizona and New Mexico, for example there are a number of nonnative fishes, including mosquito fish (*Gambusia affinis*), which detrimentally impact native fishes such as endangered Sonoran topminnow, and act as continuing deterrents to successful management and recovery. If available, transgene biotechnology specific to non-native fishes of the southwestern desert region would be a powerful tool for selective management under appropriate conditions. This task will fund (1) a comprehensive review of pertinent literature and on-going research, (2) preliminary design of laboratory and/or field studies (in secure, isolated habitats) necessary to develop and define methods for creation of a transgenic mosquito fish or other fish, (3) evaluation of costs to fully develop, deploy, and monitor transgenic donor and receptor populations; and (4) an assessment of the advisability and practicality of implementing a program that utilizes transgenic fish as a biological control mechanism for undesirable non-native fishes in the Gila River basin.

Redfield/Hot Spring canyons fish barrier feasibility study.

A. Background: Redfield and Hot Springs canyons, tributaries to the San Pedro River, both support five extant species of native fish, and both hold potential for repatriation of additional species such as threatened loach minnow and spikedace. Replication within the San Pedro River drainage of the Aravaipa Creek populations of loach minnow and spikedace is a high priority recovery action. Emplacement of a low-height, concrete fish barrier near the terminus of perennial flows in either Redfield Canyon or Hot Springs Canyon, followed by chemical

renovation upstream to remove non-native species, would protect the stream for recovery purposes by preventing invasion of non-native fishes from downstream sources. Reconnaissance of both streams, barrier feasibility design analysis, preliminary cost estimates, and recommendations for further field investigation and construction are needed in order for the barrier concept to proceed.

B. Scope of Work/Assistance: The purpose of this task is for the Bureau of Reclamation Phoenix Area Office to evaluate a potential fish barrier site on either Redfield Canyon or Hot Springs Canyon to prevent upstream movements of non-native fishes. An initial site visit will be conducted where site characteristics, including topography, geology, access, substrate, gradient, and other conditions necessary for engineering design and construction considerations of barrier configuration, will be evaluated. A report will be prepared that summarizes and discusses site description (including hydrology) and design/construction considerations, provides preliminary conceptual design, estimates contract and non-contract costs for construction, considers construction prerequisites including NEPA, ESA, and Clean Water Act compliance issues, right-of-way acquisition, and permits, and recommends further action or no action.

Redfield/Hot Springs Canyon fish barrier design.

A. Background: Following completion of task 4-32 (Redfield/Hot Spring canyons fish barrier feasibility study; Phase I), either Redfield Canyon or Hot Springs Canyon will be selected for emplacement of a low-head concrete fish barrier. The purpose of a barrier on one or the other stream is to protect existing native fishes and future repatriated species from contamination by non-native fishes. The stream will also serve as a replication site for Aravaipa Creek populations of loach minnow and spikedace. The next step toward construction of a barrier at the selected site is to fully design the structure and have contractor specifications ready. Reclamation has committed to construct a barrier at one of these sites, pending completion of the pre-construction Phase I and Phase II studies.

B. Statement of Work/Assistance: The purpose of the design phase (Phase II) is to conduct site investigations and develop final design specifications necessary for bid and award of a construction contract. Specific tasks include: conduct surveys and geologic investigations as needed to evaluate site characteristics, including topography, geology, access, substrate, gradient, and other conditions necessary for engineering design and construction considerations of barrier configuration; prepare specifications for a construction contract to include all description narrative and drawings necessary to construct the barrier; prepare a detailed engineer's cost estimate. NEPA, ESA, and Clean Water Act compliance, right-of-way acquisition, and permits, will not be undertaken/acquired.

Bonita Creek fish barrier feasibility study.

A. Background: Bonita Creek, tributary to the Gila River, supports five extant species of native fish, and holds potential for repatriation of additional species such as threatened loach minnow and spikedace. Replication within the Gila River drainage of the Eagle Creek populations of loach minnow and spikedace is a high priority recovery action. Emplacement of a low-height, concrete fish barrier near the terminus of Bonita Creek, followed by chemical

renovation upstream to remove non-native species, would protect the stream for recovery purposes by preventing invasion of non-native fishes from downstream sources. Reconnaissance, barrier feasibility design analysis, preliminary cost estimates, and recommendations for further field investigation and construction are needed in order for the barrier concept to proceed.

B. Scope of Work/Assistance: The purpose of this task is for the Bureau of Reclamation Phoenix Area Office to evaluate a potential fish barrier site on lower Bonita Creek to prevent upstream movements of non-native fishes. An initial site visit will be conducted where site characteristics, including topography, geology, access, substrate, gradient, and other conditions necessary for engineering design and construction considerations of barrier configuration, will be evaluated. A report will be prepared that summarizes and discusses site description (including hydrology) and design/construction considerations, provides preliminary conceptual design, estimates contract and non-contract costs for construction, considers construction prerequisites including NEPA, ESA, and Clean Water Act compliance, right-of-way acquisition, and permits, and recommends further action or no action.

Redrock Canyon fish barrier design.

A. Background: Redrock Canyon, a tributary to Sonoita Creek in the Santa Cruz River basin of southeastern Arizona, lies within Coronado National Forest and contains an important population of endangered Gila topminnow. Protection of this population and other native fishes (both those extant or to be repatriated) from invasion by non-native fishes downstream is paramount to conservation of the indigenous community. A potential site to emplace a fish barrier on Redrock Canyon for this purpose was identified by fish biologists and a Reclamation engineer in summer 2001. That visit was sufficient to prove the site's feasibility for emplacement of a small, inexpensive low-head concrete fish barrier.

B. Statement of Work/Assistance: Reclamation will retain funds to design a concrete fish barrier on Redrock Canyon. The design report will identify access, construction methods, specifications, and a cost estimate for the barrier, including anticipated environmental and cultural resource compliance costs (e.g., NEPA, ESA, CWA, etc.).

Evaluation of crayfish removal techniques from Fossil Creek

A. Background: Fossil Creek, tributary to Verde River in central Arizona, supports a suite of five native fishes including state-listed roundtail chub, and holds potential for repatriation of additional species such as threatened loach minnow and spikedace. The stream also is occupied by non-native fishes and a large population of non-native crayfish, *Orconectes virilis*, which pose a threat to existing and new populations of native fishes. Barrier construction and chemical renovation of Fossil Creek are proposed management strategies in behalf of the native biota (see task 20 of this agreement), however, this treatment will remove only non-native fishes and will not impact crayfish. Thus, a need exists to deplete detrimental crayfish populations as part of the overall management of Fossil Creek.

B. Scope of Work/Assistance: The purpose of this task is to provide funds to support the experimental removal of non-native crayfish from Fossil Creek. Removal efforts will focus

on sections of the stream defined by natural barriers, beginning upstream at a large falls approximately 2 km above the Irving Trailhead parking lot. This site marks the known upstream distributional limit of crayfish in Fossil Creek. Downstream sections are defined by rock pools and travertine dams of 60-120 cm height. Crayfish removal is accomplished by trapping in deeper pools and dip netting in shallower habitats. Information expected from the successful completion of this work includes data on population-level effects of crayfish removal, crayfish size sampling bias as a function of trap opening dimensions, determination of effective and economic crayfish baits, and relative efficiency of novel trap designs to remove smaller size classes of crayfish. Routine data collection will include trap or netting location (GPS), narrative habitat description, date and time of set and retrieval, and number and size class (juvenile, adult) of crayfish caught. A report will be prepared that summarizes and discusses removal efficiency (depletion effect), trap effectiveness relative to habitat and trap design and dimensions, bait selection, and utility of dip-netting, and recommends further action or non-action.

Production of southwestern fishes book

A. Background: “Fishes of Arizona” was published in 1973 by W.L. Minckley, generally recognized as the most authoritative individual on the taxonomy, ecology and conservation of native fishes of the American Southwest. That book has been widely used by scholars, researchers and interested lay persons for most of the past 30 years; however, much has changed and the document now is dated in many respects. At the time of his unexpected death in summer 2001, Minckley had largely completed revision and substantial expansion of “Fishes of Arizona” into a new volume of broader scope to be subtitled “Chronicles of a Vanishing Biota.” While most of the writing for that project is complete, important parts have yet to be done. Included among the last are creation of original color plates of native fishes and black and white line drawings of non-natives, production of range maps, identification and drafting of text illustrations, and development of funds to support production of the book by a suitable publisher.

B. Scope of Work/Assistance: The purpose of this task is to provide funds for creation of color plates of native fishes, black and white line drawings of non-natives fishes, text illustrations and range maps, and to support production of the book by a suitable publisher. Technical and administrative aspects leading to publication are being supported and funded separately by other parties and an agreement to publish has been reached with a suitable publisher. Final production is expected in about two years.

Acquisition of stream renovation supplies.

A. Background: Segregation of native and non-native fishes allows natives to successfully complete their life history functions, and is one of the most successful techniques to conserve and recover imperiled native ichthyofaunas of the southwest. Separation of the two groups is typically accomplished by constructing a fish barrier to prevent upstream movements of non-native fishes, chemically renovating the stream above the barrier, followed by repatriation of native fishes. The CAP Fund Transfer Program has identified several candidate streams for these actions that will assist with recovery of Gila River basin native fishes. However, the renovation process requires an array of technical supplies that the Program currently does not possess. The

purpose of this task is to identify and acquire supplies needed for successful application of chemical stream renovations.

B. Statement of Work/Assistance: The CAP Fund Transfer Program Technical Committee will identify supplies needed to successfully accomplish chemical stream renovations (not including chemicals). As supply needs are diverse, of limited monetary value, and are expected to be acquired from a variety of vendors, Reclamation will retain funds for their purchase using a Government Integrated Charge Card Purchase Line account. This system was established to limit administrative costs for small purchases, and seems appropriate for this task. Items to be acquired may include, but not be limited to, backpack sprayers, buckets, fittings, aerators, holding tanks, hoses, filtration units, nets, and backpack frames.

O'Donnell Canyon fish barrier feasibility

A. Background: O'Donnell Canyon contains one of the few remaining populations of the proposed endangered Gila chub *Gila intermedia* and has potential for supporting endangered Gila topminnow *Poeciliopsis occidentalis* and other native species. O'Donnell Canyon was chemically renovated in 2002 to remove the non-native green sunfish *Lepomis cyanellus*, which had invaded the stream and typically displaces native fishes once established. Headwaters of O'Donnell Canyon form an extensive cienega, one of the rarest aquatic habitats in the American southwest. There is an existing low-head concrete dam that has served as a grade control structure to protect the cienega, and two additional grade control structures approximately 1 mile downstream have further protected against down cutting of the lower streambed. Those latter structures, however, do not span the entire channel width, and progressing headward erosion is threatening to bypass the structures. Should that occur, considerable stream and riparian communities will be lost following inevitable loss of bank and channel materials. The downstream grade control structures also serve as barriers to invasion by non-native fishes from downstream, and thus provide multiple benefits to the stream ecosystem. Modification of these structures to prevent the stream from eroding headward is proposed to protect the stream channel and native biota from further damage.

B. Statement of Work/Assistance: The purpose of this task is for the Bureau of Reclamation Phoenix Area Office to evaluate the potential to modify the two downstream grade control structures on O'Donnell Canyon to better protect against headward erosion and fish invasions from downstream. An initial site visit will be conducted where site characteristics, including topography, geology, access, substrate, gradient, and other conditions necessary for engineering design and construction considerations of grade control/barrier configuration, will be evaluated. A report will be prepared that summarizes and discusses site description (including hydrology) and design/construction considerations, provides preliminary conceptual design, estimates contract and non-contract costs for construction, considers construction prerequisites including NEPA, ESA, and Clean Water Act compliance, right-of-way acquisition, and permits, and recommends further action or no action. This project will address task 2.4 of the draft Gila topminnow revised recovery plan.

State oversight and application costs for chemical renovations.

A. Background: A priority of the CAP Fund Transfer Program to conserve native fishes of the Gila River basin is to replicate rare populations and repatriate extirpated ones into suitable, protected streams. One of the primary means to secure streams for repatriations is to chemically renovate the streams to remove non-native species. The CAP Fund Transfer Program has identified several streams that require chemical renovations prior to receipt of repatriated native fishes, and it is certain that additional streams will be identified and renovated in the future. The Arizona Game and Fish Department (AZGFD) is the State-authorizing agency for application of piscicides in the wild, and thus their participation in renovation projects is necessary. AZGFD does not have funding to enable their oversight of Program-approved renovation projects.

B. Statement of Work/Assistance: The purpose of this task is to provide AZGFD with funding to facilitate their oversight, planning, and participation in Program-approved renovation projects. A block of funding will be transferred to AZGFD through an appropriate federal agreement that can be invoiced against for expenses incurred during the planning and execution of Program-approved renovation projects. It is anticipated that funding will be added to this task in the future to accommodate new projects as they arise.

Lewis Springs fish barrier feasibility study

A. Background: Lewis Springs supplies flow to a short reach of perennial stream within Government Draw, a tributary to San Pedro River east of Sierra Vista, AZ, and within the San Pedro River National Riparian Conservation Area. The stream is currently inhabited by nonnative fishes, but if renovated and protected, potentially could serve as suitable recovery habitat for Gila topminnow, desert pupfish, Gila chub, and other native species. The Bureau of Land Management, the primary landowner at the site, has proposed construction of a low-head fish barrier near the mouth of Government Draw to prevent nonnative fishes that inhabit San Pedro River from further accessing the stream. Following barrier emplacement, the stream could be renovated to remove the nonnative fauna and ready it for introductions of native species. Emplacement of a barrier on Government Draw will initiate an important step toward conserving and recovering declining native fish populations in the San Pedro River watershed.

B. Statement of Work/Assistance: The purpose of this task is for Reclamation to evaluate potential fish barrier sites on Government Draw (Lewis Springs) to prevent upstream movements of nonnative fishes. Reconnaissance of potential stream sites will be conducted where site characteristics, including topography, geology, access, substrate, gradient, and other conditions necessary for engineering design and construction considerations of barrier configurations, will be evaluated. A report will be prepared that summarizes and discusses site descriptions (including hydrology) and design/construction considerations, provides preliminary conceptual designs, estimates contract and non-contract costs for construction, considers construction prerequisites including NEPA, ESA, and Clean Water Act compliance, right-of-way acquisition, and permits, and recommends a preferred site(s) and further action or no action.

Stock tank surveys of Arnett Creek, Cottonwood Spring, and Redrock Canyon drainages.

A. Background: Arnett Creek, Cottonwood Spring (including Sonoita Creek immediately downstream), and Redrock Canyon are stream systems that have been, or are planned to be, protected against upstream invasions of non-native fishes through emplacement of low-head fish barriers. Arnett Creek was renovated in 1997 to remove resident non-native fishes, and currently awaits repatriation with native species. Cottonwood Spring and Redrock Canyon contain important populations of endangered Gila topminnow *Poeciliopsis occidentalis*, and both have potential to accommodate other native fishes. During times of high precipitation, as during monsoon storms, stock tanks in the drainages above the fish barriers may overflow and provide new sources of nonnative fishes into streams. It is important to eliminate this potential avenue of non-native fish contamination to secure the drainages for native fish recovery purposes.

B. Statement of Work/Assistance: This task will provide funds to the Arizona Game and Fish Department or another appropriate vendor to identify and locate on topographic maps or other reference resources all stock tanks in Arnett Creek, Cottonwood Spring, and Redrock Canyon drainages upstream of existing or proposed fish barriers. Next, determination of which stock tanks are perennial will be made, and then fish and amphibian surveys of perennial tanks will be undertaken using trammel nets, minnow traps, and/or seines. A comprehensive report detailing all methods and results will be provided, which will include the list of tanks recommended for removal of nonnative aquatic vertebrates. This project will address task 1.5 of the draft Gila topminnow revised recovery plan.

Effectiveness of and alternatives to fish barriers and renovations to secure native fish populations against non-native fishes.

A. Background: Populations and ranges of most native fishes in the southwest are much reduced from historic levels. Indeed, of Arizona's approximately 35 native fishes, 18 are designated as threatened or endangered under the Endangered Species Act, another is proposed as endangered, two more have been petitioned for listing as endangered, and one is extinct. Wild populations of several listed fishes are extirpated from the region. Reasons for loss of native aquatic species are complex, but two factors commonly cited are loss of habitat directly through impoundments and indirectly through watershed alterations, and interactions (hybridization, predation, competition) with introduced fishes. One method to secure or restore native fish assemblages is to construct waterfall barriers to upstream movement of nonnative fishes, followed by chemical or other treatments to remove nonnative fishes above the barriers. Although barrier construction and chemical renovation efforts have been practiced for at least 25 years, there is little literature addressing the effectiveness of the technique.

B. Statement of Work/Assistance: The purpose of this task is to conduct a review of the effectiveness of fish barriers and the associated action of removing non-native fishes upstream from the barrier through chemical or other means, in protecting native fish populations. It is presumed Arizona, New Mexico, or other southwestern Game and Fish Departments have sufficient fish sampling information, both pre- and post-barrier place to evaluate barrier effectiveness. Barrier effectiveness will use before and after data when available. Similar streams and barrier systems will also be evaluated and compared to clarify factors that enhance barrier effectiveness. These factors will be incorporated into an adaptive management strategy to increase the effectiveness of existing and future barrier and renovation projects. It is expected

that the final report will be redrafted and submitted for one or more publications by a peer-reviewed journal. This task will address several high priority tasks of the spikedace, loach minnow, Gila topminnow, desert pupfish, Apache trout, and Gila trout recovery plans.

PROPOSED FY05 CAP FUND TRANSFER PROGRAM PROJECTS

RPA 3 - Conservation of Native Fishes

Loach minnow/spikedace data assembly - AZ
Refugia for rare populations
Bubbling Ponds Hatchery development (pending task 3-45)

RPA 4 - Control of Nonnative Fishes

Upper Gila River mechanical removal of nonnatives
Upper Verde River mechanical removal of nonnatives
Transgenic fish development (year 1 of 5)

The Muleshoe project - Translocation of spikedace, loach minnow, topminnow, and pupfish + augmentation of unlisted species including lowland leopard frog in 3 streams on the Muleshoe Conservation Area. Project is progressing quite smoothly. BLM is still working on the EA, but should be finished soon. FWS is lead and is working on something? AGFD is waiting for other aspects to be completed before beginning the EA Checklist, but should be starting on that in August or September. Plan is to move fish this fall.

San Pedro Preserve ponds - Stocking of Gila chub, topminnow, and pupfish in the TNC ponds. Gila chub will come from Redfield Canyon. We're currently waiting on the fish health assessment, but we're also working on updating the EA Checklist for the project. Should be pretty straightforward and easy.

Instead of a list of Projects, Craig with the Arizona Sonoran Desert Museum offered up suggestions on how they feel they can best help with our efforts. Those suggestions are listed below.

1. A mouthpiece for helping to inform the public about issues with lower vertebrates and invertebrates.
2. A refuge for small populations to be managed as a stopgap to losing a species or a specific population of a species. Currently we house populations of Gila topminnow and Quitobaquito pupfish for this purpose. Perhaps there are others that would benefit from this as well?
3. A physical refuge for short-term holding in times of crisis (such as the Sabino Canyon situation).
4. Developing husbandry protocols for small native fishes.

As the group looks at fish conservation in Arizona, especially in region V, please think about which species might benefit from our involvement in one of the aforementioned methods.

- Bear Canyon renovation, protection, and enhancement for native fish species – The Aspen fire most likely completed the renovation of this Canyon. Surveys are planned for later this summer to determine this.
- East Side of Rincon’s renovation, protection and enhancement for native fish species – Various locations that need to be surveyed for native fish potential.
- Romero Canyon Gila chub re-establishment – Renovation was completed, however Aspen fire destroyed habitat. Habitat assessment needs to be completed.
- Investigate other locations for natives fish species renovation, protection and enhancement on Coronado National Forest that are currently unknown.
- Investigation of locations for possible fish barriers for the protection, enhancement and restoration of native fish species on Coronado National Forest that are currently unknown.
- Peck Canyon renovation, protection and enhancement for native fish species – Surveys are near completion with fish found in only one location. NEPA needs to be completed for renovation of this location and efforts to re-establish natives can begin.
- Sycamore Canyon renovation, protection and enhancement for native fish species
- Investigate lower elevation streams in the Pinaleno Mountains outside of Safford for possible native fish renovation, protection, and enhancement.
- Cave Creek renovation, protection and enhancement for native fish species – Initial surveys are to be conducted this summer with management recommendations to follow.
- East Turkey Creek renovation, protection and enhancement for native fish species – Same as Cave Creek.
- Rucker Canyon monitoring and removal of sportfish species – Forest Service has been working on removal of non-natives with electrofishing, area is not going to be managed for sport fishing.
- West Turkey Creek monitoring and re-establishment of native fish species – Ongoing through USFWS
- Parker Canyon Lake renovation for the removal of northern pike – Renovation of lake is needed to prevent the spread of pike into other waters in the Region.
- Red Rock Canyon watershed renovation, protection and enhancement for native fish species.
- Turkey Creek renovation, protection and enhancement for native fish species
- Post Creek renovation, protection and enhancement for native fish species
- O’Donnell Creek monitoring and re-establishment of native fish species

Native Fish for Bingham Cienega
March 4, 2003

Project Description

The client wishes to establish long-fin dace to Bingham Cienega, and explore the potential for other native fish species to be established on the property. It is believed that non-native mosquito fish have been extirpated, on the basis of recent visits by biologists to sample for fish in the cienega. Biologists who have been to Bingham Cienega to sample for fish include Heidi Blasius, Rebecca Davidson, and Robert Clarkson.

Bingham Cienega Natural Preserve is located in the San Pedro River valley, approximately 1.5 hours drive from Tucson. The site is owned by Pima County Flood Control District. The site owned by the District includes portions of the flowing San Pedro River as well as an adjacent cienega. AGFD biologists have sampled the San Pedro River and have determined that long-fin dace are present. No other fish have been found in the San Pedro River within the District's Bingham Cienega property, however the survey effort has been limited.

The portion of the San Pedro River channel with the District boundaries are unfenced, but GPS coordinates and aerial photographs will be provided to the consultant to assure that all work is conducted on District property. Adjacent landowners include Andy and Debbie Smallhouse (along the river) and Jack and Lois Kelly (inholding). Property boundaries of the inholding are marked by fences. Biologists should not enter private property.

Deliverables

1. Presence/absence surveys of fish and aquatic vertebrates within the Preserve boundaries, inclusive of the river and cienega. This data would be used to establish a baseline.
2. Document and describe the aquatic habitat characteristics of the Preserve. Habitat parameters would include water flow, water depth, habitat type, etc.
3. Analyze presence/absence data and habitat characteristics data to determine habitat suitability for native fish.
4. Coordinate with AGFD regarding the proper requirements for relocation/stocking of longfin dace to the cienega.
5. Develop a monitoring plan to assess the long-term health of any native fish populations established within the cienega. This would include monitoring of longfin dace, aquatic vertebrates, aquatic habitat parameters, and non-native fish species.
6. Discussions with AGFD and USFWS regarding the establishment of Gila topminnow or other native fish within the cienega.

The following list was developed in looking for possible locations for establishment of Gila chub rescued from Sabino Canyon Last summer. Most of these locations were later dropped for various reasons but each of them provide opportunities outside of Gila chub establishment for native fish management.

Santa Cruz Drainage

Fresno Canyon – Tributary to Sonoita Creek in the Santa Cruz drainage below Patagonia Lake.

- Currently occupied by Gila topminnow and green sunfish.
- Natural fish barrier in place.
- May not provide enough habitat.
- Property owned by Arizona State Parks.

Coal Mine Canyon – Tributary to Fresno Canyon in the Santa Cruz drainage below Patagonia Lake.

- Currently occupied by Gila topminnow and longfin dace.
- Habitat good to excellent
- Fish barriers located in Fresno Canyon, possibly between Fresno and Coal Mine.
- Property currently privately owned, however owner is approachable. Possible sell to state in next couple of years.

George Wise Spring – Tributary to Sonoita Creek in Santa Cruz drainage. Flows directly into Patagonia Lake.

- Current fish population is unknown.
- No fish barriers known.
- Habitat is present.
- Privately owned by same owner of Coal Mine Spring. Department is in early stages of purchasing this property.

Bond Canyon – Tributary to Josephine Canyon in the Santa Cruz drainage.

- Fish barriers present.
- Green sunfish present.
- Habitat questionable.
- Stock tank in head will be difficult due to landowners.
- Several landowners, making thing difficult. Have been approached by two landowners about doing something native.

Josephine Canyon – Tributary to Santa Cruz River.

- Current fish population unknown.
- Fish barriers possible
- Habitat questionable
- Property owned by USFS.

Sonoita Creek – Santa Cruz drainage.

- Current fish population dependant on location. Ranges from native to non-natives to mix.
- Habitat is present.
- Fish barriers not present.
- Multitude of landowner's, dependant on location.

Temporal Gulch – Tributary to Sonoita Creek in the Santa Cruz drainage, above Patagonia Lake.

- Currently occupied by longfin dace and suckers, non-native status unknown.
- No fish barriers known but possible.
- May not provide habitat.
- Property owned by USFS.

Big Casa Blanca Canyon – Tributary to Sonoita Creek above Patagonia Lake.

- Current fish population status unknown.
- Fish barrier status unknown
- Habitat presence unknown
- Property owned by USFS and private individuals.

Monkey Spring – Isolated spring in the Santa Cruz drainage.

- Current fish population status unknown.
- Fish barrier not needed.
- Habitat questionable
- Private property, with uninterested landowners.

Ramanote Canyon – Tributary to Peck Canyon in the Santa Cruz drainage.

- Current fish population status unknown.
- Status of fish barriers unknown but likely.
- Habitat questionable.
- Property owned by USFS.

Peck Canyon – Tributary to Santa Cruz River.

- Currently occupied by green sunfish, Gila topminnows were present in the canyon near the confluence with the Santa Cruz River.
- Status of fish barriers is unknown but likely.
- Habitat is present.
- Property owned by the USFS.

Arivaca Creek – Tributary to Santa Cruz River.

- Current fish population status unknown, historic Gila topminnow population.
- Habitat status unknown.
- Fish barrier status unknown and unlikely.
- Property owned by USFWS.

Redrock Canyon – Tributary to Sonoita creek above Patagonia Lake.

- Current fish population consists of Gila topminnow and mosquito fish.
- Fish barrier status unknown.
- Habitat questionable.
- Property owned by the USFS.

Bog Hole Tank – Isolated stock tank located in upper Santa Cruz drainage.

- Currently thought to be fishless due to drought conditions.
- No fish barrier needed.
- Habitat questionable due to constant threat of non-natives being re-introduced.
- Property owned by AZGFD surrounded by property owned by USFS.

Cott Tank drainage – Tributary to Redrock Canyon.

- Tank itself currently fishless due to drought conditions. Canyon below tank currently has Gila topminnow and mosquito fish.
- No fish barrier needed.
- Habitat thought to be adequate. However constant threat to non-native reintroductions due to private land ownership of tank.
- Tank at head of drainage is private property, canyon below tank is owned by the USFS.

Parker Canyon – Tributary to Santa Cruz River. Confluence is in Mexico.

- Current fish population consist of non-natives
- No known fish barriers.
- Bigger threat from top down, due to Parker Canyon Lake.
- Habitat is excellent
- Property owned by USFS, currently fenced as duck habitat with no grazing.

Scotia Canyon – Tributary to Santa Cruz River, confluence in Mexico.

- Currently fishless. Why??
- Fish barrier status unknown
- Habitat status unknown.
- Property owned by the USFS.

Neighbor Spring – Tributary to Parker Canyon.

- Longfin dace only species present in mid 90's
- Fish barrier status unknown
- Habitat status unknown.
- Property owned by the USFS

Sharp, Sheehy and Heron Springs – Isolated springs in upper Santa Cruz drainage.

- Current fish population consists of Gila topminnow and Gila chub.
- No fish barriers needed.
- Habitat questionable.

- Property ownership thought to be State and TNC.

Posta Quemada Canyon – Tributary to Cienega Creek, south end of the Rincon mtns.

- Current fish population status unknown.
- Fish barrier status unknown
- Habitat status unknown, Jeff Simms reports that area has potential.
- Property ownership is thought to be USFS.

Aqua Caliente Canyon – Tributary to Tanque Verde Canyon in the Santa Cruz drainage.

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Tanque Verde Canyon – Tributary to Rillito Wash in Santa Cruz drainage.

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Romero Canyon – Tributary to Canada del Oro in the Santa Cruz drainage.

- Currently fishless.
- Fish barriers not needed immediately.
- Habitat was present and sufficient.
- Property owned by the USFS.

Canada del Oro Wash – Tributary to Santa Cruz River.

- Fish population status unknown, reports of longfin dace have not been confirmed.
- Fish barrier status unknown
- Habitat status unknown
- Property owned by the USFS and private individuals.

Gila River

Martinez Canyon – Tributary to the Gila River near Florence.

- Native fish population consists of longfin dace and speckled dace, crayfish present as well. Location already approved for Gila Chub
- Fish barriers possible, likely not needed due to distance to the river.
- Habitat, small but present.
- Property owned by BLM

Potential Listed Fish Recovery Sites - topminnow pupfish (Habitat Suitability FY04)

Government Draw
St. David Cienega

Potential Listed Fish Recovery Sites - topminnow Pupfish (Habitat Suitability FY05)

Mesquite Tank Middle Gila
Mescal Creek
Nogales Spring
Little Nogales Spring
Moson Spring
McDowell-Craig pond
Lewis seeps and springs (A-O)
Lewis Spring South
Lewis Spring North
Muesel Spring
Lomali Spring
Little Joe Spring
Horse Thief Spring
Frog Spring (near contention)

Fish Population Monitoring

Population estimates for Cienega Creek (passive techniques)
Water quality monitoring - loss of fish in head waters
Martinez Canyon – fish monitoring, flood flows, habitat quality/quantity
Upper Empire Gulch – fish, flood flows, habitat quantity/quality and water
quantity/quality