Desert Fish Habitat Partnership

Framework for Strategic Conservation of Desert Fishes, 2008

Desert Fish Habitat Partnership Workgroup

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Prepared by:
Desert Fish Habitat Partnership Workgroup

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Executive Summary

The Desert Fish Habitat Partnership (DFHP) was formed in 2005 to conserve native desert fish. To meet this goal, our strategy calls for the protection, restoration, and enhancement of desert fish habitats in cooperation with, and in support of state and tribal fish and wildlife agencies, federal resource agencies, research and private organizations, and engaged individuals. The Partnership seeks to address critical fish and aquatic habitat conservation needs over a broad geographic area that encompasses the entirety of the Great Basin and Mohave deserts, and those portions of the Sonoran and Chihuahuan deserts that lie within the United States. These lands support at least 179 non-salmonid native fish species identified as species of concern in western states' State Wildlife Action Plans (SWAPs).

Desert fish have declined across these arid lands as a result of habitat loss and alteration and the widespread introduction and establishment of nonnative aquatic species. Despite numerous federal and state laws, regulations, and policies to protect and recover native desert fishes and their habitats, most of them remain imperiled. Current habitat conditions and threats require specific management actions and focused consideration of desert fishes if these species and their habitats are to be protected and remain viable into the future.

The Desert Fish Habitat Partnership will benefit native desert fishes by bringing agencies, organizations, and the public together to work towards the recovery and conservation of these imperiled species and their habitats. By partnering across geo-political boundaries, the Partnership will pursue more effective management strategies than are generally achieved on a local, smaller scale. By identifying priority species and habitats, integrating and applying the best available science and promoting community involvement, the Partnership will help ensure that conservation actions and funds are expended efficiently in those locations, and on those actions, most likely to yield the greatest results in arresting the decline of desert fishes.

Introduction

The arid West historically sustained approximately one-third of the native fish fauna of North America, many of which were found nowhere else in the world. The uniqueness and diversity exhibited by fishes of this region are the result of geologic, tectonic, and climatic disruptions, which created a complex topographic and geologic setting where relict populations, monotypic genera, and a high degree of endemism developed. However, due to the arid nature and unique environmental conditions, aquatic habitats and desert fishes of western North America are particularly vulnerable to anthropogenic impacts. Today's western landscape is one of rapid development, extensive agricultural production, nonnative flora and fauna invasions, high recreational use, prolonged drought, overgrazing, and widespread disturbance from modern catastrophic fire. Due to landscape scale effects of invasive plant species and climate change these disturbances are expected to become even more pronounced. Habitat disturbances, both natural and anthropogenic, coupled with a consistently increasing demand for water, have led to the degradation and loss of aquatic habitats and their native fauna throughout the range of western fishes.

Within the United States, the aquatic habitats of the Chihuahuan, Great Basin, Mojave, and Sonoran deserts support 179 native fish species identified in State Wildlife Action Plans (SWAPs) (Appendix II) as conservation priorities. Currently, 54 are federally listed, representing 39% of the total number of fishes listed under the federal Endangered Species Act (ESA).

Despite numerous federal and state laws, regulations, and policies to protect and recover native desert fishes and their habitats, many of these species remain imperiled and their habitats threatened. With few exceptions, these species have declined across these deserts. Current habitat conditions and threats require special management actions and focused consideration of desert fishes if these species and their habitats are to be protected and remain viable into the future. Furthermore, current conservation and recovery actions typically focus only on single species or relatively small areas due to limited funding, spotty coordination, and complex geographic and jurisdictional boundaries.

While existing efforts have had limited successes, the opportunistic and isolated nature of these efforts have prevented comprehensive recovery and conservation.

To date, there has been no comprehensive, cross-jurisdictional effort to plan and take action for desert fish conservation and recovery on a broad scale across the spectrum of arid land aquatic habitats. To reverse the current trend of desert fish species declines, management actions will have to include coordination of agency activities, habitat restoration, protection, and acquisition, water quantity and quality protection, nonnative aquatic nuisance species control, and increased public awareness and participation. The Desert Fish Habitat Partnership (DFHP) has assembled to take a coordinated response to improve the likelihood of sustaining desert fishes and their habitats.

The DFHP purpose is to conserve aquatic habitat in the arid west for desert fishes for the American people by protecting, restoring and enhancing these unique habitats in cooperation with and in support of, state fish and wildlife agencies, federal agencies, tribes, conservation organizations, local partners, and other stakeholders.

The DFHP seeks to address fish and habitat issues over a broad geographic area that encompasses the entirety of the Great Basin and Mohave deserts, and those portions of the Sonoran and Chihuahuan deserts that lie within the United States. The benefits of aquatic habitat conservation extend beyond desert fishes to include humans and other animal and plant species. Riparian habitats that depend on surface water not only support a significant number of terrestrial and avian species identified as priority conservation species in SWAPs, but also function to store water that supplements groundwater recharge. The declining status of so many desert fishes highlights the importance of preserving these aquatic habitats so that water is available not only for the native fish, but also for future generations of humans. The DFHP can play an important role in conserving water in the West for future generations.

The DFHP will benefit native desert fishes by bringing agencies, organizations, and the public together to work towards the recovery and conservation of imperiled species and their habitats. By partnering across geo-political boundaries, the DFHP can pursue more effective management strategies than are generally achieved on a local, smaller scale. By identifying priority species and habitats, integrating and applying the best available science and promoting community involvement, the DFHP will help ensure that conservation actions and funds are expended efficiently in those locations, and on those actions, most likely to yield the greatest results.

Overview of the Framework for Strategic Conservation of Desert Fishes

The development of the DFHP Framework for Strategic Conservation of Desert Fishes is the combined effort of many individuals from diverse agencies, tribes and organizations working towards a common goal of conservation of native desert fishes and associated aquatic habitats. This effort reflects and recognizes the merit of collaboration and cooperation among DFHP partners.

The DFHP strategic action plan provides the critically needed framework for integrating conservation on a broad scale by utilizing SWAPs and existing multi-species conservation plans to identify and prioritize necessary conservation actions to sustain desert fish habitats. The DFHP is dedicated to active support of those actions that will result in the protection and enhancement of important desert fish habitats.

This Framework for Strategic Conservation of Desert Fishes is a goal-oriented, science-based, strategic action plan that explicitly states DFHP partner goals, provides guidance for decision-making, and identifies methods for evaluating success. It is comprised of four key components: (1) vision, (2) principal goals, (3) conservation priorities, and (4) strategic conservation actions to address priorities and attain goals.

The DFHP believes this Framework will provide the foundation for a carefully focused, technically credible and publicly accountable program linking projects to specific strategies so that funding will be utilized most effectively. As such, criteria for project funding recommendations will be consistent with the vision, goals, key priorities and actions of the Framework for Strategic Conservation of Desert fishes. The Framework is also intended to provide opportunities for partners to coordinate data gathering, planning, and implementation of conservation actions.

The DFHP partnership is confident the Framework will complement other existing western fish conservation and recovery efforts, serve as a model for other sensitive species and aquatic habitat conservation partnerships, and assure progress in the recovery of imperiled desert fishes and their habitats for the benefit of current and future generations and the ecosystems on which we depend.

Fish in the Desert

Desert aquatic habitats within the DFHP consist of four major types and include **rivers**, **streams**, **springs/spring brooks**, and **cienegas**, which support relatively depauperate fish assemblages rich in endemism and special adaptations. Large ocean-bound **rivers** form from sizeable montane watersheds and are usually groundwater-dependent and include the upper and lower Colorado River and Rio Grande, as well as their major tributaries like the Gila, San Juan, and Pecos rivers. Fed by underground springs or runoff from rain and snow melt, **streams** such as the San Rafael (Upper Colorado), Rio Nutria (Lower Colorado), Black River (Pecos Basin), as well as isolated, often groundwater-driven relic drainage systems such as the Upper White River (Basin and Range) connect to these larger river systems. Smaller spring-fed pool and run systems occur throughout the arid west and are included in the **spring/spring brook** habitats. **Cienegas** are water-saturated and poorly drained wetland areas associated with perennial spring and seep systems in isolated arid basins of the southwest. Cienega habitats are unique to the desert west and rapidly disappearing.

A review of priority species in the partner SWAPs identified at least 179 desert fishes that are species of greatest conservation need (Appendix III), excluding native salmonids of this region. Currently, approximately 30% of desert fishes are imperiled to the degree that they are federally listed as threatened or endangered and 82% are endemic to the desert west, a testimony to the unique nature of the fauna. Many of these species have ranges extending across political boundaries of one or more states, across the jurisdiction of multiple federal and state land and resource management agencies, and on tribal and private lands, emphasizing the need for a comprehensive and collaborative strategy and approach for effective conservation.

Identification of Critical Threats

Desert aquatic habitats and desert fish species throughout the Western United States are disappearing as a result of shared and unique threats (Table 1), especially those threats that result in habitat fragmentation and alteration and in the direst situations complete habitat loss. Principal causes of habitat fragmentation in desert aquatic systems are dam and reservoir construction, water diversion, groundwater development, and increased sedimentation resulting from a variety of land management practices.

Extended and on-going drought conditions in the southwest have impacted all desert aquatic habitats, from the snow-pack driven Rio Grande and its tributaries to groundwater dependent spring systems in the Great Basin. Results have included local extirpation of desert fish species from previously occupied stream segments. Climate change is expected to further these impacts to surface hydrology (changes in precipitation, snow pack, and summer baseflows) and groundwater hydrology (groundwater supply to springs). Aquatic systems with natural flows (unaltered by dams and diversions) are more resilient and better able to respond to climate changes, both short-term and long-term.

Large rivers in the west have been greatly impacted by the construction of dams and diversions, which alter instream habitat characteristics, create unnatural lentic habitats, affect downstream hydrographs, and sediment transport. Desert rivers are in most cases naturally highly variable systems characterized by high runoff in winter and early spring, and low summer flows punctuated by short duration high flow events during monsoon storms. Hydrologic alteration due to dam operations change the frequency, magnitude, timing, and rate of change of stream flow below dams, affecting those desert species whose life history has evolved with the natural hydrograph. Changes in sediment transport affect channel characteristics and therefore river habitats. Dams and diversions also act as barriers to natural, historic fish movement and disrupt metapopulation dynamics.

Spring systems have been impacted by the development of groundwater, which reduces surface flows, as well as through physical alterations for the use and diversion of surface water outflows. Groundwater pumping for irrigation and development can lower the water table, causing reductions in stream base flow and alter or attenuate flow during high runoff events. These effects are exacerbated by drought, particularly in the arid southwestern United States. The compounded effects of water reductions limit available habitat, reduce connectivity, and can increase negative intra- and interspecific interactions (*e.g.*, greater predation pressure).

Changes in land-use have also negatively affected aquatic habitats in the west. Improper grazing practices and water diversions for irrigation and mining cause water quality problems resulting in the decline and extinction of desert fishes. Improper grazing can negatively impact riparian habitats and fish populations. Unmanaged livestock trample stream banks, compact soils, and remove protective riparian vegetation from the stream bank, resulting in increased erosion, sedimentation, and water temperatures, and decreased habitat quality for native fish species. Water diversions remove water from streams that would otherwise provide habitat for desert fishes.

Additionally, desert aquatic habitats have been impacted by a variety of biological threats, including invasive and nonnative species. Introduced species threaten desert aquatic habitats across the west. The establishment of baitfish and game fish species beyond areas of intentional introduction has, in many cases, resulted in competitive and predatory exclusion of native desert species from their historic ranges and is a primary threat to desert fish conservation. Predation and competitive impacts may also be exacerbated when habitats are altered.

Basin and Range: least chub

LEAST CHUB, *lotichthys phlegethontis*, is a small minnow native to the Bonneville Basin. Although the species formerly occurred in many areas of the Bonneville Basin, there are only six remnant populations remaining. Fortunately, efforts are now underway to expand the numbers and distribution of the least chub.

Table 1. Known and Recognized Threats to Desert Aquatic Habitats and Species were compiled from State Wildlife Action Plans.

Threat Category	Key Stressor	River	Stream	Spring	Cienega
Habitat Degradation	Loss of adjacent uplands and watershed functions	X	X	X	X
	Improper grazing, agricultural and forest management, including road development	X	X	X	X
	Beaver removal and control	X	X	X	X
	Road and trail construction and management	X	X	X	
	Disrupted sediment transport regime	X	X		
	Fragmentation of habitat (water storage, water extraction, and water quality)	X	X	X	
	Oil, gas, and mineral extraction, including mine tailings. Geothermal energy development.	X	X	X	
	Recreational use, trails, roads, off-highway vehicless	X	X	X	
	Water and air quality (excess nutrients, algal blooms, illegal dumping of toxic materials, petroleum and chemical spills, pesticides, wastewater, and litter)	X	X	X	X
Hydrologic/ Channel Alteration	Dams, barriers, reservoirs, impoundments, diversions, and water transfers	X	X	X	
	Stream/river channel alteration (riprap, levees, channelization, stabilization, Irrigation diversions, and dredging)	X	X		
	Altered disturbance regimes (unnatural fire and flood frequency)	X	X	X	X
Loss of Habitat	Water development and surface water withdrawal	X	X	X	X
	Groundwater depletion and springhead use	X	X	X	X
	Urban and rural growth and development	X	X	X	X
Nonnative Species	Predation, competition, and hybridization	X	X	X	X
	Disease and pathogen vectors	X	X	X	X
Intractable Threats*	Conflicting fish management policies, water laws, climate change, air quality, drought international border activities and military operations				

*Intractable threats are multi-national or inter-jurisdictional and are not likely to be addressed by individual DFHP projects.

Geographic Scope of the Desert Fish Habitat Partnership

The scope of the Partnership is based upon geographic inclusion of defined aquatic habitat (*e.g.*, river, stream, spring, and cienega) in North American deserts and the distribution of fish species of greatest conservation need identified in SWAPs.

Geographic boundaries of the DFHP partnership are defined by the distribution of arid land aquatic habitats that support fish species of greatest conservation need. To determine this, the distribution of North American deserts was overlaid with the major western hydrographic basins (Figure 1). The DFHP used the Ecological Regions of North America classification by the Commission for Environmental Cooperation to define the deserts of North America, which includes the Mojave, Chihuahuan, Great Basin, and Sonoran, which extend from eastern British Columbia in the north to Baja California and north central Mexico. The geographic boundaries were further refined from the western hydrographic basins, defined as Hydrologic Unit Codes (HUC) Regions 13 (Rio Grande), 14 (Upper Colorado), 15 (Lower Colorado), 16 (Great Basin), 17 (Pacific Northwest), and 18 (California), as those waters that lie within the deserts of North America as defined above **and** support desert fishes identified in the SWAPs (Figure 2). Review was completed by biologists within each area to determine the specific reaches of waters, to the specificity of the 8-digit HUC, to be included.

The boundaries of the DFHP were identified by the Partners and encompass basins in the United States that either occur in or support desert fish habitat, including tributary areas, as defined by known current or historic occupancy by desert fish species. This area, covering parts or all of 11 states, totals approximately 705,182 square miles (Table 2). Distribution of aquatic habitat is not continuous within this area; the distribution of desert fishes varies from solitary species inhabiting isolated springs in a single watershed (such as the White River spinedace) to wider-ranging species in multiple watersheds that traverse state and national boundaries (*e.g.*, flannelmouth sucker or Yaqui chub). Further, native desert fishes included in the DFHP share drainages and in some cases concurrent habitats with native salmonids and other headwater-dependent upper-elevation fish species, which are not principally resident in arid land aquatic habitats in the strictest sense.

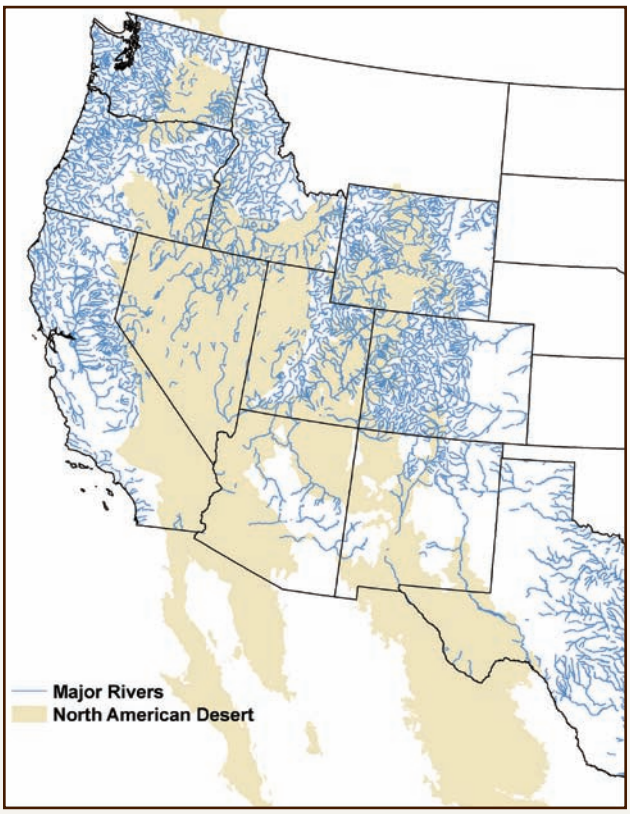


Figure 1. North American Desert habitats (from the Commission for Environmental Cooperation) and the major rivers of the West.

Figure 2 Geographic Scope and Subregions of the Desert Fish Habitat Partnership.

Based on ecological characteristics and species distributions the DFHP workgroup subdivided the overall partnership area into four subregions. These subregions include the Rio Grande (most of HUC Region 13), Upper Colorado River (all of HUC Region 14), Lower Colorado River (all of HUC Region 15), and Basin and Range (parts of HUC Regions 16, 17, 18) (Table 2). These areas were delineated based upon the commonality of the watersheds, habitats, fish species, and threats within each. For instance, the Lower Colorado region is dominated by rivers and streams, which are faced with threats from dams and diversions, whereas the Basin and Range region is dominated by isolated spring systems and streams threatened by water development and physical habitat alteration.

The DFHP is currently organized to function only within the United States even though the ranges of some native desert fish species extend to Mexico. The DFHP recognizes that various agencies and conservation entities within neighboring countries will be important partners in assisting the DFHP in accomplishing its objectives for certain species. In addition, a member of the DFHP, the Desert Fishes Council, has worked to build and strengthen relationships with Mexico for desert fish conservation.

Although the DFHP is specifically focused on the conservation of non-salmonid desert fishes and their habitats, the Partnership fully recognizes the importance of native western trout and that many of these species also face critical conservation needs, including the seven native trout species which are listed under the ESA as threatened or endangered. The DFHP is dedicated to working with the Western Native Trout Initiative (WNTI) and other aquatic habitat partnerships to implement watershed-based approaches to aquatic habitat conservation so that effective strategies can be applied to all species resident to these important aquatic systems. Climate change resulting in changes in available habitat types and increases in water temperatures may create new zones of overlap between some native nongame fish species and native trout. Close coordination with WNTI can foster a proactive approach between the two partnerships to avoid or minimize potential conflicts with native fish restoration, develop win-win, habitat-based strategies, and prevent working at cross-purposes in these zones of overlap. Furthermore, coordination with WNTI provides coverage of entire drainage basins rather than just stream segments or portions of drainages where suitable temperatures and habitats exist for selected species. If climate change-driven warming of stream temperatures force shifts in native trout and native nongame fish species distributions, a pre-existing and collaborative working relationship with WNTI will ensure a coordinated response. Given the complexity and interrelationship of fish species and habitat distributions across the American West having two broad and **complementary, not competing**, regional fish habitat partnerships provides flexibility and a mechanism for the Partnership members to cross jurisdictional boundaries and will streamline actions to address these challenges.

Table 2. Four Subregions of the Desert Fish Habitat Partnership.

Subregions	Major Basins	States Included	Area (square miles)
Basin and Range	Bear, Great Salt Lake, Escalante, Humboldt, Lahontan, Columbia, Yakima, Snake, Klamath, and Sacramento	CA, ID, NV, OR, UT, WA	315,871
Upper Colorado	Colorado, Gunnison, Dolores, Green, White-Yampa, and San Juan	AZ, CO, NM, UT, WY	113,479
Lower Colorado	Colorado, Little Colorado, Bill Williams, Gila, Río de la Concepcion, Río Yaqui, and Río Sonoyta	AZ, CA, NM, NV, UT	144,446
Rio Grande	Rio Grande, Pecos, and Tularosa	CO, NM, TX	131,386
Total			**705,182**

The Desert Fish Habitat Partnership Organization

The organizational structure and function of the DFHP meets the requirements established for formal partnerships by the National Fish Habitat Board (NFHB). This Partnership: 1) operates on a regional scale to set conservation goals, 2) focuses local conservation efforts (actions) on high-priority issues and geographic areas; 3) facilitates cost-share funding for projects (in fact, emphasizes utilization of existing funds and directs them to these priorities); 4) ranks proposals for funding; and 5) tracks results of actions and performance of the Partnership.

The DFHP is a collaborative partnership composed of states, federal agencies, tribes, and other government and private conservation partners with a collective interest in the conservation of native desert fish species and associated aquatic habitats within the partnership area. Partners of the DFHP will enter into a Memorandum of Understanding to facilitate cooperation among the National, State, Tribal, and local levels of agencies and non-government organizations for planning and implementing mutually beneficial actions, projects and general activities related to the conservation of desert fishes and their habitats, as outlined in this strategic framework. Activities will complement the respective missions of the Partners and serve their mutual interests and those of the general public.

The DFHP currently includes 11 western states—Arizona, California, Colorado, Idaho, Nevada, New Mexico, Oregon, Texas, Utah, Washington, and Wyoming; seven Federal agencies, U.S.Fish and Wildlife Service (USFWS), U.S.Geological Survey (USGS), U.S.Forest Service (USFS), Bureau of Land Management (BLM), Bureau of Reclamation (BOR), Natural Resources Conservation Service (NRCS), and National Park Service (NPS); and three non-governmental organizations, The Nature Conservancy (TNC), Desert Fishes Council (DFC), and Trout Unlimited (TU); and two tribal representatives, Southwestern Tribal Fishery Commission (STFC) and the Native American Fish and Wildlife Society (NAFWS).

The Partnership will operate under guidelines outlined in the DFHP Operating Structure (Appendix I). The organization will be governed by an Executive Committee and a Steering Committee made up of representatives from a subset of the signatory parties to the MOU. Regional or ad-hoc workgroups will be established to address regional or site-specific issues in order to draw upon local and regional expertise. A Partnership-At-Large Council will also be established to accomplish the goals and objectives set forth in the Framework.

Upper/Lower Colorado: roundtail chub

ROUNDTAIL CHUB, *Gila robusta*, is a fairly large minnow native to the Colorado River system of the western United States. The species prefers large rivers, and is most often found in murky pools near strong currents in the main-stem Colorado River, and in the Colorado River's large tributaries. Roundtail chub eat terrestrial and aquatic insects, mollusks, other invertebrates, fishes, and algae. The species spawns over areas with gravel substrate during the spring and summer. Eggs are fertilized in the water, and then drop to the bottom where they adhere to the substrate until hatching about four to seven day later. Although locally common in places, roundtail chub have been reduced in numbers and distribution due to flow alteration and the introduction of nonnative fishes.

Upper/Lower Colorado: bluehead sucker

BLUEHEAD SUCKER, *Catostomus discobolus,* is native to parts of Utah, Idaho, Arizona, New Mexico, and Wyoming in the Colorado River system, the Snake River system, and the Lake Bonneville basin. Bluehead sucker is a benthic (bottom dwelling) species with a mouth modified to scrape algae (the primary food of the bluehead sucker) from the surface of rocks. Members of the species spawn in streams during the spring and summer. Fast flowing water in high gradient reaches of mountain rivers has been identified as important habitat for bluehead sucker. Bluehead suckers have been reduced in numbers and distribution due to flow alteration, habitat loss/alteration, and the introduction of nonnative fishes.

Although the signatories to the Partnership will represent the primary entities for achieving the objectives of the Framework, implementation of on-the-ground actions will require partnership with other groups, including private land owners, industry, NGOs, and other local, state, and tribal governments. The organization of this Partnership will allow others to help the Partnership achieve the Framework objectives without becoming a signatory to the MOU.

The Desert Fish Habitat Partnership Vision

The vision of the DFHP is to:

Improve the quality of life for the American people by conserving native desert fishes through preservation of unique aquatic ecosystems. The DFHP will support state and tribal fish and wildlife agencies, federal agencies, research institutions, and private organizations in protecting, restoring, and enhancing aquatic habitats.

To attain this vision and protect America's natural heritage legacy the Desert Fish Habitat Partnership will:

- Promote partner collaboration and speak with a unified voice on the conservation and value of native desert fishes.
- Work cooperatively across geographic and jurisdictional boundaries to maximize conservation benefits for aquatic habitats and desert fishes through an ecosystem approach.
- Increase and leverage funding and resources by building local and regional partnerships to accomplish strategic actions that conserve native fishes and aquatic habitats identified in partner states' State Wildlife Action Plans.
- Support and encourage the development and implementation of educational and outreach programs to increase public awareness of desert aquatic habitats, their fishes, and threats to their continued existence.

Upper/Lower Colorado: flannelmouth sucker

FLANNELMOUTH SUCKER, *Catostomus latipinnis*, is native to the Colorado River system of the western United States and northern Mexico. Flannelmouth suckers are benthic (bottom dwelling) fish that primarily eat algae, although invertebrates and many types of plant matter are also consumed. The species spawns in streams over gravelly areas during the spring and early summer. Flannelmouth suckers prefer large rivers, where they are often found in deep pools of slow-flowing, low gradient reaches. Flannelmouth sucker populations have been reduced in both numbers and distribution, primarily due to flow alteration, habitat loss/alteration, and the introduction of nonnative fishes.

Lower Colorado: longfin dace

LONGFIN DACE, *Agosia chrysogaster*, is found throughout the lower Colorado River tributaries, including the Bill Williams and Gila rivers. Unlike many other native minnows in the southwestern United States, longfin dace appears to be stable in most of its historical range. However, even this seemingly hardy, cosmopolitan species cannot survive compounded and increased threats such as degradation of habitat and introduction of nonnative species—declines in longfin dace populations are appearing throughout its range.

Basin and Range: Modoc sucker

MODOC SUCKER, *Catostomus microps*, is native to the upper Pit River Basin, including the Goose Lake sub-basin, in northeastern California and south-central Oregon. Threats to Modoc sucker include habitat loss, possible hybridization with the sympatric Sacramento Sucker, *C. occidentalis*, and predation by nonnative fishes.

Restoring spring habitats in the Great Basin to conserve rare native fish species: The Railroad Valley springfish at Big Warm Spring, Nevada

The Railroad Valley springfish, *Crenichthys nevadae*, is a rare endemic fish species occurring only in two large thermal spring complexes in central Nevada's Railroad Valley. Big Warm Spring, near Duckwater Nevada, once held the largest population of springfish but had been modified for development of a commercial fish farm and for agricultural water delivery systems. The population of springfish was lost by 2004 because of the habitat modifications and escape of nonnative fishes from the commercial facility. Restoration of Big Warm Spring was particularly challenging because of the large scale of the modifications and ownership that included both Tribal and public lands.

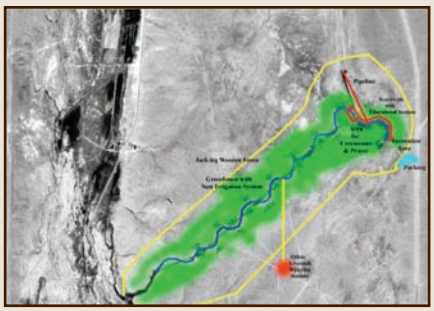
A partnership incorporating the Duckwater Shoshone Tribe, US Fish and Wildlife Service, Nevada Department of Wildlife, Bureau of Land Management, and other cooperators was able to secure funding and implement large-scale restoration of the spring and outflow system which included renovation of the spring source pool and 1.5 miles of historic outflow stream; removal of the abandoned fish farm; eradication of nonnative fishes including Tilapia and catfish; replacement of tribal water diversions with a more fish-friendly design; and restoration of important tribal cultural areas near the spring source pool. Springfish were released back into the spring system in 2007 and are thriving in their restored habitats.

This project has significantly enhanced the recovery status of the springfish while incorporating Tribal enterprise, cultural and agricultural needs into the final design. Project partners have continued this success with planning and restoration of the adjacent Little Warm Spring native fish habitats which will be completed in 2009.

The Railroad Valley springfish, *Crenichthys nevadae*, is endemic to only two thermal spring complexes in central Nevada's remote Railroad Valley.

Tilapia sp. and other nonnative fishes had infested the spring and spring outflow system, almost entirely eliminating the native fish community.

An abandoned commercial fish farm and deteriorated water delivery system had altered and impacted the spring source and springbrook fish habitats.



A site restoration plan developed cooperatively by project partners removed the fish farm, restored the spring source pool and 1½ miles of outflow stream, and renovated tribal water delivery systems to minimize effects on critical fish habitat.

Local natural materials were used to restore and stabilize the spring source pool.

The historic spring outflow stream was recreated incorporating natural meander patterns.

The restored spring source pool area has enhanced an important tribal cultural site and provides public outreach on desert fish conservation.

The Desert Fish Habitat Partnership Principal Goals

If we fail to halt desert aquatic habitat degradation, modification, and loss we will continue to watch and document the parallel declines in native fish throughout North American desert ecosystems.

The achievement of the following four goals is paramount for desert fish recovery and conservation.

- Protect and maintain intact healthy aquatic ecosystems supporting desert fish habitats.
- Prevent further degradation of desert fish habitats that have been impaired.
- Reverse declines in the quality and quantity of desert fish habitats to improve the overall population status of desert fishes and other aquatic organisms.
- Increase the quality and quantity of fish habitats that support a broad natural diversity of desert fishes and other native aquatic species.

The Desert Fish Habitat Partnership Conservation Priorities

The DFHP strategic plan is guided by the following three fundamental conservation priorities:

1. Integrate State Wildlife Action Plan priorities with the National Fish Habitat Action Plan (NFHAP) strategies to include the following:

- Protect intact and healthy habitats.
- Restore and maintain flow and water levels.
- Restore connectivity, while protecting native populations at-risk from nonnative encroachment.
- Remediate and minimize sediments and excessive input of nutrients to habitats supporting species at-risk.

Each DFHP partner state included fish species of greatest conservation need in their respective SWAPs. A review of these plans identified at least 179 fish species occurring within the geographic scope of the DFHP, excluding salmonids. Approximately 150 of these fish species are endemic to North American deserts. These desert fishes encompass a tremendous variety of habitats and life histories from the wide-ranging flannelmouth sucker, which occurs in seven western states to the Devils Hole pupfish, which is found only in a 10 square meter cavern in Ash Meadows, Nevada, but the DFHP provides the framework for integrating efforts for these species across SWAPs and jurisdictional boundaries to identify and prioritize needed conservation actions.

2. Implement on-the-ground projects that focus actions to protect the most under-served, imperiled desert fish species identified in SWAPs to enhance their conservation status and prevent their extirpation and extinction.

The 179 fish species on the DFHP conservation priorities matrix (Appendix III) occur in waters of the Deserts of North America and are species of greatest conservation need identified in SWAPs. The Partnership priority is those species that are unique to the deserts of North America, highly imperiled, and underserved by lacking adequate management and resources to ensure effective conservation. Criteria describing these characteristics were developed, including Global Heritage Rank (NatureServe.org), desert endemism, need for cross-jurisdictional cooperation, federal listing status, population status as determined by expert opinion, and level of management available or identified for the species. Numeric scores for each criterion were assigned by state representatives and then averaged to arrive at an overall rank. Certain criteria (endemism and management level) were considered of such importance

Rio Grande: Pecos pupfish

PECOS PUPFISH, *Cyprinodon pecosensis, is native to the Pecos River in Texas and New Mexico. Hybridization with nonnative sheepshead minnow caused the loss of Pecos pupfish from much of its historical habitat. The hybridization, along with degradation of habitat, led to increased concern about this fish, including a proposal to list the fish as Federally Endangered. In 1999, state and federal land and resource managers began working cooperatively for the benefit of this species through the Conservation Agreement for Pecos Pupfish. Today, cooperative efforts, such as establishing replicate, secure populations and erecting barriers to prevent movement of sheepshead minnow, have assisted in securing the species and preventing the need for federal protection.*

to the focus of the Partnership that these criteria were weighted in the overall ranking process. Species scores ranged from 0.9 to 2.8 with the highest priority desert fish species receiving scores greater than two.

3. Prioritize projects to conserve and restore habitat for the most under-served, imperiled desert fish species.

A review of the SWAPs indicated that all natural aquatic habitats were recognized as of high importance within their arid systems. Across the DFHP geographic area, springs were not ranked higher than cienegas, and streams were not considered more or less important than rivers. At any point in time, or under any particular set of circumstances each habitat can be affected by the range of threats listed in Table 1. Across the American west, aquatic resources within their respective desert ecosystems share the same high priority.

To reflect and continue this relative equality of desert aquatic habitat value, yet accommodate site and temporal factors affecting desert waters, no overarching priority classification has been identified in the Framework. Instead, the following criteria will be considered when evaluating actions proposed for the DFHP sponsorship in any aquatic habitat:

- The relative importance of the aquatic system to the continued support of a high priority species or community (*e.g.*, does it support the only known occurrence of a species or assemblage?)
- The immediacy and significance of threats known to act upon the system that would affect its continued capacity to support desert aquatic resources (*e.g.*, is dewatering imminent without action?)
- The anticipated response of the habitat to the stated actions to be implemented (*e.g.*, is it a proven method for aquatic habitat conservation?)
- Partner support (*e.g.*, are there matching or in-kind resources for the project?)
- Percentage of habitat of species or community protected, maintained, or enhanced (*e.g.*, will this project benefit the entire population, or multiple native species?)
- Rarity of habitat within its respective system (*e.g.*, is this the only free-flowing river in the southwest or only perennial stream within the range of a species?)

National Fish Habitat Partnership Demonstration Project: Red Rock Cienega

Wetland and cienega habitats are rare in the desert southwest and rapidly disappearing due to changes in the water table and invasive vegetation. In New Mexico, two cienega fish species, Gila topminnow *Poeciliopsis occidentalis* and Gila chub *Gila intermedia*, exist in only single isolated populations. To provide habitat for these fish, the New Mexico Department of Game and Fish in partnership with the Desert Fish Habitat Partnership is restoring the cienega in the Red Rock Wildlife Management Area near the Gila River. The area once had perennial surface water but now is only seasonally wet and contains nonnative vegetation including tamarisk and bull thistle. This project will remove nonnative vegetation and restore native vegetation, recreate the wetland in connection with the water table and provide an emergency source of water during drought years, and provide educational opportunities with an interpretive trail. The cienega will provide habitat not only for the fish, but also for waterfowl in the area, and increase the recreation value of the Wildlife Area. Construction will take place in 2009 with funding provided by U.S. Fish and Wildlife Services' Candidate Partnership Demonstration Projects and the Bureau of Reclamation's Central Arizona Project.

The historical cienega is currently ephemeral and choked with invasive vegetation, like tamarisk.

Gila chub (left) and Gila topminnow (right) will be repatriated into the cienega with assistance from Arizona Game and Fish Department.

- The potential of the proposed action to protect intact habitat or re-establish the natural hydrograph (*e.g.*, will the project impact larger natural processes?)
- Continued support of the project, including adequate monitoring and maintenance.

The Partnership will identify coordinated and cooperative actions that benefit desert fishes through protection, maintenance, or enhancement of their habitats.

The Desert Fish Habitat Partnership Strategic Conservation Actions

The DFHP recognizes the value and need of having both regional and local scales for addressing conservation actions. Regional scale conservation actions will be implemented by the Partnership and will focus on project prioritization, funding, and oversight; whereas local scale conservation will encompass on-the-ground actions accomplished primarily by individual partners or cooperators.

Regional Scale Conservation Actions

DESERT FISH HABITAT AND SPECIES INFORMATION SYNTHESIS The primary objective of the DFHP is to focus funding on imperiled desert habitats where conservation efforts will directly enhance those species that are currently "under-represented" in ongoing conservation efforts. By prioritizing funding for these species, the DFHP anticipates cooperatively implementing and completing actions, which will provide immediate benefits to these species and their habitats, and directly assist in the achievement of priority conservation needs identified in SWAPs. The following tasks provide the regional scale process considerations for assembling information needed for context of local conservation actions. Some of these tasks will require annual in-person meetings with the DFHP partners for resolution. Other tasks may require the use of ad-hoc subgroups to successfully identify and complete the action(s).

1.1 Utilize State Wildlife Action Plans to identify gaps in existing species and habitat conservation efforts.

- Organize and illustrate results from the DFHP fish conservation priorities matrix assessment, which highlights a ranking of conservation needs for desert fish species identified in SWAPS.
- Species receiving a priority ranking of two or greater will require an additional status review based on published and expert information. Some species and their habitat may benefit from a detailed review of the literature (published and gray).
- Species receiving a ranking of less than two will require an informal review of their known status and habitat requirements with species experts to determine if an additional assessment at a range-wide scale is required.

1.2 Utilize the efforts of the NFHAP Science and Data committee to integrate their work with information gaps on species in the DFHP fish matrix.

- Appoint two liaisons to the Science and Data committee from the DFHP.
- Assist the Science and Data committee in identifying information and methods of assessment that will contribute to the goals and conservation priorities of the DFHP.

1.3 Review current programs that benefit native desert fish species and identify areas where DFHP projects can be of assistance.

- Review programs throughout the area of the DFHP that benefit desert fish species and use the results where appropriate to identify areas where DFHP projects can be of assistance.

Three species, roundtail chub, bluehead sucker, and flannelmouth sucker, were found to be declining in 2002. Although, not federally listed as threatened or endangered, threats to their continued existence were identified in portions of their natural ranges. This prompted state agencies to enter into a Range-wide Conservation Agreement for the three species for the purpose of proactively and cooperatively protecting and recovering these species. The original signatories developed a protocol by which additional partners, such as federal agencies and Native American tribes could join the conservation agreement.

- Identify opportunities to support inter-jurisdictional conservation needs for priority species and habitats occurring in more than one partner state or across tribal, public, or private land boundaries.

- Utilize the periodic reviews of SWAPs to assist in the identification of gaps in current and future programs and activities for DFHP species and their habitats.

- Identify new or improved collaboration among concurrent programs and initiate development and implementation of cooperative projects.

1.4 Identify habitat requirements for each desert fish species listed in 1.1 that received a two or greater prioritization ranking.

- Identify habitat type(s) where each species of greatest conservation need is currently located and / or determine habitat types historically used during their life histories.

- Compile life history stage habitat requirements for all priority species of greatest conservation need from literature review.

1.5 Compile information on projects implemented under the umbrella of the DFHP.

- Compile and maintain information from project completion reports into a centralized database. This information can be used to satisfy NFHAP and partner reporting requirements.

1.6 Develop and prioritize strategies to assist in addressing regional threats facing native desert fish species and habitats.

- Use Table 1 (*Known and Recognized Threats to Desert Aquatic Habitat and Species*) to identify priority threats and stressors to desert fish species and habitats, which can be addressed through DFHP support of on-the-ground project actions.

- Identify and prioritize geographic or threat-based areas of focus within the greater Partnership area where desert fish species and habitat threat interactions can be addressed by DFHP partners and cooperators.

RESEARCH Research is vital to conserving aquatic desert ecosystems and the species, which inhabit these areas. For some species and desert habitats very little information is available, including knowledge that would improve our understanding of the cumulative effects of multiple stressors. The DFHP supports research that increases our understanding of aquatic desert ecosystems and will encourage and endorse new and ongoing research to further DFHP goals and conservation actions.

2.1 Track on-going research and identify and prioritize additional research needs to support DFHP actions to sustain priority species and habitats.

- Review and refine results from the habitat and species information synthesis to identify where research can provide critical information to understand and implement habitat and species restoration.

- Meet annually with Desert Fishes Council Area Coordinators, Lower Colorado River Aquatic GAP Project, NFHAP Science and Data Committee, and other research partners to identify changes in status and trends of priority desert fish species, and to identify areas where the Partnership could assist in addressing critical research information needs through the support of specific projects and other actions.

2.2 Collaborate with partners to encourage research that addresses the following issues.

- Identify minimum instream flows, hydrological regimes, and groundwater-supported surface flows necessary to maintain viable desert fish populations, habitats, and associated aquatic communities.

- Determine the short and long term effects on desert fish populations and their habitats of management and conservation actions such as: (a) nonnative or invasive species removal during restoration activities; (b)

re-connecting habitats including tributaries to mainstem riverine habitats by removing barriers, screening irrigation canals or restoring instream flows to allow migration of aquatic species; and (c) the effectiveness of barriers in protecting native species from nonnative aquatic species.

ADAPTIVE MANAGEMENT The DFHP strategic framework utilizes existing knowledge, technology, and experience to set goals and develop monitoring programs identified in the strategy. As new information becomes available the DFHP will reassess the components of the strategic plan and make adjustments using an adaptive management approach. The tasks identified below frame this approach.

3.1 Evaluate DFHP outcomes of sponsored, habitat-based desert fish conservation actions to ensure DFHP goals and objectives are being met.

- Evaluate DFHP conservation actions to ensure accountability, efficiency, and effectiveness of implemented actions.
- Identify actions that work and improve actions that are ineffective.

3.2 Use new information and findings from projects to update conservation goals and priorities.

- Allow for rapid response to changing situations, priorities, and techniques. The incorporation of new information may be critical in emergency situations.
- Utilize both positive and negative project outcomes to bring up-to-date future strategies and actions.

3.3 Modify strategic plan to reflect new information from monitoring and research.

- Utilize data collected from projects to modify the strategic plan if significant changes occur in known threats to aquatic habitats, desert fish species, or in the manner best suited to address those threats.
- Signatories may propose and must approve changes to the signed strategic plan.

OUTREACH AND EDUCATION PROGRAMS An educated and informed constituency that understands that perpetuation of desert fishes requires protection of habitats upon which the species depend for survival, and upon which people ultimately depend, is an invaluable ally for recovery. The DFHP will develop, implement and support engaging outreach and educational programs to increase public and policy maker awareness of desert fishes, their aquatic habitats, and their plight. Programs and educational materials will focus on various media (*e.g.*, print, video, and radio) for use in schools, community-based events, and work related programs and should be available in both English and Spanish.

4.1 Outreach and education for desert fishes will be achieved through the following actions.

- The partnership will develop and maintain a DFHP web site. The web site will contain information on all priority desert fish species identified within the partnership, their status, biology, distribution, conservations needs and threats, and conservation actions. Links to existing information from partners and other appropriate entities will be incorporated.
- The DFHP will work with environmental coordinators to develop hands-on activities that are based on aquatic wildlife and aquatic ecosystems. The activities will lead students from awareness to action in desert fish conservation.

Local Scale Conservation Actions

REQUIREMENTS FOR LOCAL SCALE CONSERVATION PROJECTS Local scale desert fish habitat projects will be required to address tasks 1.1 and 1.2. Implementation of these tasks into local scale conservation projects will help ensure project effectiveness and will also support the goals and objectives set forth by the DFHP.

1.1 Monitor implementation and effectiveness of actions and projects to secure, protect and restore habitat, including costs, partner contributions, and other results that will help determine net benefit to the species and associated aquatic habitats.

- Use currently available information to establish baseline data for affected habitats and species in the project area.
- Develop a habitat based project plan for each project using physical and biological data and watershed features. The plan will identify habitat characteristics required to successfully achieve project goals for target native species and habitats, and will include an assessment of current habitat, species threats, and measures of project success.
- Develop criteria for long-term project monitoring protocols with the objectives of estimating changes in target population status and trends over time.
- Require annual progress reports on project activities and accomplishments until completion.

1.2 Certain actions are considered best management practices when implementing habitat protection and restoration projects for desert fish habitats and species, and should be incorporated where applicable in any supported projects. Such practices include, but are not limited to:

- Avoid and manage the spread of infectious diseases and parasites to habitats of desert fish species.
  - Prevent detrimental effects of disease and parasites by implementing Hazard Analysis of Critical Control Points (HAACP) protocols during field activities, in culture, and during movement and release of desert fish species as part of management actions.
  - Cooperate with national aquatic animal health efforts.
- Prevent the movement and introduction of nuisance species into or from project habitats.
- Ensure genetic management concerns are addressed for desert fish species and populations affected by project implementations, where appropriate, based on the scope and scale of the project.
  - Review existing genetic information on affected desert fish species and, as needed, identify and facilitate applications of techniques to better understand the genetic variability within and among affected species populations.
  - Determine if known information is adequate to answer management questions related to conservation genetics, and identify if additional genetic characterization is needed.
  - Incorporate conservation genetic techniques into species monitoring protocols.
- Incorporate adaptive management practices in project design and implementation to inform and evaluate project techniques and strategies as new information is acquired

Recommendations and Guidance for Local Scale Projects

SECURE, ENHANCE, AND CREATE HABITAT The DFHP will provide guidance and assistance to partners as they identify and implement measurable restoration actions to maintain, restore, or enhance habitat for aquatic and riparian dependent species.

1.1 Secure currently occupied and functioning desert fish habitat.

- Secure currently occupied habitat through conservation agreements and purchases.
- Provide for the future protection of these habitats through conservation agreements.

1.2 Improve and maintain habitat quality.

- Improve or maintain high quality habitat to allow reproduction and completion of all life history stages for desert fishes.
- Establish strategies to prevent loss of habitat for species. Projects will address activities that reduce the quality of habitat, such as those that reduce water quantity or quality, or other impacts to habitat, including invasions of nonnative species. Overall watershed condition will be considered in maintaining aquatic habitat quality, including the contribution of impacts to uplands and associated features (*e.g.*, road location and condition, vegetative patterns, and historic land uses).

1.3 Restore altered habitat to suitable conditions.

- Evaluate potential priority habitats, including rivers, streams, springs, and cienegas to identify opportunities for habitat restoration. Areas within the historical range of a species are preferred. Areas outside that range may be considered to secure species for the short or long-term in case of immediate threat of extirpation or where identified in existing species conservation planning.
- Eliminate, reduce, and preclude the effects of physical, chemical, and biological stressors to stream channels, riparian areas, springs, and groundwater source areas. Stressors may include, but are not limited to unnatural flow regimes, erosion, water diversion, excessive groundwater pumping, road construction, excessive nutrients, nonnative riparian vegetation, invasions of nonnative aquatic species, unnaturally high temperatures, channelization and other direct physical alterations and urbanization.
- Implement habitat improvements, including, but not limited to restoration of natural flow and temperature regimes, coarse sediment supply, physical and structural restoration such as reconstructing natural meander patterns, addition of woody debris, and nonnative plant and animal control.

1.4 Develop and implement strategies to restore or protect adequate flow regimes.

- Support state, private and federal parties in developing flow management strategies to secure in-stream flow (*e.g.,* water rights, leases, and agreements) to maintain aquatic habitat quality and availability, sediment management, and to protect natural temperature regimes.
- Incorporate the spatial and temporal habitat requirements for all life history stages of native fish species into flow management strategies.

1.5 Enhance and/or restore connectivity to allow movement among disjunct populations of desert fishes.

- Evaluate and prioritize opportunities by adequacy of current water levels or flows and immediacy of dewatering.
- If connectivity among occupied habitats cannot be maintained, metapopulation dynamics may be secured through human-assisted movement of fish among fragmented populations.
- Identify and implement strategies to minimize and mitigate the negative effects of water development projects to connectivity among desert fish populations.

- Identify existing in-stream infrastructure (*e.g.*, dams and culverts) that may inhibit movements and develop strategies and projects to mitigate or remove elements that contribute to habitat fragmentation.

1.6 Maintain and protect fish refugia throughout historic range and utilize artificial refuges where they may contribute to species survival.

- Maintain and protect existing refugia habitats that support native species and contain high quality habitat free of nonnatives. Although existing habitats are a priority, artificial habitats provided by museums, universities, private individuals, and other appropriate stakeholders may serve as temporary refuges or as key places for reproduction of individuals to be later released back into the wild.
- Utilize monitoring and observe fishes maintained in refuges to increase knowledge of species life history, ecology, and behavior.

1.7 Eradication or control of detrimental nonnative and invasive aquatic species in habitats designated for conservation of desert fish species.

- Identify and prioritize habitats for management of invasive aquatic species.
- Develop strategies for control or management of invasive aquatic species that may threaten the continued existence of desert fishes or their habitat. Strategies may include mechanical or chemical removal and/or prevention.
- Implement actions identified in SWAPs to reduce or eliminate threats to desert fishes.

1.8 Restore natural fire regimes in watersheds where desert fish species and their aquatic habitats occur.

- Improve and secure habitat through the use of prescribed fire, wildland fire use, noncommercial thinning, and invasive plant species control to reduce the risk of catastrophic fire and allow for restoration of natural fire regimes.
- Restore natural vegetation in areas where invasive plant species have been removed.

1.9 Under some circumstances it may be appropriate to incorporate selected non-habitat based actions at the project level to ensure the successful and comprehensive implementation of projects in arid land aquatic habitats. Such actions may include, but are not limited to the following:

- Salvage species facing imminent, uncontrollable threats and relocate to refuge habitats.
- Augment wild and captive populations as needed to facilitate increases in fish populations and to maintain and improve genetic integrity where populations have been extirpated and the causes of their extirpation have been eliminated; where populations are low in abundance and subject to inbreeding risks or extirpation; where historic habitat is suitable, but unoccupied; and where natural recruitment of a valuable population is absent or impaired to the point that extirpation is imminent, with the purpose of preventing extinction in the wild.
- Replicate local populations where opportunity exists. Replicating populations will ensure no net loss of populations and help assure the continued existence of a species in the wild should catastrophic loss occur to some local populations.
- Where captive propagation has been identified as a conservation and recovery tool, propagate species in need to allow stocking into suitable habitats with an appropriate genetic stock, and as assurance against species extinction in the wild.
- Expand population distributions by establishing sustainable populations in appropriate habitats within historic range through translocation and stocking programs based on best available genetic information. Expanding population distributions may also include stocking into currently fishless habitats, within historic habitats to increase the number of refuge populations and to expand distribution.

OUTREACH AND EDUCATION PROJECTS. Support and foster the development of collaborative aquatic education outreach strategies with states, federal agencies, tribes, and non-governmental organizations to increase public awareness and appreciation of aquatic resources with an emphasis on desert habitats and desert fish.

2.1 Promote and develop public education and outreach opportunities for desert fish conservation.

- Develop desert fish informational and educational materials (*e.g.*, videos, bookmarks, brochures, maps, posters, tee shirts, replicas of native fish, live fish displays, and tours).
- Develop education curriculum to foster responsible actions toward desert fishes and their habitats for students in kindergarten through grade 12 including state or school district approved curriculum. An example of this is the Rio Grande cutthroat trout board game and curriculum that was developed by the Santa Fe National Forest.
- Encourage and support volunteer and school group participation in surveys and monitoring programs.

Aquatic and Riparian Habitat Restoration in the Chihuahuan Desert

Aquatic-riparian habitat in Howard Well all but disappeared due to invasion by cattails and the accumulation of sediment and organic materials. In 2006, the Bureau of Land Management, through an internal grant and cooperators restored Howard Well for the purpose of repatriating desert pupfish (*Cyprinodon macularius*).

1

Before restoration

2

A bulldozer and back hoe were used to remove cattails, sedges, and sediment from Howard Well to create open water habitat and to reconfigure the aquatic habitat for native fish and wildlife. Prior to restoration no open water habitat existed at Howard Well.

3

Bentonite was applied to the aquatic habitat at Howard Well to seal the bottom to reduce loss of water from infiltration.

4

Rock and log structures were placed in the aquatic and riparian habitats to provide vertical structure for fish and macroinvertebrates and loafing and basking structures for birds, amphibians, and reptiles.

5

After restoration

6

On July 1, 2008, the Arizona Game and Fish Department and the Bureau of Land Management stocked 243 desert pupfish into Howard Well.

Desert Pupfish

Appendix I - Operating Structure

Organization

The development of the DFHP Framework is the result of the effort of many individuals from diverse agencies, tribes, and organizations working towards accomplishing a common goal (*i.e.*, the conservation of western arid land associated aquatic habitats and native fishes). This effort reflects and recognizes the merit of collaboration and cooperation among DFHP partners, in particular, the merit of coordinated leadership by the steering committee.

The Desert Fish Habitat Partnership Steering Committee is a self-directed group of partner representatives interested in achieving the DFHP purpose to conserve aquatic habitat in the arid west for desert fishes for the American people by protecting, restoring and enhancing these unique habitats in cooperation with and support of state fish and wildlife agencies, federal agencies, tribes, local partners, and other stakeholders.

The Steering Committee is the decision-making body for the DFHP and has oversight responsibility for all DFHP activities. The activities of the Steering Committee directly support the DFHP Framework, which will identify the planning, implementation, and evaluation processes for the implementation of the partnership.

Roles and Responsibilities

STEERING COMMITTEE

1. The DFHP Steering Committee will promote, oversee, and facilitate the actions of the Partnership. This includes, but is not limited to:
    - directing development and adaptive management of the Framework;
    - guiding development, implementation, monitoring, and evaluation of conservation actions priorities at range-wide, regional and local scales;
    - ranking actions (projects) for funding consideration;
    - facilitating cost-sharing and leveraging of funds to implement conservation actions and partnership functions;
    - providing direction and input to any DFHP working group(s) as needed;
    - supporting the DFHP with financial and/or staff resources, as available;
    - participating in outreach efforts to garner additional resources to build support for desert fish conservation;
    - coordinating with other NFHAP Partnerships where there is geographic overlap with DFHP species and habitats;
    - reporting results to partners, stakeholders, and the National Fish Habitat Action Plan Board and their working groups (*i.e.*, Science and Data and Communication Committees) on the status, accomplishments, and needs of the DFHP; and
    - conducting annual DFHP meetings.
2. The DFHP Steering Committee should not exceed 23 Members. This will include representation as follows:
    - 11 States (AZ, CA, CO, NM, NV, ID, OR, TX, UT, WA, and WY).
    - Seven Federal agencies (BLM, BOR, NPS, NRCS, USFS, USFWS, and USGS).

- Two Tribal representatives (Native American Fish and Wildlife Society and Southwest Tribal Fisheries Commission).
- Three non-governmental organizations (The Nature Conservancy, Desert Fishes Council, and Trout Unlimited).

3. Each DFHP Steering Committee entity shall appoint a representative and an alternate who works in a position that is at a level both adequate and appropriate to perform the duties of the Steering Committee.
4. The DFHP Steering Committee will adopt a set of administrative By-Laws by which the Steering Committee will conduct its business.

EXECUTIVE COMMITTEE

The DFHP Executive Committee will consist of a Chair, Vice-Chair, additional committee members representing regional subcommittee boundaries selected by the full Steering Committee and a representative from a non-governmental organization.

The Executive Committee will respond quickly to issues raised by the Steering Committee that require immediate response, or decisions that require less than a seven day turn-around time. In addition, the Executive Committee will:

- Oversee the responsibilities of a DFHP coordinator.
- Oversee development of the DFHP final prioritization criteria
- Oversee and manages completion of DFHP development and operation tasks.
- Serve as liaisons between the DHFP and the Western Association of Fish and Wildlife Agencies (WAFWA), including attending WAFWA meetings and providing briefings to WAFWA and individual State Agency Directors as requested.
- Participates in NFHAP meetings and teleconferences.

REGIONAL/GEOGRAPHIC OR AD HOC WORKING GROUPS

The DFHP encompasses 11 states with populations of many species occurring in and overlapping multiple states. This unique situation will likely require occasional, regional-local level planning and coordination to address DFHP related issues. To meet this need, DFHP will utilize regional working groups or ad hoc working groups on an as needed basis. The regional groups are: 1) **Basin and Range** including the states of Nevada, California, Oregon, Utah, Washington, and Idaho; 2) **Upper Colorado** including Utah, Wyoming, Colorado, and New Mexico; 3) **Lower Colorado** including California, Nevada, Arizona, New Mexico and Utah; and 4) **Rio Grande** including Colorado, New Mexico and Texas. A lead within each regional group will be identified from the Steering Committee to facilitate communication and provide representation on the Executive Committee.

DFHP PARTNERSHIP-AT-LARGE COUNCIL

The DFHP will strive to maintain continued interest and support by considering all interested parties as members of an at-large council that collectively work to accomplish the goals and objectives set forth in the Framework for Strategic Conservation of Desert Fishes. To this end, the DFHP encourages individuals, groups, and agencies to participate or provide assistance (*e.g.,* financial or technical) in implementing our goals, objectives, and strategic actions.

This group will also assist in information exchange and communication among DFHP and partners and provide feedback to the DFHP coordinator and steering committee regarding new opportunities for conservation collaboration and expansion. The council will convene via teleconference or other means, as needed, to discuss emerging issues of importance to the success of the partnership.

New DFHP partners wishing to participate on the steering committee may request that the steering committee add them to the partnership council at any time. Requests will be acted upon by the steering committee at their next scheduled meeting or teleconference.

DFHP COORDINATOR

As funding becomes available, a part-time or full time coordinator for the DFHP will be established. The coordinator will provide primary staff support to the DFHP steering committee and will be responsible for disseminating information, coordinating and facilitating overall implementation of actions and projects within the DFHP, coordinating outreach activities, and pursuing funding and grant opportunities. In the interim, the Executive Committee and their agency's/organization's staff, will assist with filling this role.

ACCOMPLISHMENTS AND ACCOUNTABILITY

Annual reports summarizing project, partnership, and fiscal accomplishments will be conducted on a bi-annual basis or as requested and reported to the NFHAP board, partners, the general public and others interested in the partnership.

BUDGET AND FUNDING OPPORTUNITIES

A DFHP MOU among partners will support the operations and coordination of DFHP activities. Although nothing in the MOU obligates any agency to any funding responsibilities, to date, various federal, state, tribal and non-governmental organizations have contributed to conservation efforts for species of greatest conservation need, including development of this partnership, strategic planning, and the MOU. The Framework identifies conservation actions; however, the actual completion of actions is contingent upon availability of funding. Implementation funding will be provided by a variety of sources. Federal, state, and local sources will provide or secure funding to accomplish the actions in the plan. Other operational and project implementation funds will be sought through grant programs, donations, gifts, and other funding sources that are available to the partnership. The DFHP anticipates specific funding opportunities for completing strategic conservation actions from the following agencies:

STATE AGENCIES

The Partner state agencies all have authorities for the management and conservation of resident wildlife including native fishes, and have programs specific to the conservation and management of desert fish species. The States through their SWAPs have identified conservation priorities for many of the species identified in the DFHP Framework. Nongame fish programs, although often not funded as robustly as other state game and fish programs, provide a significant funding source for implementing actions consistent with the goals and objectives of the Framework. Total funds for nongame fish programs in the participating state agencies vary annually dependent on appropriations and available funding sources. Leveraging these funds and in-kind services with other funding opportunities creates a significant funding source for DFHP priority actions. The DFHP creates a platform to coordinate these state funding sources with other funds (NGO, federal agency, and NFHB grants) to achieve on-the-ground actions.

FISH AND WILDLIFE SERVICE

The U.S. Fish and Wildlife Service works with others to conserve, protect and enhance fish, wildlife, plants and their habitats for the continuing benefit of the American people, and several grant programs are available to support these efforts. The Partners for Fish and Wildlife is a habitat restoration program that focuses on restoring habitat for migratory birds, native fish, and declining plant and animal species. The National Fish Passage Program is a program to restore native fish and other aquatic species to self-sustaining levels by reconnecting habitat that has been fragmented by man-made barriers. The Tribal Wildlife Grant Program provides funds for activities that benefit wildlife and their habitat, including species of tribal, cultural, or traditional importance and species not hunted or fished. The State Wildlife Grant Program provides funding to state wildlife agencies to help meet the conservation needs of animal species considered to be "at risk." It places

primary emphasis on the conservation of traditionally under-funded species. The Conservation Grants program provides financial assistance to States to implement conservation projects for listed species and species at-risk. The DFHP Framework will help the USFWS and its partners to identify and prioritize projects that support restoration of desert fishes using these grant programs.

NATIONAL PARK SERVICE

The National Park Service is charged with promoting and regulating the units of the National Park System for the conservation of scenery, national and historic objects and wild life in a manner that provides for their enjoyment and leaves them unimpaired for future generations. There are 70 NPS units with a total area of 13 million acres within the geographic scope of the DFHP; many of these units include waters that provide habitat for desert fishes including taxa that have been identified as "priority species" by the DFHP. Although the primary purposes of NPS units vary according to type (*e.g.,* park, monument, historic site, or recreation area) and enabling legislation, the NPS is required to protect native species and maintain the quality of aquatic and terrestrial environments except where this is inconsistent with other purposes identified by Congress. The NPS does not generally have base funding that is dedicated to the conservation of fishes or aquatic habitat but native fish and aquatic habitat research and restoration projects are funded through several internal competitive sources. Legislation passed in 2008 authorizes the NPS to enter into cooperative agreements for the purpose of protecting the natural resources of the National Park System through collaborative efforts on land inside and outside of NPS boundaries. This allows the NPS to expend appropriated funds outside its boundaries if there are clear and direct benefits to park natural resources.

U.S. GEOLOGICAL SURVEY

The US Geological Survey provides research support and technical assistance to Department of the Interior, other Federal, State, Tribal, local and non-governmental natural resource agencies and organizations. The USGS Biological Resources Discipline has committed funding and personnel in support of the National Fish Habitat Initiative, to implement the National Fish Habitat Action Plan, and to develop Fish Habitat Partnerships (FHPs) that address the Resource Protection and Use responsibilities of the Department of the Interior. Two USGS Programs—Fisheries: Aquatic and Endangered Resources and Status and Trends, provide scientists to co-chair and participate in the Science and Data Committee, staff the NFHB and participate in the National Fish Habitat Federal Caucus. These USGS science programs and the National Fish Habitat Science and Data Committee sponsored the 2008 NFHAP Science and Monitoring Needs Workshop to develop a short-term science and monitoring agenda for the National Fish Habitat Board. The USGS has dedicated cyclical funding to support USGS research projects that focus on science and monitoring priorities for FHPs identified by the interagency group.

BUREAU OF RECLAMATION

Established in 1902, the Bureau of Reclamation is best known for the dams, power plants, and canals it has constructed in the 17 western states. The agency's new mission is to assist in meeting the increasing water demands of the West while protecting the environment and the public's investment in this infrastructure. At this time, only the Lower Colorado Region (LCR), which includes parts of southern California and western New Mexico, southern Nevada, and Arizona, has a discretionary program with which to fund projects to conserve and recover federally listed species. Each of the area offices within the LCR has the ability to fund DFHP projects within their respective geographical areas. We anticipate that this program will continue to be available in the future although the overall program budget may not increase. As the DFHP gains in visibility and accomplishments, other Regions within the agency may also chose to participate. In order to comply with the reasonable and prudent measures in a biological opinion, the Phoenix Area Office provides annual funding to be used to conserve and recover listed aquatic species and to manage against invasive species within the Gila River basin in Arizona and New Mexico. A joint Technical and Policy committee made up of federal and state biologists reviews project proposals and makes recommendations for funding.

BUREAU OF LAND MANAGEMENT

The Bureau of Land Management administers land throughout a significant portion of the desert ecosystems subject to this Framework. Fisheries funding is currently allocated to BLM State Offices for disbursement to field offices to support on-the-ground actions to meet fisheries goals and objectives. Although the BLM does not have a grant program similar to other federal agencies (such as the US Fish and Wildlife Service), it establishes funding priorities through the budget allocation process and can support projects on public and private land. The Wyden Amendment gives the BLM the authority to expend federally appropriated funds on private land, provided those actions have a direct benefit to BLM resources. In fiscal year 2008, each BLM State Office was encouraged to utilize between 20-30% of their base fisheries allocation, representing about $2.7 million dollars to support partnership projects under the National Fish Habitat Action Plan. In FY09, BLM State Offices are directed to commit this funding to NFHAP projects. This framework provides a mechanism for partners to identify needs and help direct BLM fisheries funds to support mutually defined project priorities.

USDA NATURAL RESOURCES CONSERVATION SERVICE

The Natural Resources Conservation Service USDA Farm Bill programs provide financial support to non-federal land managers for conservation actions to improve soil, water, and habitats for species of greatest conservation need. Programs most suitable for improving conditions for aquatic species, especially desert fishes, are the Wildlife Habitat Incentives Program (WHIP), the Environmental Quality Incentives Program (EQIP), the Wetland Restoration Program (WRP), and other easement programs such as the Farm/Ranch Protection Program (FRPP). These programs provide conservation dollars to non-federal land managers for installment of practices associated with a conservation plan, such as removal of barriers that impede migration of species of greatest conservation need, riparian and floodplain restoration, or as incentives for conservation of key aquatic habitats. Funds for these programs have ranged from $50,000 to over $500,000 over the past five years. This framework will provide opportunities for non-federal partners, including tribes and private landowners to implement conservation actions consistent with DFHP priorities and compete more effectively for these funds.

USDA FOREST SERVICE

The USDA Forest Service Regions 1, 2, 3, 4, 5, and 6 contain portions of National Forest or Grasslands in the DFHP geographic scope. Funding of fisheries program work is currently combined with wildlife program dollars and is distributed to accomplish work at the individual National Forest or Ranger District level. The USFS also has authorities under the Wyden Amendment to fund actions on private lands where they will benefit adjacent public (USFS) lands and resources. Current funding is targeted at accomplishing national strategic goals and objectives, which include: reducing adverse impacts from invasive species (measure is "percent of priority acres protected") and restoring and maintaining diverse habitat and healthy watersheds (measure includes "acres of aquatic habitat restored"). The means to accomplish these objectives include maintaining resilient land and water conditions at the watershed level; and developing and implementing conservation strategies to conserve threatened, endangered, and other at-risk species. Where available, USFS funds may be used to leverage partnership dollars. The DFHP principal goals complement work the Forest Service is currently directed to carry out.

THE NATURE CONSERVANCY

The Nature Conservancy's mission is to preserve the plants, animals and natural communities that represent the diversity of life on Earth by protecting the lands and waters they need to survive. The DFHP area encompasses portions of three Conservancy conservation regions. Conservancy state programs engage in a variety of activities including scientific assessments, conservation planning, ecological monitoring, acquisition of properties, conservation easements and water rights, habitat management and restoration, government relations and policy initiatives, community outreach and fundraising. Nationally and at the state level, the Conservancy works cooperatively with a wide variety of agencies and organizations, and is an active participant in the National Fish Habitat Partnership and FHPs throughout the country. The Conservancy is actively conserving freshwater habitats across the DFHP area, and has recently identified the Colorado River basin as one of its

global priorities. This designation includes the development of a system-wide strategy that combines on-the-ground conservation action in 35 sites with cross-cutting policy and project work addressing issues such as water use and rights, climate change and ecosystem services valuation. Key strategies include flow restoration, removal of invasive species and protection and restoration of riparian areas. The Conservancy is able to raise private dollars and use its staff time as in-kind match for public grant funding for DFHP activities.

NATIVE AMERICAN TRIBES

Native American Tribes value and exercise responsibilities for the management of Indian lands and tribal trust resources. In keeping with the federal policy of promoting tribal self-government, the component agencies, bureaus and offices of the Department of the Interior and the Department of Commerce (Departments), shall respect the exercise of tribal sovereignty over the management of Indian lands and tribal trust resources. Accordingly, Tribes shall govern the extent to which tribal resource management plans for tribal trust resources outside Indian lands can be incorporated into actions to address the conservation needs of listed species. Native American governments and Departments harmonize the work and exchange of technical expertise regarding matters of mutual interest, such as the conservation and recovery of fish and wildlife. We manage tribal trust resources as outlined in the Native American Policy of the U.S. Fish and Wildlife Service, the American Indian Tribal Rights, Federal-Tribal Trust Responsibilities, and the Endangered Species Act.

Appendix II - State Wildlife Action Plans

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Appendix III - Desert Fish Conservation Priorities Matrix

The Desert Fishes Habitat Partnership matrix includes those desert fish species (sorted taxonomically), which were identified in State Wildlife Action Plans as Species of Greatest Conservation Need.

NOTES:

Desert Endemic: X = species only found in the deserts of North America

U.S. Endangered Species Act Status: E = Endangered, T=Threatened, C = Candidate

Global Heritage Rank: Nature Serve Global ranks, based on a one to five scale, ranging from critically imperiled 1 to demonstrably secure 5 (NatureServe.org)

DFHP Rank: this is the overall rank determined for the species, based upon Global Heritage Rank, desert endemism, need for cross-jurisdictional cooperation, federal listing status, population status as determined by expert opinion, and level of management available or identified for the species. Numeric scores for each criterion were assigned by state representatives and then averaged to arrive at an overall rank. Certain criteria (endemism and management level) were considered of such importance to the focus of the Partnership that these criteria were weighted in the overall ranking process.

						Habitat Type				Desert Occurance				
Common Name	Scientific Name	State Occurence	Desert Endemic	ESA status	Global Heritage Rank	Rivers	Streams	Springs	Cienegas	Upper Colorado	Lower Colorado	Rio Grande	Basin and Range	DFHP Rank
river lamprey	*Lampetra ayresii*	WA			4	X	X						X	1.78
Pit-Klamath brook lamprey	*Lampetra lethophaga*	CA, OR	X		3		X						X	2.11
Miller Lake lamprey	*Lampetra minima*	OR	X		1				X				X	2.33
Klamath River lamprey	*Lampetra similis*	CA, OR	X		3	X	X						X	2.11
Goose Lake lamprey	*Lampetra sp.*	CA, OR	X		5		X		X				X	2.33
Klamath Lake lamprey	*Lampetra sp.*	OR	X		3				X				X	1.78
Pacific lamprey	*Lampetra tridentata*	CA, ID, OR, WA	X		5	X	X						X	1.89
machete	*Elops affinis*	AZ			5	X					X			0.89
longfin dace	*Agosia chrysogaster*	AZ, NM	X		4		X	X	X		X			1.67
Mexican stoneroller	*Campostoma ornatum*	AZ, TX	X		3		X				X			2.33
beautiful shiner	*Cyprinella formosa*	AZ	X	T	2	X	X	X			X			2.22
proserpine shiner	*Cyprinella proserpina*	TX	X		3		X	X				X		2.33
Manantial roundnose minnow	*Dionda argentosa*	TX	X		2		X	X				X		2.33
Devils River minnow	*Dionda diaboli*	TX	X	T	1		X	X				X		1.67
roundnose minnow	*Dionda episcopa*	NM, TX	X		5	X	X	X				X		1.56
desert dace	*Eremichthys acros*	NV	X	T	1			X					X	2.22
Alvord chub	*GIla alvordensis*	OR, NV	X		2		X		X				X	2.22
Utah chub	*Gila atraria*	ID, NV, UT, WY	X		5		X			X			X	1.78
Silver Lake tui chub	*Gila bicolor*	OR	X		4		X		X				X	1.89
Fish Creek Springs tui chub	*Gila bicolor euchila*	NV	X		4			X					X	2.11
Sheldon tui chub	*Gila bicolor eurysoma*	NV, OR	X		4		X		X				X	2.00
Independence Valley tui chub	*Gila bicolor isolata*	NV	X		4			X	X				X	1.78
Newark Valley tui chub	*Gila bicolor newarkensis*	NV	X		4			X					X	2.11
Lahontan Lake tui chub	*Gila bicolor pectinifer*	CA, NV	X		4		X		X				X	1.89
Big Smokey Valley tui chub	*Gila bicolor ssp.*	NV	X		4			X	X				X	2.33
Catlow tui chub	*Gila bicolor ssp.*	OR	X		4		X							2.33
Dixie Valley tui chub	*Gila bicolor ssp.*	NV	X		4				X				X	2.33
Eagle Lake tui chub	*Gila bicolor ssp.*	CA	X		4				X				X	1.44
Fish Lake Valley tui chub	*Gila bicolor ssp.*	NV	X		4			X					X	2.44
High Rock Springs tui chub	*Gila bicolor ssp.*	CA	X		4			X					X	2.22
Hutton tui chub	*Gila bicolor ssp.*	OR	X	T	4			X					X	1.22
Lahontan tui chub	*Gila bicolor ssp.*	NV	X		4		X						X	1.44
Little Fish Lake Valley tui chub	*Gila bicolor ssp.*	NV	X		4			X	X				X	2.33
Pit River tui chub	*Gila bicolor ssp.*	CA	X		4		X						X	1.78
Railroad Valley tui chub	*Gila bicolor ssp.*	NV	X		4			X	X				X	2.00
Summer Basin tui chub	*Gila bicolor ssp.*	OR	X		4		X		X				X	1.89
Warner Basin tui chub	*Gila bicolor ssp.*	OR	X		4	X			X					2.00
Goose Lake tui chub	*Gila bicolor thalassina*	CA, OR	X		4		X		X				X	2.00
Cowhead Lake tui chub	*Gila bicolor vaccaceps*	CA, NV, OR	X		4		X		X				X	2.33
Borax Lake chub	*Gila boraxobius*	OR	X	E	1				X					1.56
blue chub	*Gila coerulea*	CA, OR	X		3		X		X				X	1.89
humpback chub	*Gila cypha*	AZ, CO, UT, WY	X	E	1	X	X			X	X			1.67

Common Name	Scientific Name	State Occurence	Desert Endemic	ESA status	Global Heritage Rank	Habitat Type				Desert Occurance				OFHP Rank
						Rivers	Streams	Springs	Cienegas	Upper Colorado	Lower Colorado	Rio Grande	Basin and Range	
Sonora chub	*Gila ditaenia*	AZ	X	T	2		X				X			2.22
bonytail	*Gila elegans*	AZ, CA, NV, UT	X	E	1	X				X	X			1.67
Gila chub	*Gila intermedia*	AZ, NM	X	E	2		X	X	X		X			2.11
headwater chub	*Gila nigra*	AZ, NM	X	C	2		X	X			X			2.44
Chihuahua chub	*Gila nigrescens*	NM	X	T	1	X	X	X	X			X		2.22
Rio Grande chub	*Gila pandora*	CO, NM, TX	X		3	X	X					X		2.56
Yaqui chub	*Gila purpurea*	AZ	X	E	1	X	X	X			X			2.33
roundtail chub	*Gila robusta*	AZ, CO, NM, UT, WY	X		3	X	X			X	X			2.00
Pahranagat roundtail chub	*Gila robusta jordani*	NV	X	E	3		X	X					X	2.11
Virgin River	*Gila seminuda*	AZ, NV, UT	X	E	1	X					X			2.11
California roach (Pit)	*Hesperoleucus symmetricus mitrulus*	CA, OR			5		X						X	1.33
Rio Grande silvery minnow	*Hybognathus amarus*	NM, TX	X	E	1	X						X		2.00
least chub	*Iotichthys phlegethontis*	UT	X	C	1		X	X					X	2.22
White River spinedace	*Lepidomeda albivallis*	NV	X	E	1		X	X					X	2.11
southern leatherside chub	*Lepidomeda aliciae*	UT	X		2		X						X	2.11
northern leatherside chub	*Lepidomeda copei*	ID, NV, UT, WY	X		1		X			X			X	2.00
Virgin spinedace	*Lepidomeda mollispinis mollispinis*	AZ, NV, UT	X		1	X	X				X			2.33
Big Spring spinedace	*Lepidomeda mollispinis pratensis*	NV	X	T	1		X	X			X			1.89
Little Colorado spinedace	*Lepidomeda vittata*	AZ	X	T	1	X	X				X			2.22
speckled chub	*Macrhybopsis aestivalis*	NM, TX			3	X	X					X		1.56
spikedace	*Meda fulgida*	AZ, NM	X	T	2		X				X			2.22
Moapa dace	*Moapa coriacea*	NV	X	E	1		X	X			X			1.89
striped mullet	*Mugil cephalus*	AZ, TX			5	X					X	X		0.89
Tamaulipas shiner	*Notropis braytoni*	TX	X		4	X	X					X		2.44
Chihuahua shiner	*Notropis chihuahua*	TX	X		3	X	X					X		2.56
Rio Grande shiner	*Notropis jemezanus*	NM, TX	X		3	X	X					X		2.11
Pecos bluntnose shiner	*Notropis simus pecosensis*	NM, TX	X	T	2	X	X					X		1.67
woundfin	*Plagopterus argentissimus*	AZ, NV, UT	X	E	1	X	X				X			2.22
Colorado pikeminnow	*Ptychocheilus lucius*	AZ, CA, CO, NM, NV, UT	X	E	1	X	X			X	X			1.67
relict dace	*Relictus solitarius*	NV	X		2			X	X				X	2.56
longnose dace	*Rhinichthys cataractae*	CO, ID, NM, NV, OR, TX, UT, WY			5	X	X					X	X	1.22
leopard dace	*Rhinichthys falcatus*	ID, WA			4	X	X						X	1.56
speckled dace	*Rhinichthys osculus*	AZ, CA, CO, ID, NM, NV, OR, UT, WY			5	X	X	X	X	X	X		X	1.00
Amargosa Canyon speckled dace	*Rhinichthys osculus amargosae*	CA	X		5	X	X						X	2.11
Klamath specked dace	*Rhinichthys osculus klamathensis*	OR	X		5		X						X	1.89
Big Smokey Valley tui chub	*Rhinichthys osculus lariversi*	NV	X		5			X	X				X	2.33
Independence Valley specked dace	*Rhinichthys osculus lethoporus*	NV	X	E	5			X	X				X	1.89
Moapa speckled dace	*Rhinichthys osculus moapae*	NV	X		5		X				X			1.56
Ash Meadows speckled dace	*Rhinichthys osculus nevadensis*	NV	X	E	5			X					X	2.00
Clover Valley specked dace	*Rhinichthys osculus oligoporus*	NV	X	E	5			X					X	1.89
Diamond Valley speckled dace	*Rhinichthys osculus ssp.*	NV	X		5		X	X					X	2.33
Foskett speckled dace	*Rhinichthys osculus ssp.*	OR	X	T	5			X					X	1.33
Long Valley speckled dace	*Rhinichthys osculus ssp.*	CA	X		5			X					X	2.22
Meadow Valley speckled dace	*Rhinichthys osculus ssp.*	NV	X		5		X				X			2.11
Monitor Valley speckled dace	*Rhinichthys osculus ssp.*	NV	X		5			X					X	2.44
Oasis Valley speckled dace	*Rhinichthys osculus ssp.*	NV	X		5		X	X					X	2.11
Owens speckled dace	*Rhinichthys osculus ssp.*	CA	X		5		X						X	2.11
White River speckled dace	*Rhinichthys osculus ssp.*	NV	X		5		X	X					X	2.11
Kendall Warm Springs dace	*Rhinichthys osculus thermalis*	WY	X	E	5			X		X				1.22
Pahranagat speckled dace	*Rhinichthys osculus velifer*	NV	X		5		X	X					X	2.00
Colorado River speckled dace	*Rhinichthys osculus yarrowi*	NV, AZ, UT	X		5	X	X				X			2.11
Umatilla dace	*Rhinichthys umatilla*	ID			4		X						X	1.44
redside shiner	*Richardsonius balteatus*	ID, NV, OR, UT, WY			5	X	X			X			X	0.89
Lahontan redside	*Richardsonius egregius*	CA, NV, OR	X		5	X	X						X	1.56
hotspring redside shiner	*Richardsonius thermophilus*	OR	X		5			X					X	1.89
Mohave tui chub	*Siphateles bicolor mohavensis*	CA	X	E	1	X	X						X	2.33
Owens tui chub	*Siphateles bicolor snyderi*	CA	X	E	1	X	X	X					X	2.11

Common Name	Scientific Name	State Occurence	Desert Endemic	ESA status	Global Heritage Rank	Habitat Type				Desert Occurance				OFHP Rank
						Rivers	Streams	Springs	Cienegas	Upper Colorado	Lower Colorado	Rio Grande	Basin and Range	
Albert Lake tui chub	*Siphateles sp.*	OR	X		4		X		X				X	1.89
loach minnow	*Tiaroga cobitis*	AZ, NM	X	T	2	X	X				X			2.00
Utah sucker	*Catostomus ardens*	ID, NV, UT, WY	X		5		X						X	1.56
Yaqui sucker	*Catostomus bernardini*	AZ	X		4	X	X	X			X			2.22
desert sucker	*Catostomus clarkii*	AZ, NM, NV, UT	X		3	X	X			X	X			1.67
White River desert sucker	*Catostomus clarkii intermedius*	NV	X		3		X	X					X	2.22
Meadow Valley Wash desert sucker	*Catostomus clarkii* ssp.	NV	X		3		X				X			2.22
bluehead sucker	*Catostomus discobolus*	AZ, CO, ID, NM, UT, WY	X		4	X	X			X	X			1.89
Zuni bluehead sucker	*Catostomus discobolus yarrowi*	AZ, NM	X	C	1		X				X			2.67
Owens sucker	*Catostomus fumeiventris*	CA	X		3		X						X	2.44
Sonora sucker	*Catostomus insignis*	AZ, NM	X		3	X	X				X			1.78
flannelmouth sucker	*Catostomus latipinnis*	AZ, CA, CO NM, NV, UT, WY	X		3	X	X			X	X			2.00
Modoc sucker	*Catostomus microps*	CA, OR	X	E	1		X						X	2.44
Goose Lake sucker	*Catostomus occidentalis lacusanserinus*	CA, OR	X		5		X		X				X	2.11
mountain sucker	*Catostomus platyrhynchus*	CA, CO, ID, NV, OR, UT, WY	X		5		X						X	0.89
Rio Grande sucker	*Catostomus plebeius*	NM, CO	X		3,4							X		2.22
Klamath smallscale sucker	*Catostomus rimiculus*	CA, OR	X		5	X	X		X				X	2.00
Klamath largescale sucker	*Catostomus snyderi*	CA, OR	X		3	X	X		X				X	2.11
Little Colorado sucker	*Catostomus sp.*	AZ	X		2	X	X				X			2.22
Wall Canyon sucker	*Catostomus sp.*	NV	X		1		X						X	2.67
Tahoe sucker	*Catostomus tahoensis*	CA, NV, OR	X		5	X	X						X	1.89
Warner sucker	*Catostomus warnerensis*	NV, OR	X	T	1		X		X				X	2.33
shortnose sucker	*Chasmistes brevirostris*	CA, OR	X	E	1	X	X		X				X	2.00
Cui-ui	*Chasmistes cujus*	NV	X	E	1	X							X	1.56
June sucker	*Chasmistes liorus*	UT	X	E	1	X							X	1.67
blue sucker	*Cycleptus sp.*	NM, TX			3	X	X					X		2.67
Lost River sucker	*Deltistes luxatus*	CA, OR	X	E	1		X		X				X	2.00
smallmouth buffalo	*Ictiobus bubalus*	NM, TX	X		5	X						X		2.11
gray redhorse	*Moxostoma congestum*	NM, TX	X		4	X	X					X		2.22
West Mexican redhorse	*Scartomyzon austrinus*	TX	X		3	X						X		2.56
razorback sucker	*Xyrauchen texanus*	AZ, CA, CO, NM, NV, UT, WY	X	E	1	X				X	X			1.67
Mexican tetra	*Astyanax mexicanus*	NM, TX	X		5		X	X				X		1.67
blue catfish	*Ictalurus furcatus*	NM, TX			5	X						X		1.44
headwater catfish	*Ictalurus lupus*	NM, TX	X		3	X	X					X		2.33
Yaqui catfish	*Ictalurus pricei*	AZ	X	T	2	X	X				X			2.44
Chihuahua catfish	*Ictalurus sp.*	TX	X		1,2		X	X				X		2.67
mountain whitefish	*Prosopium williamsoni*	CA, CO, ID, NV, OR, UT, WY			5	X	X			X			X	1.44
rainwater killifish	*Lucania parva*	NM, TX			5	X	X	X	X			X		0.89
Gila topminnow	*Poeciliopsis occidentalis occidentalis*	AZ, NM	X	E	3			X	X		X			2.00
Yaqui topminnow	*Poeciliopsis occidentali sonoriensis*	AZ	X	E	3			X	X		X			1.89
San Felipe Gambusia	*Gambusia clarkhubbsi*	TX	X		1		X					X		2.78
Big Bend Gambusia	*Gambusia gaigei*	TX	X	E	1			X				X		1.89
Pecos Gambusia	*Gambusia nobilis*	NM, TX	X	E	2		X	X				X		1.89
blotched gambusia	*Gambusia senilis*	TX	X		3		X					X		2.56
Preston White River springfish	*Crenichthys baileyi albivallis*	NV	X		2			X					X	2.33
White River springfish	*Crenichthys baileyi baileyi*	NV	X	E	2			X					X	1.89
Hiko White River springfish	*Crenichthys baileyi grandis*	NV	X	E	2			X					X	2.00
Moapa White River springfish	*Crenichthys baileyi moapae*	NV	X		2			X			X			1.89
Moorman White River springfish	*Crenichthys baileyi thermophilus*	NV	X		2			X					X	2.33
Railroad Valley springfish	*Crenichthys nevadae*	NV	X	T	2			X					X	1.89
Pahrump poolfish	*Empetrichthys latos*	NV	X	E	1			X					X	2.11
Leon Springs pupfish	*Cyprinodon bovinus*	TX	X	E	1			X	X			X		1.89
Devils Hole pupfish	*Cyprinodon diabolis*	NV	X	E	1			X					X	1.89
Comanche Springs pupfish	*Cyprinodon elegans*	TX	X	E	1			X	X			X		1.89
Sonoyta pupfish (Quitobaquito)	*Cyprinodon eremus*	AZ	X	E	1			X	X		X			1.89
Conchos pupfish	*Cyprinodon eximius*	TX	X		3		X	X				X		2.56
Devils River pupfish	*Cyprinodon eximius sp.*	TX	X		3		X	X				X		2.44
desert pupfish	*Cyprinodon macularius*	AZ, CA	X	E	1			X	X		X			2.11

Common Name	Scientific Name	State Occurence	Desert Endemic	ESA status	Global Heritage Rank	Habitat Type				Desert Occurance				OFHP Rank
						Rivers	Streams	Springs	Cienegas	Upper Colorado	Lower Colorado	Rio Grande	Basin and Range	
Amargosa pupfish	*Cyprinodon nevadensis*	CA	X		2		X	X					X	2.22
Ash Meadows Amargosa pupfish	*Cyprinodon nevadensis mionectes*	NV	X	E	2			X	X				X	1.67
Saratoga Springs pupfish	*Cyprinodon nevadensis nevadensis*	CA	X		2			X					X	1.67
Warm Springs pupfish	*Cyprinodon nevadensis pectoralis*	NV	X	E	2			X					X	2.22
Shoshone pupfish	*Cyprinodon nevadensis shoshone*	CA	X		2			X					X	2.67
Pecos pupfish	*Cyprinodon pecosensis*	NM, TX	X		1	X	X	X	X			X		2.56
Owens pupfish	*Cyprinodon radiosus*	CA	X	E	1	X	X	X					X	2.11
Cottonball Marsh pupfish	*Cyprinodon salinus milleri*	CA	X		1				X				X	1.78
White Sands pupfish	*Cyprinodon tularosa*	NM	X		1		X	X	X			X		1.78
Salt Creek pupfish	*Cyprinodon salinus salinus*	CA	X		1		X	X	X				X	1.78
mottled sculpin	*Cottus bairdii*	CO, ID, NM, NV, OR, UT, WY			5	X	X			X			X	0.89
Paiute sculpin	*Cottus beldingii*	CO, CA, ID, NV, OR, UT, WY	X		5		X	X					X	1.33
Malheur mottled sculpin	*Cottus bendirei*	OR	X		4		X						X	1.89
Shoshone sculpin	*Cottus greenei*	ID			2		X						X	2.44
Upper Klamath marbled sculpin	*Cottus klamathensis klamathensis*	CA	X		4	X	X						X	1.78
Wood River sculpin	*Cottus leiopomus*	ID			2	X	X						X	2.44
margined sculpin	*Cottus marginatus*	OR, WA	X		3		X						X	2.44
pit sculpin	*Cottus pitensis*	CA, OR	X		4		X						X	2.11
Klamath Lake Sculpin	*Cottus princeps*	OR	X		3				X				X	2.11
Rio Grande darter	*Etheostoma grahami*	TX	X		3	X	X					X		2.33
greenthroat darter	*Etheostoma lepidum*	NM, TX	X		3		X	X				X		2.22
bigscale logperch	*Percina macrolepida*	NM, TX			5	X	X					X		1.44

Appendix IV - Acknowledgements

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Appendix V - Abbreviations and Acronyms

BLM	Bureau of Land Management
BOR	Bureau of Reclamation
DFC	Desert Fishes Council
DFHP	Desert Fish Habitat Partnership
EQIP	Environmental Quality Incentives Program
FHPs	Fish Habitat Partnerships
FRPP	Farm/Ranch Protection Program
HAACP	Hazard Analysis of Critical Control Points
HUC	Hydrologic Unit Codes
LCR	Lower Colorado Region
MOU	Memorandum of Understanding
NAFWS	Native American Fish and Wildlife Society
NFHAP	National Fish Habitat Action Plan
NPS	National Parks Service
NRCS	Natural Resources Conservation Service
STFC	Southwestern Tribal Fishery Commission
SWAPs	State Wildlife Action Plans
TNC	The Nature Conservancy
TU	Trout Unlimited
USGS	United States Geologic Survey
USFS	United States Forest Service
USFWS	United States Fish and Wildlife Service
WRP	Wetland Restoration Program
WHIP	Wildlife Habitat Incentives Program
WNTI	Western Native Trout Initiative