

**Recovery Plan for Yaqui Chub (*Gila purpurea*)**

**Amendment 1**

**For  
U.S. Fish and Wildlife Service  
Region-2  
Albuquerque, NM**

**December 2018**

Approved: \_\_\_\_\_ DRAFT \_\_\_\_\_ Date: \_\_\_\_\_  
Regional Director, Region 2  
U.S. Fish and Wildlife Service

**BACKGROUND INFORMATION**

a. Summary of prior actions.

Listing: 49 FR 34490.  
Date: August 31, 1984.  
Listed status: Endangered.  
Recovery Plan: Fishes of the Rio Yaqui Recovery Plan.  
Prepared by: Kevin S. Cobble, U.S. Fish and Wildlife Service, Douglas,  
Arizona.  
Approved: March 29, 1995.

b. Reason for amendment.

Recovery plans should be consulted frequently, used to initiate recovery activities, and updated as needed. A review of the recovery plan and its implementation may show that the plan is out of date or its usefulness is limited, and therefore warrants modification. Keeping recovery plans current ensures that the species benefits through timely, partner-coordinated implementation based on the best available information. The need for, and extent of, plan modifications will vary considerably among plans. Maintaining a useful and current recovery plan depends on the scope and complexity of the initial plan, the structure of the document, and the involvement of stakeholders.

An amendment involves a substantial rewrite of a portion of a recovery plan that changes any of the statutory elements. The need for an amendment may be triggered when, among other possibilities: (1) the current recovery plan is out of compliance with regard to statutory requirements; (2) new information has been identified, such as population-level threats to the species or previously unknown life history traits, that necessitates new or refined recovery actions and/or criteria; or (3) the current recovery plan is not achieving its objectives. The amendment replaces only that specific portion of the recovery plan, supplementing the existing recovery plan, but not completely replacing it. An amendment may be most appropriate if significant plan improvements are needed, but resources are too scarce to accomplish a full recovery plan revision in a short time.

Although it would be inappropriate for an amendment to include changes in the recovery program that contradict the approved recovery plan, it could incorporate study findings that enhance the scientific basis of the plan, or that reduce uncertainties as to the life history, threats, or species' response to management. An amendment could serve a critical function while awaiting a revised recovery plan by: (1) refining and/or prioritizing recovery actions that need to be emphasized, (2) refining recovery criteria, or (3) adding a species to a multispecies or ecosystem plan. An amendment can, therefore, efficiently balance resources spent on modifying a plan against those spent on managing implementation of ongoing recovery actions.

Section 4(f)(1)(B)(ii) of the Endangered Species Act (Act) requires that each recovery plan shall incorporate, to the maximum extent practicable, "objective, measurable criteria which, when met, would result in a determination...that the species be removed from the list." Legal challenges to recovery plans (see *Fund for Animals v. Babbitt*, 903 F. Supp. 96 (D.D.C. 1995)) and a Government Accountability Audit (GAO 2006) have also affirmed the need to frame recovery criteria in terms of threats assessed under the five threat factors (ESA 4(a)(1)). In this document, we establish delisting criteria for Yaqui chub (*Gila purpurea*), which supplement the original downlisting criteria included in the Fishes of the Rio Yaqui Recovery Plan (Recovery Plan).

## **METHODOLOGY USED TO COMPLETE THIS AMENDMENT**

U.S. Fish and Wildlife Service (USFWS) personnel associated with San Bernardino National Wildlife Refuge (SBNWR) and with the Regional Biological Science Division completed this finding using best available information from the Recovery Plan (USFWS 1995), pertinent published literature, USFWS files, and personal knowledge of this species. While there is no formal Yaqui Chub Recovery Team, subject matter experts representing Arizona Game and Fish Department, USFWS Region-2 Ecological Services, USFWS Region-2 Fish and Aquatic Conservation Division, San Bernardino National Wildlife Refuge, the Republic of Mexico, academia, and private interests regularly meet and/or correspond and discuss Rio Yaqui fish recovery. All of these parties have provided personal communications and perceptions regarding

recovery of the Yaqui chub, and that information was used by the USFWS to develop the information contained in this document.

## **SPECIES BACKGROUND**

Having the most restricted geographic range of all the Río Yaqui fishes, the Yaqui chub was federally listed as endangered throughout its range, with critical habitat including all aquatic habitats in the main portion of SBNWR, on August 31, 1984. The primary objective of the 1995 Recovery Plan is to restore the endangered Yaqui chub and Yaqui topminnow (*Poeciliopsis occidentalis sonorensis*), and the threatened Yaqui catfish (*Ictalurus pricei*) and the beautiful shiner (*Cyprinella formosa*) as secure and self-sustaining members of the indigenous fish fauna of the aquatic ecosystems in which they once occurred (USFWS 1995). While the Recovery Plan covers all four fish in a single document, the information identified in this supplemental finding pertains only to the Yaqui chub. The Recovery Plan defines “secure” as inclusive of legal protection and protection from natural (physical, chemical, or biological) catastrophes as well as technologically and economically possible; “reestablished” as maintaining a self-sustaining population, with no or minimal human intervention; “self-sustaining” as populations that are reproducing naturally and maintaining sizes and structures indicative of persistence for a reasonable period; and “reasonable” in this context as through tens to hundreds of generations.

Recovery objectives and downlisting criteria for Yaqui chub were established in the original Recovery Plan (USFWS 1995); however, delisting criteria were not established at that time. Our knowledge of the species has increased since it was originally listed.

For many years, the Yaqui chub was confused with the similar desert chub (*Gila eremica*) described by DeMarais (1991), which ranges from the westernmost tributaries of the upper Rio Yaqui basin west and southward to the upper Rio Sonora and Rio Matape (Minckley and Marsh 2009). Before genetic work was conducted to examine the fish species, the range of the Yaqui chub was incorrectly thought to include a much larger portion of the Rio Yaqui watershed and about 98 percent of the range of the Yaqui chub was wrongly thought to exist only in Mexico. The Recovery Plan for this species (USFWS 1995) was completed based on this information, which was the best available information at the time. We now recognize that the range of the Yaqui chub is restricted to the Rio San Bernardino system in Arizona and Sonora. It was historically and still remains known in Mexico only from a <3.0 km perennial reach of Rio San Bernardino, immediately south of the international border in Sonora (Varela-Romero et al. 1992). Most of its range is therefore in the U.S., and the majority of that is directly protected on SBNWR.

The Yaqui chub live in springs, spring-fed ditches, creeks, (and has adapted well to ponds) over substrates of silt, clay, sand, and gravel. Water may be clear or muddy, with associated vegetation including watercress, cattail, sedges, and willows. Depths of capture vary to >1.5 m;

and currents are none to moderate (Minckley and Marsh 2009; Stewart et al. 2017; Stewart et al. 2019). Spawning occurs mostly during spring – early summer and has been recorded in all but midwinter months. The reproductive potential of this fish is very high, with large populations able to quickly develop from only a few adults when habitat conditions are favorable (DeMarais and Minckley 1993; Kline and Bonar 2009). The species feeds mostly on algae, invertebrates, and detritus (Galat and Gerhardt 1987).

Continuing threats to this fish include: very limited range making potential loss from catastrophic events more likely; loss, alteration, and degradation of suitable wetland habitat; competition with, and/or depredation by, non-native species; and long-term drought combined with expanding human populations, which are creating increased demand for water for human consumption (Minckley and Marsh 2009). Yaqui chub populations in the San Bernardino Valley, Douglas High School, and Bar-Boot Ranch continue to be threatened due to infestations by the non-native Asian tapeworm (*Bothriocephalus acheilognathi*), while those on El Coronado Ranch and Coronado National Forest currently remain free of this parasite. However, Kline et al. (2007) determined that Asian tapeworm infestations of Yaqui chub can cause intestinal blockage and a reduced growth rate, but that infestation by this tapeworm did not result in an overall threat to the Yaqui chub population. While this parasite may impact Yaqui chub, it does not appear to kill or threaten the fecundity of the chub, which has adapted well to the occurrence of the tapeworm (Kline et al. 2007).

Since the development of the 1995 Recovery Plan, populations of Yaqui chub have responded well to conservation efforts and intensive management, and have established large and viable populations in diverse habitats (Hendrickson and Brooks 1991; USFWS 1994). Approximately 35 managed populations of Yaqui chub currently occur across the known range. Yaqui chub are living in nearly all wetlands on SBNWR (16 separated ponds, Black Draw, and Hay Hollow Wash). Additionally, the species has been established in Leslie Creek on Leslie Canyon National Wildlife Refuge (LCNWR), in West Turkey Creek on the Coronado National Forest, and at the following locations on private property: in House Pond on Slaughter Ranch (covered by a conservation easement and a warranty deed), in two ponds on the 99-Bar Ranch, in two ponds on the Bar-Boot Ranch (where it is covered by separate conservation easements and a Safe Harbor Agreement), in one pond at Douglas High School, in eight ponds at El Coronado Ranch (where it is covered by a Habitat Conservation Plan), and in at least two ponds on Rancho San Bernardino in Sonora, Mexico.

Since the Recovery Plan was developed, much work has been done to meet these conditions, including understanding and managing water capacity, controlling non-native, harmful species, and protecting habitats from human impacts. Additional data provided from research and management has improved our knowledge base. The 1995 Recovery Plan provides the following conditions/objectives for recovery of the four Yaqui fishes:

“All the following conditions must be met within currently occupied habitat for a period of 10 years before consideration of delisting for beautiful shiner and Yaqui catfish or downlisting for Yaqui chub and topminnow:”

*Secure and protect San Bernardino Valley aquifers so that all artesian and other flows from subsurface sources are perennial. Secure and protect Leslie Creek, Black Draw and Mimbres River, NM watersheds to ensure adequate, perennial flow. And,*

Earman et al. (2003) delineated catchment area, recharge and flow rates, storage volumes and other attributes of the underground aquifers for portions of the watershed that included San Bernardino/ Leslie Canyon SBNWR/LCNWR. Since the mid-1990's, we also are working to identify and quantify the volume of water required to sustain the existing wetland ponds found throughout the refuge. The impact to the aquifer appears to be minimal and the aquifer has demonstrated a pattern of natural recharge.

*Eradicate all non-indigenous fish species and other undesirable organisms such as bullfrogs from critical habitat. And,*

Non-indigenous fish species have been successfully eradicated on SBNWR, LCNWR, and Slaughter Ranch (private property) since the 1990's. Additionally, all non-indigenous fish were removed from ponds on El Coronado Ranch (private property) that supported Yaqui chub during 2015 (although green sunfish (*Lepomis cyanella*) still exist in adjacent West Turkey Creek). U.S. Fish and Wildlife Service personnel have surveyed annually and occasionally biannually and no longer observe any non-indigenous fish species at SBNWR, LCNWR, House Pond on Slaughter Ranch, and Big Tank on El Coronado Ranch.

Non-native green sunfish are known to occur throughout portions of West Turkey Creek in Cochise County, AZ where they are sympatric with Yaqui chub. Sunfish may feed upon the eggs and young of Yaqui chub and may limit recovery of Yaqui chub in this stream system. Permanent removal of sunfish downstream from these stream reaches is currently impractical as infested impoundments on adjacent private lands support green sunfish and landowners are not receptive to elimination of this fish. However, since at least 2000 USFWS personnel have actively captured and removed hundreds of sunfish from West Turkey Creek and thus we have depleted and seek to continue to suppress populations in stream reaches known to support Yaqui chub.

American bullfrogs (*Lithobates catesbeiana*), a non-native amphibian, remain on San Bernardino NWR, Slaughter Ranch, El Coronado Ranch, and in adjacent wetlands. We believe this species poses little direct risk to Yaqui chub though it may compete for limited food resources. For example, Liu et al. (2017) reported on the analysis and composition of bullfrog (native and

nonnative) diets around the world and found that their diets primarily consisted of insects and anurans, including aquatic algal foods. Fish comprised a smaller portion of their diet and was found to not be significant in their model-based exercise (Liu et al. 2017). Other studies corroborate these findings and report that non-indigenous bullfrogs did not typically affect small-bodied fishes, though some have found that the presence of Mosquitofish may negatively affect amphibians (Blaustein and Kiesecker 2002; Kats and Ferrer 2003; Liu et al. 2017). Still, adult Yaqui chub (*Gila purpurea*) have been found in the stomachs of bullfrogs collected at SBNWR and El Coronado Ranch, documenting that this fish does represent a food source for bullfrogs. Therefore, we cannot exclude the occurrence of predation by bullfrogs on any of the smaller-bodied Rio Yaqui fishes (Beautiful Shiner, Yaqui Chub, and Yaqui Topminnow), these species number in the hundreds to thousands (the Yaqui Topminnow numbers in the hundreds of thousands) in a single pond and have been self-sustaining since non-indigenous bullfrogs invaded the SBNWR and associated waters. Since the initial invasion of bullfrogs, the numbers of Yaqui chub have continued to remain stable and self-sustaining, indicating that bullfrogs do not pose a threat to the persistence of the Yaqui chub.

A non-indigenous parasitic cestode species, the Asian tapeworm also occurs throughout much, but not all, of the habitat occupied by Yaqui chub in Cochise County, AZ. The presence of Asian tapeworm in fishes of the Rio Yaqui watershed represents new information to the USFWS regarding disease and predation on the Yaqui chub (Miller et al. 2005, Kline 2007). Asian tapeworm are not host-specific and can therefore move between similar and dissimilar taxa. Kline (2007) determined that Asian tapeworm infestations of Yaqui chub can cause intestinal blockage and a reduced growth rate, but that infestation by this tapeworm did not result in an overall threat to the Yaqui chub population. While this parasite may impact Yaqui chub, it does not kill or threaten the fecundity of the chub, which has adapted well to the occurrence of the tapeworm.

*Protect critical habitat and other habitats where species of concern occur or are reestablished from human disturbances including excessive grazing, irrigated agriculture, introductions of non-indigenous species and water diversion or removal.*

Critical habitat for the Yaqui chub is designated for all aquatic habitat on SBNWR in the U.S. Livestock grazing has been eliminated on the refuge since establishment in 1982, and adjacent lands are not impacted by excessive grazing in the U.S. or in Mexico. Irrigated agriculture does not occur on surrounding private lands in the U.S., but does occur to a limited extent immediately south of the refuge in Mexico. Water use also occurs on private land (Slaughter Ranch) adjacent to SBNWR, where it is used to maintain a park-like atmosphere to encourage public use. The effects of these small-scale irrigation activities upon Yaqui chub populations are poorly known. With the exception of West Turkey Creek which is occupied by green sunfish, no non-indigenous fish species occur in wetlands occupied by Yaqui chub in the United States, but

this is not the situation in Mexico, where Western mosquitofish co-occur with the chub in some areas. Water diversion is not an immediate threat to Yaqui chub habitat in the U.S. or in Mexico, but the future consequences of groundwater withdrawal in this area is unknown.

## **RECOVERY CRITERIA**

The 1995 Recovery Plan identifies conditions for delisting the beautiful shiner and Yaqui catfish, and downlisting Yaqui chub and Yaqui (Gila) topminnow. No delisting criteria were identified for the Yaqui chub or the Yaqui topminnow. The current recovery criteria can be found on pages 21-22 in the 1995 Recovery Plan.

### **Amended Recovery Criteria**

The original Recovery Plan (USFWS 1995) does not identify delisting criteria for the Yaqui chub. The range of this species was not accurately defined at the time the Recovery Plan was written, and was anticipated to be much broader throughout the Rio Yaqui watershed in Mexico. Because fish biologists considered a wide distribution, they therefore anticipated the insurmountable threats to the species that are widespread throughout the entire Rio Yaqui watershed. Such threats included habitat loss, predation, competition with non-native species, increasing human development and demand for water, and the predicted trends of warmer, drier, and more extreme hydrological conditions associated with climate change throughout the expected Mexican range of the Yaqui chub. Most of these threats were technically or politically unfeasible to address in Mexico. For example, addressing the widespread proliferation of non-native fish (including species considered to be valuable sport fish) within the Rio Yaqui in Mexico and eliminating the potential for continual contamination and/or recontamination of these exotic species into sensitive habitats in order to promote recovery of Yaqui chub remains undeterminable but seem unlikely to occur. Additionally, restoring chub habitat by reversing the desiccation of springs or removing existing agricultural or municipal dams in Mexico are not likely to have support. The 1995 Recovery Plan identified that Yaqui chub could be downlisted to threatened status when self-sustaining populations are established and secure on SBNWR, LCNWR, and West Turkey Creek; when San Bernardino Valley aquifers are secure and protected; when non-indigenous fish and other undesirable organisms have been eradicated from critical habitat; and when critical habitat is protected from human disturbances, water diversion, or water removal (USFWS 1995). About 35 managed populations of Yaqui chub currently occur across the known range, where they have been self-sustaining for 10-36 years.

We now recognize that the range of the Yaqui chub is restricted to a much smaller portion of the Rio San Bernardino system in Arizona and Sonora, where it historically and currently remains known in Mexico only from a <3.0 km perennial reach of Rio San Bernardino, immediately south of the international border in Sonora (Varela-Romero et al. 1992). Because most of its range is directly protected in the U.S. on SBNWR and LCNWR, delisting criteria can be determined for the Yaqui chub. Since the Recovery Plan was written in 1995, our knowledge

base for the species has significantly increased, our understanding of the species' status, threats, and recovery needs has changed, and data gaps and uncertainties that once existed have been resolved to the degree that they no longer impede recovery progress. We establish delisting criteria for Yaqui chub as follows:

The Yaqui chub will be considered for delisting when:

- 1) Arizona populations of Yaqui chub will be monitored annually to allow and document viable populations supported by the perpetuation of dozens of reproductive cohorts in a total of  $\geq 35$  distinct (unconnected) suitable wetland metapopulations within a combination of locations that include SBNWR, LCNWR, El Coronado Ranch, Bar-Boot Ranch, Slaughter Ranch, and other suitable sites in the U.S. This number of metapopulations is at least five times greater than what is identified to have occurred historically for the Yaqui chub in Arizona, and should serve to adequately mitigate anticipated threats to the species.
  
- 2) Sonora populations of Yaqui chub are secure, reestablished, and self-sustaining (allowing and documenting populations supported by the perpetuation of dozens of reproductive cohorts) in a total of  $\geq 5$  (unconnected) suitable wetland metapopulations within a combination of locations that include Rancho San Bernardino and other favorable sites. This number of metapopulations is also about five times greater than what was known historically for the Yaqui chub in Sonora, and should serve to adequately mitigate anticipated threats to the species.

Justification for Delisting Criterion 1 and 2:

Drought has been identified as a significant variable that threatens the future viability of Yaqui chub. Annual monitoring of populations has occurred since the SBNWR was established as a refugium in 1982, and includes periods of drought, flooding, and even a hurricane. Typically, the effects of climate-induced drought can be detected across a 10-year period, and the effects of extreme drought can be measured over a 20-year period. These scenarios have been evaluated and monitoring data collected for more than 36 years supports that the Yaqui chub has been secure and reestablished in locations on SBNWR in Arizona and Rancho San Bernardino in Sonora during throughout the climatic conditions and time period. Therefore we plan to continue to monitor these and any future populations to document the successful recovery of Yaqui chub.

Maintaining several populations with relatively independent susceptibility to threats is an important consideration for the long-term viability of Yaqui Chub. Considering the wide-scale flooding throughout the Refuge in 2014 due to a hurricane, it was of interest to



continue establishing multiple meta-populations to provide continued security in case of another catastrophic event, disease outbreaks, or repeated year-class failures. Currently about 35 managed populations of Yaqui Chub occur on the landscape. The positive effect of creating additional independent populations can be demonstrated by the following examples. Given that this species is considered a boom or bust species, consider (as an example) that a single population has a probability of extinction from an unforeseen event of 50% in 200 years. If we establish 13 independent populations, the risk of extinction is 0.01% ( $0.50^{13}$ ) (Casagrandi and Gatto 1999). Even with an extinction probability of 90% for one population, the probability of extinction for 43 and 50 populations reduces to 1.08% ( $0.90^{43}$ ) and <1% ( $0.90^{50}$ ) (Casagrandi and Gatto 1999). Additionally, our continuing management is to introduce this species into additional ponds to reach a total of 50 populations in the United States to ensure that even under the high scenario (90% single population extinction risk) these species remain secure now and into the future. By also establishing up to 10 additional independent populations in Mexico, the extinction risk declines even more from 0.51% to 0.18%.

### **Rationale for Amended Recovery Criteria**

Populations of Yaqui chub have been monitored annually since establishment of SBNWR in 1982. During these years, Yaqui chub of multiple size classes are routinely captured in these habitats, indicating that the areas are suitable for recruitment and recovery, and documenting the potential for recovery if aquatic habitats are maintained. While overall annual numbers of fish vary widely (this is a boom or bust species, quick to take advantage of favorable habitat conditions), monitoring supports that the species has been secure and reestablished in locations on SBNWR in Arizona and Rancho San Bernardino in Sonora for over 36 years.

Continued long-term monitoring of populations will allow for the documentation that these self-sustaining populations within the greatest number of wetlands at SBNWR, LCNWR, El Coronado Ranch, Bar-Boot Ranch, and Slaughter Ranch in Cochise County, Arizona, and at Rancho San Bernardino in Sonora, Mexico remain secure. Furthermore, recently updated monitoring protocols are being implemented that account for the effects of decreased capture efficiency due to environmental factors such as submergent aquatic vegetation (Stewart et al. 2017; Stewart et al. 2019), improving the objectivity and accuracy of monitoring estimates. Research continues to clarify important species-habitat relationships (habitat requirements) and potential inter-specific interactions that will help to inform management plans in the future.

The following five general factors that frame recovery criteria for the Yaqui chub have been addressed, or are being addressed, toward helping justify the rationale that supports amended recovery criteria for this species that would include delisting.

#### **A. Present or threatened destruction, modification, or curtailment of its habitat or range.**

San Bernardino Valley aquifers are secure and protected so that all artesian-well and other

flows from subsurface sources are perennial. SBNWR was acquired in 1982, and helps assure surface water on the landscape for the Yaqui chub. Flow in Leslie Creek has been secured and protected through acquisition of LCNWR in 1988, acquisition of in-stream flow state water rights in 1993, purchase of upstream conservation easements to prevent development and additional water use on private land in 2011, establishment of the Leslie Canyon Watershed Safe Harbor Agreement in 2008 to facilitate Yaqui chub reintroduction, and ongoing monitoring to document perpetuation of surface water.

To help research and document the assurance of adequate, perennial flow in the Black Draw watershed that supports SBNWR and Rancho San Bernardino in Mexico, a variety of hydrologic studies have been conducted on and adjacent to SBNWR. An extensive hydrologic study, based on carbon-14 analysis and tritium activity, was published by New Mexico Institute of Mining and Technology (Earman, et al. 2003). Additionally, an aquifer test was performed by the USFWS on SBNWR during 2002 to determine hydraulic properties such as transmissivity and storativity of the deep, confined aquifer that supports rare fish on the refuge. The final conclusion of this study indicated that the water yielded by wells on SBNWR is connected and transmitted by preferential flowpaths consisting of fractures in well-cemented alluvium and/or channel deposits (Broska 2002). Between 2010-2012, refuge staff seasonally collected water samples at locations on Slaughter Ranch and SBNWR to help determine hydrologic relationships between individual springs, ponds, and wells. Finally, during 2012, U.S. Geological Survey personnel collected water samples from sites on Slaughter Ranch and SBNWR for isotopic testing.

- B. Over-utilization for commercial, recreational, scientific, or educational purposes.** The Yaqui chub is not utilized commercially, recreationally, scientifically, or for educational purposes, and none of these uses poses a threat to recovery of the species.
- C. Disease or predation.** All non-indigenous fish species and other undesirable organisms that negatively impact Yaqui chub have been eradicated from critical habitat in Arizona. Asian tapeworm is present but does not threaten the perpetuation or recovery of Yaqui chub (Kline et al. 2007). American bullfrog is present but does not threaten the perpetuation or recovery of Yaqui chub (Blaustein and Kiesecker 2002; Kats and Ferrer 2003; Liu et al. 2017).
- D. The inadequacy of existing regulatory mechanisms.** The Yaqui chub was listed as endangered on August 31, 1984 and the Endangered Species Act has been effective in protecting the species from extinction through acquisition of SBNWR on April 1, 1982 and LCNWR on May 31, 1988.
- E. Other natural or manmade factors affecting its continued existence.** Self-sustaining populations of Yaqui chub are protected on SBNWR and LCNWR, and critical habitat for the Yaqui chub is formally designated to include all aquatic habitat on SBNWR (USFWS 1995). Off refuge wetland habitats also help protect this species. The El Coronado Ranch Habitat Conservation Plan helps protect this fish within the West Turkey Creek watershed draining the Chiricahua Mountains (Minckley and Duncan 1997). The Malpai Borderlands multi-species Habitat Conservation Plan (Lehman et al. 2008) helps protect this fish in the San Bernardino watershed. Both of these planning documents provide an innovative framework for creative partnerships with the ultimate goal of reducing conflicts between listed species and planned activities by the landowners. Habitats where Yaqui chub occur in

the U.S. are therefore protected from human disturbances such as excessive grazing, irrigated agriculture, introductions of non-indigenous species, and water diversion or removal.

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