# PETITION TO LIST THE GILA CHUB (*Cyprinidae Gila intermedia*) AS AN ENDANGERED SPECIES UNDER THE U.S. ENDANGERED SPECIES ACT OF 1973

. . . . . March 15, 1998

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SOUTHWEST CENTER FOR BIOLOGICAL DIVERSITY
ENDANGERED SPECIES SERIES No. 38

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March 4, 1998

Mr. Bruce Babbitt
Secretary of the Interior
Office of the Secretary
Department of the Interior
18th and "C" Street, N.W.
Washington, D.C. 20240

The Southwest Center For Biological Diversity, Sky Island Watch, and Sky Island Alliance hereby formally petition to list the Gila chub *(Gila intermedia)* as endangered pursuant to the Endangered Species Act, 16 U.S.C. 1531 et seq. (hereafter referred to as "ESA"). This petition is filed under 5 U.S.C. 553(e) and 50 CFR 424.14 (1990), which grants interested parties the right to petition for issue of a rule from the Assistant Secretary of the Interior.

Petitioners also request that Critical Habitat be designated concurrent with the listing, pursuant to 50 CFR 424.12, and pursuant to the Administrative Procedures Act (5 U.S.C. 553).

Petitioners understand that this petition action sets in motion a specific process placing definite response requirements on the U.S. Fish and Wildlife Service and very specific time constraints upon those responses.

*Southwest Center for Biological Diversity*

*Sky Island Watch*

*Sky Island Alliance*

## EXECUTIVE SUMMARY

The Gila chub (*Gila intermedia*), a minnow (Cyprinidae) endemic to the Gila River Basin, has been in decline since at least the 1950's. Despite repeated warning from fisheries biologists and the environmental community, Federal, State, and private interests have failed to develop an effective, comprehensive plan to protect wetland and stream habitats, and to prohibit continued introductions of predacious, non-native fish.

The Gila chub has been extirpated from New Mexico. It is currently limited to fewer than 10 locations in Arizona. It is in grave danger of complete extinction.

Gila chubs require cienegas and small creeks with deep pools. Declines are the result of the combined effects of habitat destruction and loss, and the introduction of competitive and predacious exotic species.

About a hundred species of exclusively freshwater fishes occur naturally in the United States west of the Rocky Mountains. They are characterize by a large degree of regional endemism (Miller 1961). In the American southwest, large-scale degradation of river systems and wetlands by dam construction, overgrazing, water pumping, and road construction have caused regional and local reductions in groundwater, habitat alteration, habitat loss, and declines in native fish populations. Introduction of predaceous exotic fishes into habitats occupied by endemic fish add to the deterioration of native fish populations. Of the 41 strictly freshwater fishes native to the American southwest, 28 (68%) were officially listed as threatened, endangered, or of special concern by the American Fisheries Society in 1989 (USFS 1991). Three species (Las Vegas speckled dace, Pahranagat spinedace, and Monkey Spring pupfish) are extinct.

In this context, this petition describes the taxonomy, natural history, habitat requirements, associated species, and distribution of the native Gila chub (*Gila intermedia*; Order Cypriniformes, Family Cyprinidae). Threats to the Gila chub and its habitat are described in detail. The objective of this petition is to document all available evidence that Gila chub is a recognized species, to describe the factors that distinguish the Gila chub from taxonomically similar species, to characterize the habitat requirements of the Gila chub, and to document the causes of the decline of available habitat in which this species can remain viable. Designation of critical habitat is recommended and legally required.

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## I. DESCRIPTION

The Gila chub is a dark steel grey, chunky-bodied fish, occasionally lighter on the belly or with diffuse lateral bands, and no basicaudal spot (Figure 1). Breeding males become bright red or orange on the lower cheek, posterior parts of lips, paired fin bases, and on ventro-lateral surfaces, including the caudal peduncle (Minckley 1973).

Mature Gila chub may reach 8 - 10 inches in length (20-225 cm), and average 5-8 inches in length. Their scales are large, thick, and broadly imbricated, usually with basal radii. They usually have 8 or fewer dorsal fin rays (rarely 9), 8 or fewer anal fin rays, and 8 to 9 pelvic fin rays. *G. intermedia* has 38 - 45 total vertebrae (usually fewer than 42). An abrupt, fatty, nuchal hump rarely develops in large females (Redbook 1974; Minckley 1973). The pharyngeal arch is similar to *G. robusta*: teeth 2, 5-4, 2 (NMDGF 1988; Minckley 1973). *G. intermedia* is distinguished from *G. robusta* by its relatively chunky build, fewer than 80 scales in the lateral line and a head-length/caudal-peduncle-depth ratio of 3.0 or less (NMDGF 1988).

## II. TAXONOMY

***PHYLOGENY.*** Chubs of the genus *Gila* can be traced from the Mid-Miocene to the present, and species closely related to *G. robusta* are present in records from the late Pliocene. Rinne (1976) proposed the hypothesis that precursors of *G. intermedia* may have dispersed into north-flowing tributaries of the pre-Gila River Basin at any time during the Pliocene or the Pleistocene. It may have then moved into the region south west of the Mogollon Highlands as downcutting progressed over time. The idea that *G. intermedia* originated from the south is supported by its similarity to the following fishes:

- *G. ditaenia* Miller from the Rio de la Concepcion (Arizona and Sonora), and the Rio Sonora,
- *G. nigrescens* from the Guzman Basin, New Mexico, and Chihuahua, and
- *G. pandora* from the Rio Grande and Pecos basins of New Mexico and Texas.

Figure 1. Gila Chub (*Cyprinidae Gila intermedia*)

These species are dark, large bodied fishes with

relatively low numbers of fin rays and lateral scales. Rinne's hypothesis implies that populations of *G. intermedia* of the Gila River are most likely derived from stream captures by north-flowing tributaries of the Gila River. The basis of taxonomic distinctions described by Rinne (1976) is the lack of ecotypy among *Gila* of the lower Colorado Basin, and a distribution of species that precludes any possible species intergradation, at least among *Gila elegans*, *Gila intermedia*, and *Gila robusta*.

Rinne (1976) provides an excellent summary of the natural history of southern New Mexico, Arizona, and Northern Mexico as it relates to speciation of endemic Colorado River chubs.

***ONTOGENY.*** Details of the breeding behavior and development of Gila chub from egg to breeding adult are not known. Reproduction occurs in late spring and summer (Minckley 1983), and may continue into autumn in some populations. Large females are attended by numerous smaller males as they swim through aquatic vegetation. Spawning behaviors of Gila chub are not described, but the comments of Minckley (1983) imply that spawning occurs on submerged aquatic plants.

Gila chub probably mature in their second or third year of life. Griffith and Tiersch (1989) measured lengths of 113 Gila chub and found a size range of 45 - 222 mm total length (TL). Fish were aged with scale analysis, and lengths for ages 1-4 years were estimated to be 90, 135, 160, and 183 mm respectively. No estimates of life expectancy were available for this writing, but data from Griffith and Tiersch (1989) indicate the presence of 4 age groups in the Redfield Canyon population, suggesting that Gila chub live for 3 to 4 years.

***SUB-SPECIFIC STATUS.*** Baird and Girard (1854) originally described this species as *Gila gibbosa* based on a specimen from the Santa Cruz River, and later (1856) as *Tigoma intermedia*. The designation *gibbosa* is not available because of homonymy. Rinne (1976) provides all historical references to *Gila intermedia.*

*G. intermedia* is currently listed as a subspecies of *G. robusta* by the American Fisheries Society, but most authors recognize the Gila chub as a full species (TNC 199??). Rinne (1976) argues for the specific identity of *G. intermedia* on the basis of the number of scales in the lateral series, the strongly inscribed basal radii, the number of dorsal fin rays, anal fin rays, and pelvic fin rays, and on the length-of-head/depth-of-caudal-peduncle ratio. According to The Nature Conservancy (TNC 199??) "specific status for *Gila intermedia* was supported by DeMarais (1986) for the following primary reasons:

- Morphological differences between *G. robusta* and *G. intermedia*. [If] not for phenotypic intermediates between these two types which are of unknown origin, their specific status would be unquestioned.

- Contiguous populations of *G. robusta* and *G. intermedia* have maintained and continued to perpetuate their independence over evolutionary and recent time.

While older records suggest local sympatry in complex habitats, no current zones of sympatry are known (Rinne 1976).

## III. DISTRIBUTION

***HISTORICAL.*** *Gila intermedia* is endemic to the

Gila River Basin of Mexico, New Mexico, and Arizona (Rinne 1976; Gori 1993). The northern extent of its historic range is the upper Verde River below the Mogollon Rim (e.g., Big Chino Wash and Oak Creek). It was once common in the Santa Cruz River system, small tributaries of the upper San Simon River system (San Simon Cienega, Hidalgo Co.), and in habitats of the Salt and Gila Rivers of central Arizona (USFWS 1974; Gori 1993). Its historical range includes the Agua Fria, San Pedro, and Verde River basins (Gori 1993). Gila chub has been documented in the Tularosa River (Catron Co.), and in Duck Creek (Grant Co.) (NMDGF 1988).

***CURRENT.*** The Gila chub has been extirpated from its habitat in New Mexico (Minckley 1983), and from Fish Creek, Cave Creek, Babocamori River, and Monkey Springs (Young 1994). It is currently limited to fewer than 15 streams of the Gila River basin in central and southeastern Arizona (Minckley 1983), and is considered abundant in no more than 10 locations (TNC 199??).

Table One lists sites where *G. intermedia* and associated species have been caught during recent surveys. In Rye Creek, the 1 specimen was positively identified and represented the only Gila chub found in a survey of most tributaries to Tonto Creek. Only 2 individuals were located in Hot Springs Creek in a 1991 Survey (Gori 1993), but Civish (1995) remarked that Hot Springs Creek lacked sufficient pool habitat to support a self-sustaining Gila chub population. Numbers of fish found in surveys of Silver Creek, Little Sycamore creek, and Turkey Creek were not available. Table 2 lists streams within the historic range of *G. intermedia*, but in which *G. intermedia* have been absent in recent surveys. Correspondence with resource managers confirms the accuracy of Table 1 (Young 1994; Civish 1995; Cartwright 1994; Cheniae 1994).

## IV. NATURAL HISTORY

***HABITAT REQUIREMENTS***. Minckley (1973; 1983) describes *G. intermedia* as highly secretive, hiding in deeper waters of small creeks, cienegas, and some impoundments (Rinne 1976). As with many species of fish, habitat requirements of Gila chub change with the different life stages. The youngest Gila chub, which are very small, dwell in the shallowest possible waters, among plants or woody cover. Sub adults occur in swifter currents than adults (e.g., riffles), and are active throughout the day. Adults favor deep pools with undercut banks and stream margins with overhanging vegetation or woody debris, feeding during morning and evening hours (Minckley 1985). Gila chub are omnivores, eating small fish, aquatic and terrestrial invertebrates and filamentous algae (Minckley 1973, Rinne 1976).

Cienegas offer highly favorable habitat for Gila chub, but are rapidly declining as a result of altered hydrologic regimes and cattle grazing (see below). This unique habitat type is found in the Basin and Range Geomorphic Province in the north-south trending San Simon, Sulphur Springs, San Pedro, and Santa Cruz valleys. In this region, faults along mountain fronts allow the release of groundwaters as springs, and alluvial deposits provide an aquifer for storage of groundwaters. Cienegas are characterized by relatively warm temperatures, and stable flows (Hendrickson and Minckley 1984).

Cienegas are rarely subjected to harsh conditions in winter. Because cienegas occur in springs and headwater streams, scouring floods are not a natural feature of these habitats. On the contrary, cienegas are depositional zones,

with up to several meters of organic substrate. Pools are characterized by vertical walls of organic sediments, with undercut banks below the roots of semi-aquatic vegetation (Hendrickson and Minckley 1984). Characteristic bank vegetation includes sedges (Cyperaceae), rushes (Juncaceae), and grasses (Gramineae), and water purslane (*Ludwigia natans*), while aquatic species include watercress, (*Rorippa nasturtium-aquaticum*) and water pennywort (*Hydrocotyle verticillata*).

Physical and chemical parameters, and riparian characteristics of waters inhabited by *G. intermedia* vary widely. Data describing the habitat of the Spring Creek population (Coconino County, elev. 3300-3500 ft.) are as follows (Minckley 1983):

| | |
|---|---|
| Temperature (°F) | 72 |
| Dissolved oxygen (mg/L) | 8.3 |
| Total alkalinity (mg/L) | 244 |
| Turbidity (FTU) | 2 |
| Total hardness (mg/L) | 248 |
| pH | 8.3 |
| $NO_3$-N (mg/L) | 0.13 |
| Total dissolved solids(mg/L) | 320 |
| Sulfates (mg/L) | 6 |

***ASSOCIATED FISH SPECIES.*** Native fish fauna associated with Gila chub include the loach minnow (*Tiaroga cobitis*), spikedace (*Mida fulgida*), speckled dace (*Rhynichthys osculus*), longfin dace (*Agosia chrysogaster*), Sonora sucker (*Catastomas insignis*), and desert sucker (*Pantosteus clarki*). Historically Gila chub has been associated with woundfin (*Plagopterus argentissimus*), bonytail chub (*Gila elegans*), squawfish (*Ptychocheilus lucius*), razorback sucker (*Xyrauchen texanus*), and Gila topminnow (*Poeciliopsis occidentalis*), all of which have been extirpated from the Gila River basin (TNC 199??).

The habitat of Gila chub is currently occupied by exotic fishes (Table 1), including the yellow bullhead (*Ameirus natalis*), green sunfish (*Lepomis cyanellus*), the red shiner (*Cyprinella lutrensis*), and the fathead minnow (*Pimephales promelas*).

## V. THREATS TO THE SPECIES

The Gila chub is classified as threatened in Arizona and has been extirpated from its habitats in the state of New Mexico. *G. intermedia* has been declining throughout its range since approximately the 1950's (TNC 199??). Population declines have occurred in the context of many simultaneous anthropogenic changes (e.g., non-native fish introductions and habitat degradation and loss). As a result, identification of a single cause of decline is impossible: population declines are likely the result of cumulative effects of multiple insults (Appendix A). Reasons for the decline of this species are summarized in this section.

***HABITAT DEGRADATION AND LOSS.*** Habitat degradation has been cited by several experts and interested parties as the leading cause of declines in Gila chub populations, even as early as the 1960s (Cheniae 1994; Cartwright, Jr. 1994; Gori 1993; TNC 199??; NMDGF 1988; Minckley 1983, 1985; Rinne 1976; USFWS 1974; Miller 1961). Gila chub are dependent on cienega habitats and small streams. Habitat changes that lead to unstable or increased temperatures, that cause sedimentation and filling of deep pools, or that alter cover or flow regime are particularly bad for the Gila chub (Gori 1993; TNC 199??; Redbook 1974).

Numerous land uses result in the degradation of

cienega habitats, particularly grazing, water diversion, groundwater pumping, timber harvest, which are described in greater detail below. In addition, mining, creation of reservoirs, and drainage concentration into ditches, under bridges, and along railroads and roads (Cartwright, Jr. 1994; Hendrickson and Minckley 1984) result in siltation of available habitats, and removal of water from existing habitats. Other activities generally associated with degradation of native fish habitats are heavy recreational use (e.g., over-fishing), and off-road vehicle (ORV) use which causes erosion, soil compaction, and arroyo cutting (Cartwright, Jr. 1994). Beaver trapping, which began in the 1830s, has also reduced the abundance of habitats with low current velocity, high insect productivity and abundant bank cover that is ideal for Gila chub (Hendrickson and Minckley 1984). The history and effects of grazing, water diversion, and timber harvest are described below.

***LIVESTOCK GRAZING***. Spanish missionaries in the late 17th and early 18th centuries were the first to bring large herds of cattle to the Sonora region. These early settlers conducted intense grazing throughout the 18th century. In the early 19th century, domestic problems within the newly formed Mexico pushed the cattle industry further north into Arizona. After abandonment by the Mexicans shortly thereafter, Anglo-American settlers recorded observation of very large herds of feral cattle in 1846 and 1851. Anglo-American settlers developed their own cattle industry following the Civil War and the establishment of railroads in the 1880s. The industry grew rapidly, and overgrazing and drought contributed to massive mortality of domestic cattle in Arizona in 1893 (Hendrickson and Minckley 1984; Hastings 1959).

The onset of severe overgrazing corresponds to the beginning of the widespread loss of riparian vegetation, severe erosion, and arroyo cutting that destroys cienegas and small stream habitats (Hendrickson and Minckley 1984; Miller 1961). Cattle grazing contributes to this process with at least three major effects:

- Soil compaction through trampling, especially the development of "cattle trails"
- Trampling and eating of riparian plants. Riparian vegetation acts to stabilize soils and retain subsurface waters during dry periods.
- Large scale loss of vegetation in upland areas, contributing to reductions in the permeability of upland soils, increased runoff, and increasingly "flashy" flood events.

Cattle grazing continues in drainages where the last Gila chub populations are found (Civish 1995; Cartwright 1994; Cheniae 1994), and these destructive processes continue to create deeply incised stream beds, increasing frequency of catastrophic flood events, and the widespread destruction of habitats of the Gila chub. Increased erosion causes siltation and filling of pools and alteration of submerged aquatic vegetation upon which Gila chub spawn, or suffocation of the eggs themselves. Trampling of streamside habitats results in loss of undercut banks and associated cover, which

TABLE 1. RECENTLY IDENTIFIED *GILA INTERMEDIA* POPULATIONS*.

| Drainage Basin | Site | Number of Fish | Date (Mo/Dy/Yr) | Source |
|---|---|---|---|---|
| Agua Fria | Silver Creek | NA | 10/08/92 | USFWS 1993a |
| Santa Cruz | Cienega Creek | 81 | 10/12/93-10/28/93 | Simms 1993a |
| Gila River | Bonita Creek | 189 | 12/8/93-12/10/93 | Simms 1993b |
| Gila River | Bonita Creek | 224 | 12/8/93-12/10/93 | Simms 1993b |
| Tonto Creek | Rye Creek | 1 | 10/14/79 | Abarca and Weedman 1993 |
| Sonora | Rio San Pedro | 35 | 8/90<br>9/91 | Varela-Romero 1992 |
| San Pedro | Redfield Creek | 113 | 5/19/83-5/22/83 | Griffith and Tiersch 1989 |
| | Bass Creek | 98 | 9/91<br>10/91 | Gori 1993 |
| San Pedro | Hot Springs Creek | 2 | 9/91<br>10/91 | Gori 1993 |
| San Pedro | Redfield Creek | 533 | 9/91<br>10/91 | Gori 1993 |
| San Pedro | O'Donnell Creek | 145 | 9/91<br>10/91 | Gori 1993 |
| Salt River ? | Blue River | 14 | 5/85 | Bestgen 1985 |
| | Sheehy Spring | 107 | 3/15/77-3/19/77 | Johnson 1977 |

* Numbers do not represent population estimates.

TABLE 2. SITES WHERE *GILA INTERMEDIA* HAVE NOT BEEN FOUND IN RECENT SURVEYS.

| Drainage Basin | Site | Date (Mo/Dy/Yr) | Source |
|---|---|---|---|
| | O'Donnell Creek | 8/11/93 | TPM 1993 |
| Agua Fria | Indian Creek | 10/11/92 | USFWS 1993a |
| | Lousy Canyon | 9/25/92 | USFWS 1993a |
| | Larry Creek | 6/1/92 | USFWS 1993a |
| | Ash Creek | 7/30/92 | USFWS 1993a |
| | Little Ash Creek | 7/30/92 | USFWS 1993a |
| | Dry Creek | 7/30/92 | USFWS 1993a |
| Tonto Creek | Brady Canyon | 8/91-6/92 | Abarca and Weedman 1993 |
| | South of 76 Ranch | 8/91-6/92 | Abarca and Weedman 1993 |
| | E. of Jake's Corner | 8/91-6/92 | Abarca and Weedman 1993 |
| | Cottonwood Canyon | 8/91-6/92 | Abarca and Weedman 1993 |
| | Indian Farm Well | 8/91-6/92 | Abarca and Weedman 1993 |
| | Cocomunga Canyon | 8/91-6/92 | Abarca and Weedman 1993 |
| | E. of Haycox Mtn. | 8/91-6/92 | Abarca and Weedman 1993 |
| | W. of Soldier Camp Creek | 8/91-6/92 | Abarca and Weedman 1993 |
| | Houston Creek | 8/91-6/92 | Abarca and Weedman 1993 |
| | Rye Creek | 8/91-6/92 | Abarca and Weedman 1993 |
| | Greenback Creek | 8/91-6/92 | Abarca and Weedman 1993 |

| | | | |
|---|---|---|---|
| *** | Double R Creek | 9/91-10/91 | Gori 1993 |
| | Sonoita Creek | 9/91-10/91 | Gori 1993 |

is particularly significant in light of the introduction of predaceous exotic fishes. Stream bed incision results in the homogenization of stream habitat; i.e., loss of pools within which most adult Gila chub are found (e.g., Hot Springs canyon; Civish 1995). Intense scouring floods cause direct mortality of Gila chub (Big Chino Wash; Young, 1994).

***WATER DIVERSION AND GROUNDWATER PUMPING***. Irrigation of stream and cienega waters directly diverts water away from fish habitat. Fish can be carried into irrigation ditches, where they die following desiccation. Irrigation dams prevent movement of fish between populations, resulting in genetic isolation within species.

Groundwater pumping has gradually lowered the water table in the southwest. As a result, numerous springs and cienegas and riparian habitats have become desiccated. For example, the Santa Cruz River, once lined with cottonwoods and lush riparian vegetation, has become desiccated and habitat poor as a direct result of groundwater pumping (Davis 1994; Hastings 1959). Lowering of the water table also contributes to arroyo cutting. Increasing demands for water, population growth, and unnecessary development are likely to continue this process.

***TIMBER HARVEST.*** Timber cutting in the headwaters of southwest streams has been underway since the earliest settlers inhabited the region. Large scale timber harvest in recent years has increased the rate of soil erosion, accelerated sedimentation of streams, increased the intensity of flood events following storms, and occasionally lowered of the water table (Miller 1961) causing downcutting.

## PREDATION AND COMPETITION

Exotic sport and bait fish and their parasites, crayfish, and some exotic plants have been reported as threats to the existence and/or health of native fish (Cartwright, Jr. 1994). For example, in lower Bonita Creek (below "the Narrows"), Gila chub have been observed to exhibit poor body condition, infestation with ectoparasites, and disease (Civish 1995), while Gila chub above the Narrows have not exhibited this degraded condition. Resource managers report exotic fishes (as well as physical habitat alterations) to be the source of these problems (Civish 1995). Unfortunately, while Civish (1995) describes the Gila chub population in the upper portion of the creek as "a healthy reproducing population", at least some of the same exotic fishes are in both sections of the creek (Table 1).

Invasion of non-native predatory and competitive exotic species was identified by The Nature Conservancy (TNC 199*) as one of two principal causes for the decline of the Gila chub. Exotic fishes and crayfish prey directly on Gila chub and their eggs. Predation on Gila chub by exotic fishes has been a leading cause of decline in *G. intermedia* according to Cheniae (1994). For example, a population in Monkey Spring, New Mexico was decimated by predation by largemouth bass (*Micropterus salmoides*), and the decline and disappearance of Gila chub from the San Carlos River corresponded with increasing numbers of green sunfish (*Lepomis cyanellus*) (Minckley 1973). TNC (199*) identifies *Cyprinella* (formerly *Notropis*) *lutrensis*, *Ictalurus punctatus*, *Pylodictis olivaris*, *Gambusia affinis*, *Lepomis cyanellus*, *Micropterus salmoides*, and *M. dolomieui* as examples of fish that are competitive with or predatory on Gila chub. These and other species currently occupy habitat where Gila chub are found (Table 1) and where they have been extirpated (Table 2).

## INADEQUACY OF EXISTING REGULATORY MECHANISMS.

***STATE AGENCIES.*** Both the states of Arizona and New Mexico have listed *Gila intermedia* as a special status species (threatened in Arizona, and endangered, group 3, in New Mexico), but neither state has taken steps to protect their habitat or created management plans to restore this species. The Bureau of Land Management and the Arizona Game and Fish Commission have proposed stocking previously occupied streams in the Agua Fria basin with "seed fish" from Silver Creek (USFWS 1993a). However, excessive handling of wild fish is known to damage the health of fish and cause mortality. The wisdom of major population transplants in the absence of a hatchery program and prior restoration of release areas is questionable.

***U.S. FOREST SERVICE.***

***BUREAU OF LAND MANAGEMENT.***

## VI. CRITICAL HABITAT DESIGNATION RECOMMENDED

Petitioners strongly recommend the designation of critical for *Gila intermedia* coincident with its listing. Critical habitat should be designated in all areas where it is currently located and in key unoccupied areas where restoration is necessary for the conservation of the species.

Respectfully submitted, this ?? day of March, 1998,

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## VII. LITERATURE CITED


Abarca, F. J., and D.A. Weedman. 1993. Native fishes of Tonto Creek, Tonto National Forest, Arizona. Final report: Non-Game and Endangered Wildlife Program. 20 pp. + Appendices.

Anderson, R., and P. Turner. 1977. Stream Survey of the San Francisco River. First Report to the New Mexico Department of Game and Fish. Department of Fishery and Wildlife Sciences, New Mexico State University. Las Cruces, NM. 20 pp.

Baird, S. F., and C. Girard. 1854. Descriptions of new species of fishes collected on Texas, New Mexico, and Sonora, by Mr. John H. Clark, on the U.S. Mexican Boundary Survey. Proceedings of the Academy of Natural Sciences, Philadelphia. 7:24-29.

Bestgen, K. R. 1985. Results of identification of collections of larval fish made in the Upper Salt and Gila Rivers, Arizona. A report to the U.S. Fish and Wildlife Service, Fort Collins, CO. 80523.

Cartwright, Jr., C. W. 1994. Letter to Peter Galvin. Regional Forester, Southwestern Region, USDA Forest Service. December 15, 1994.

Cheniae, G. L. 1994. Letter to Peter Galvin. District Manager, Phoenix District, U.S. Bureau of Land Management. December 5, 1994.

Civish, W. T., 1995. Letter to Peter Galvin. District Manager, Safford District. U.S. Bureau of Land Management. February 21, 1995.

Davis, A. 1994. Headwaters of denial. Tucson Weekly. Dec. 8- Dec. 14, 1995, p. 14.

DeMarais, B.D. 1986. Morphological variation in *Gila* (Pisces: Cyprinidae) and geologic history, lower Colorado River basin. M.S. Thesis. Arizona State University, Tempe, AZ. 85 pp.

Gori, D.F. 1993. Monitoring native fish populations on the Coronado Forest and Nature Conservancy Preserves in Arizona. Report submitted to the Coronado National Forest in completion of CCS-3-91-05-014. The Arizona Nature Conservancy, Tucson, AZ.

Griffith, J. S., and T. R. Tiersch. 1989. Ecology of fishes in Redfield Canyon, Arizona with emphasis on *Gila robusta intermedia*. The Southwestern Naturalist. 34(1):131-164.

Hastings, J. R. 1959. Vegetation change and arroyo cutting in southeastern Arizona. Journal of the Arizona Academy of Science. 1(2):60-67.

Hendrickson, D.A., and W.L. Minckley. 1984. Cienegas: Vanishing climax communities of the American Southwest. Desert Plants. 6(3):130-175.

Johnson, J. 1977. Files: Gila topminnow survey, Arizona. March 15-19, 1977. U.S. Fish and Wildlife Service.

Miller, R.R. 1961. Man and the changing fish fauna of the American Southwest. Papers of the Michigan Academy of Science, Arts, and Letters. 46:365-404.

Minckley, W.L. 1973. The Fishes of Arizona. Arizona Game and Fish Department, Phoenix AZ. 293 pp.

Minckley, C.O. 1983. Status report for *Gila intermedia* (Gila chub). Prepared for the Office of Endangered Species. U.S. Fish and Wildlife Service. Albuquerque, NM.

Minckley, W.L. 1985. Native Fishes and natural aquatic habitats in U.S. Fish and Wildlife Service Region 2 West of the Continental Divide. Report to the US Fish and Wildlife Service, Alb, New Mexico. Department of Zoology, Arizona State University, Tempe, AZ. pp. ix - 158.

NMDGF. 1988. Handbook of Species Endangered in New Mexico. Report C-128, pp. 1-2. New Mexico Department of Game and Fish, Santa Fe, NM.

USFWS 1974. The Red Book. United States Fish and Wildlife Service. Washington D.C.

Rinne, J. F. 1976. Cyprinid fishes of the Genus *Gila* from the lower Colorado Rover basin. The Wasman Journal of Biology. 34(1):65-107.

Simms, J. R. 1993a. Memorandum to the Regional Director, Region 2, U.S. Fish and Wildlife Service. Fishery Biologist, Bureau of Land Management, Tucson Resource Area Office, Tucson, AZ. December 7, 1993.

Simms, J. R. 1993b. Memorandum to the Regional Director, Region 2, U.S. Fish and Wildlife Service. Fishery Biologist, Bureau of Land Management, Tucson Resource Area Office, Tucson, AZ. December 17, 1993.

Spiller, S. F. 1995. Letter to Jennifer Sampson. State Supervisor, U.S. Fish and Wildlife Service, Arizona Ecological Services State Office, Phoenix, AZ. January 18, 1995.

TNC. 199??. Element Stewardship Abstract for *Gila intermedia* Gila chub. Prepared by S.P. Vives, Department of Biology, Georgia Southern University. FOR: The Nature Conservancy, Arizona Field Office, Tucson, AZ.

TPM. 1993. Fish Data Sheet: Topminnow and Pupfish Monitoring 1993-1994 Sitename: O'Donnell Creek @ Canelo Hills. Site Number 205. October 11, 1993.

USFS. 1991. Native Fishes of Arid Lands. General Technical Report, RM-206. United States Forest Service. Fort Collins, CO. 80526.

USFWS. 1993. District Environmental Assessment (EA) scoping, review, and approval form: Gila chub reintroduction proposal. Applicant: Bureau of Land Management. EA assigned to Dan Langhorst, EA No. AZ-02-024-93-019.

Varela-Romero, A. 1992. Prospecion de peces nativos en la cuenca del Rio San Pedro, Sonora, Mexico. Prepared for The Nature Conservancy, Arizona State Office, Tucson, AZ.

Young, K. 1994. Personal communication with Jennifer Sampson. Manager, Non-Game Fish Division, Arizona Game and Fish Department, Phoenix, AZ. December 1994.

# APPENDIX A
# OPINION OF KNOWLEDGEABLE PERSONS AND AGENCIES

***NEW MEXICO DEPARTMENT OF GAME AND FISH.*** "The Gila chub has declined throughout its range. In Arizona, generally small populations survive in perhaps 15 areas, and some of these are subject to elimination by natural and man-caused perturbations. In New Mexico, such former stations as Duck Creek and San Simon Cienega are no longer suitable for the species and perhaps could not be restored for it. Loss of habitat has been the major problem for the Gila chub, especially that due to extreme modification of spring habitats and by arroyo cutting and subsequent dewatering. In addition, this and related chubs are quite susceptible to predation by introduced fishes, including bass (*Micropterus dolomieui* and *M. salmoides*) and catfishes--especially in areas where habitat is limited." (NMGFD 1988)

***W. L. MINCKLEY.*** "Maintenance of this distinctive chub will likely require direct acquisition of or management easements on habitats in the form of headwater cienegas or spring-fed streams. The species seems to do well in spring fed ponds so long as not subject to predation or other pressures from non-native fishes...Some populations of (Gila chub) appear to have been extirpated after introduction of largemouth bass, bluegill, goldfish (*Carassius auratus*), and/or other non-native species. Others have disappeared as a result of habitat desiccation the last especially due to loss of cienegas. The species is restricted in occurrence and reduced in numbers; listing as threatened is appropriate." (Minckley 1985)

***U.S. FISH AND WILDLIFE SERVICE.*** "The [U.S. Fish and Wildlife] Service is also concerned about the Gila chub. In February 1992, the Desert Fishes Recovery Team recommended that Gila chub be listed as a threatened or endangered species. The recommendation was based on the combined personal knowledge of team members. Team members believe sufficient information exists to support a proposal to list Gila chub." (Spiller, 1995. pers. comm.)

***THE NATURE CONSERVANCY.*** The "continued presence [of Gila chub] in Arizona could be in jeopardy in the near future." (TNC 199??)