

**United States Department of the Interior
U.S. Fish and Wildlife Service
2321 West Royal Palm Road, Suite 103
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Telephone: (602) 242-0210 FAX: (602) 242-2513**

May 22, 1997

In Reply Refer To:
AESO/SE
2-21-97-F-051

MEMORANDUM

TO: Geographic Manager, Arizona, Albuquerque, New Mexico (AES)

FROM: Field Supervisor

SUBJECT: Draft Biological Opinion for the San Bernardino National Wildlife Refuge Asian Tapeworm Eradication

Attached is a draft intra-Service biological opinion for the San Bernardino National Wildlife Refuge Asian Tapeworm Eradication that covers the Yaqui topminnow, Yaqui chub, and beautiful shiner, and Huachuca water umbel for your signature. For your convenience, we have included a floppy disk.

The Refuge's personnel have informed us that they wish to begin the project in May 1997. If you have any questions, please contact Doug Duncan or Angie Brooks.

/s/ Sam F. Spiller

Attachment

**United States Department of the Interior
U.S. Fish and Wildlife Service
2321 West Royal Palm Road, Suite 103
Phoenix, Arizona 85021
Telephone: (602) 242-0210 FAX: (602) 242-2513**

May 29, 1997

In Reply Refer To:
AESO/SE
2-21-97-F-051

MEMORANDUM

TO: Refuge Manager, San Bernardino National Wildlife Refuge, Douglas, AZ

FROM: Geographic Manager, Arizona

SUBJECT: Biological Opinion for the San Bernardino National Wildlife Refuge Asian Tapeworm Eradication

The U.S. Fish and Wildlife Service (Service) has reviewed the Intra-Service section 7 consultation on the Asian tapeworm eradication project on the San Bernardino National Wildlife Refuge (SBNWR), Cochise County, Arizona. Your request was received on November 4, 1996. This document represents the Service's biological opinion on the effects of that action on the following listed species: the endangered Yaqui topminnow (*Poeciliopsis occidentalis sonoriensis*), endangered Yaqui chub (*Gila purpurea*) with critical habitat, threatened beautiful shiner (*Cyprinella formosa*) with critical habitat, and the endangered Huachuca water umbel (*Lilaeopsis schaffneriana* ssp. *recurva*) in accordance with section 7 of the Endangered Species Act of 1973, as amended, (16 U.S.C. 1531 et seq.).

Intra-Service activities will consider effects on listed, proposed, and candidate species (Fish and Wildlife Service Manual 733 FW 3.2(b)). Candidates are treated as if they are proposed for listing. The only candidate species considered in the consultation is the Chiricahua leopard frog (*Rana chiricahuensis*). In our memorandum of November 18, 1996, we concurred that the Chiricahua leopard frog will not be affected by the project and that further consultation was unnecessary for that species.

This biological opinion is based on information provided in the October 22, 1996 Intra-Service section 7 Biological Evaluation (BE); information provided in your Memorandum of December 18, 1996; telephone conversations; field investigations; data in our files; and other sources of information. A complete administrative record of this consultation is on file in this office.

After reviewing the current status of the endangered Yaqui chub, threatened beautiful shiner, endangered yaqui topminnow, the endangered Huachuca water umbel, and the candidate Chiricahua leopard frog, the environmental baseline for the action area, the effects of the proposed action, and the cumulative effects, it is the Service's biological opinion that the action, as proposed, is not likely to jeopardize the continued existence of these species. Critical habitat has been designated for the Yaqui chub and beautiful shiner, however, the proposed action causes no net change in the amount of critical habitat, and may increase the quality of critical habitat, hence, there is no destruction or adverse modification of critical habitat.

BIOLOGICAL OPINION

DESCRIPTION OF THE PROPOSED ACTION

The purpose of the proposed action is to eradicate from the Refuge the Asian tapeworm (*Bothriocephalus acheilognathi*), an exotic fish parasite that has been found in Yaqui chub, Yaqui topminnow, and beautiful shiner. This parasite presents a potential danger to native fish populations on the refuge and possibly throughout the Rio Yaqui drainage should it be transferred into Black Draw.

Asian tapeworm may be compromising the health and recovery of native fishes in the Yaqui Basin. This project, as proposed, will assist ecologists and refuge personnel in attaining the Refuge goals of ecosystem restoration by improving conditions of fish health, habitat diversity and quality, habitat management, water conservation, and control of exotic species. We believe that ecosystem restoration can not proceed without these conditions.

The proposed action will involve creating new habitat, chemical treatment of existing aquatic habitats to exclude intermediate tapeworm life stages, and medicinal treatment of infected fishes to remove tapeworms. In addition, the eradication project presents an opportunity to: 1) reduce the impacts of exotic bullfrogs (*Rana catesbeiana*) on native fauna; 2) enhance reestablishment and recovery efforts of the Chiricahua leopard frog; 3) enhance reestablishment efforts of Huachuca water umbel in historic cienega areas that are free of encroaching cattail (*Typha* spp.) and bulrush (*Scirpus* spp.); 4) to redesign and implement aquatic habitats for wellwater conservation; 5) redesign aquatic habitats that will aid ecosystem restoration and recovery of threatened and endangered species; 6) and aid in management of aquatic habitat.

The proposed action will be implemented in phases. An incremental plan will allow refuge personnel to conduct eradication procedures using adaptive management and be cost effective. Standard population monitoring will be conducted through all phases of the project. The species present at each project site, the phase of development, and whether or not the replacement habitat is a stream or pond is shown in Table 1.

Table 1. Locations of listed species at project sites on the San Bernardino National Wildlife Refuge that are planned for renovation, their implementation phase, replacement habitat type, and known presence of Asian tapeworm in each species. +++ denotes presence without tapeworm and --- denotes presence and known infection by tapeworm.

Water body	Yaqui topminnow	Yaqui chub	beautiful shiner	Huachuca water umbel	Phase	Replacement habitat type
North	---	---			I	stream
Bunting	+++				I	stream
Mesquite	+++	---	---	+++	II	stream
Oasis	+++	---	---	+++	II	pond
Twin	+++	---	---		III	pond
Evil Twin	+++		---	+++	III	pond
Robertson	+++				III	pond

Phase I will involve constructing new habitats near the North Pond/Bunting Spring complex. Wells supplying North Pond will be closed temporarily and the pond will be allowed to dry by evaporation, transpiration, and seepage. Plumbing will be re-routed to the newly built habitats. A series of ponds, pools, and riffles will be constructed using local rock and cement. Natural and historical cienega/stream habitat will be emulated as closely as possible. Habitat structures (*e.g.* rock, root wads, undercuts, upwelling zones) will be established in appropriate locations. Fencing the new habitats will take place before filling with water which will allow future reestablishment of Chiricahua leopard frogs and Mexican garter snakes where bullfrogs have been excluded. Additional specifications on Phase I construction is included as Appendix 1. Once filled, the new habitats will be allowed adequate time to populate with indigenous aquatic invertebrates and flora. Well water may be recirculated or piped into Black Draw (for Huachuca water umbel restoration and native riparian vegetation reestablishment), dependent on water

volume and quality. Initially, water from the end of the system will be put through a packed column for cooling and aeration, and returned to the stream at the head of pool #3. The return water may be piped into Black Draw after the absence of tapeworm in fish in the constructed stream has been confirmed for at least six months. Huachuca water umbel will be planted on margins of the new aquatic habitats.

Drawdown of North Pond will be conducted to concentrate fish for ease of collection. Fishes will be transferred to holding tanks (with supplemental oxygen and salt to reduce stress; antibiotic treatment to reduce secondary infections) where they will receive either single or multiple treatments of Droncit de-wormer for a period of 24-48 hours. Yaqui topminnows will not be treated with Droncit as it is believed they would be killed (J. Landye, Pinetop Fish Health Center, pers. comm.). Though the topminnow may not be killed directly by Droncit, many are so heavily infested with yellow grubs, the fish would probably succumb to the loss of the grubs or secondary infection. The topminnow will be held in tanks and allowed to breed. The F1 progeny of these fish will be removed upon birth, and later released into the new habitats. The wild caught topminnow will be held for breeding until they die naturally. Droncit-treated fishes will be transferred immediately to the new habitat. The old pond will continue to be dried and sediments will be treated with lime to prevent future infestations. The old pond will be filled in and covered with soil which currently serves as its berms.

The Mesquite Pond complex and Oasis Pond are to be treated as Phase II of this project. The Mesquite Pond complex will use similar materials and methods as Phase I. The Oasis Pond portion of Phase II will consist of relocating the fishes to a smaller pond to be constructed in the vicinity of the old pond. Huachuca water umbel, from Oasis Pond, will be translocated to the new aquatic habitats (emergent vegetation encroachment is threatening existence of this population).

The Twin Pond complex and Robertson Pond will be Phase III and the methods of the Oasis Pond renovation will be repeated. The specifics of Phase II and III have not been determined as yet.

New habitats are designed to increase water conservation and quality of aquatic habitat by:

- 1) reducing evaporation, transpiration, and seepage losses;
- 2) reducing accumulated salts and evaporites;
- 3) reducing probability of parasite reinfection;
- 4) providing habitat heterogeneity for fishes, leopard frogs, and gartersnakes;
- 5) improving sediment stability and aggradation in Black Draw;
- 6) improving management of emergent vegetation;

- 7) improving habitat conditions for Huachuca water umbel;
- 8) incorporating modularity that would allow for spot repairs and changes in habitat;

STATUS OF THE SPECIES

Listed species/critical habitat

Yaqui Topminnow

Both subspecies of Sonoran topminnow (*Poeciliopsis occidentalis*) were listed as endangered on March 11, 1967. Critical habitat has not been designated for this species. The Yaqui topminnow is a small, livebearing fish of the family Poeciliidae (Minckley 1973). It is found throughout the Rio Yaqui and adjacent drainages in Arizona and Sonora, Mexico, but is listed only in the United States portion of its range (Hendrickson *et al.* 1980, Juarez-Romero *et al.* 1988, Campoy-Favela *et al.* 1989). Its historic range in the United States encompassed the lower to mid elevation reaches of the Rio Yaqui basin, including Whitewater and Black Draws. Much of the habitat in those areas has been lost to water diversion, stream downcutting, backwater draining, vegetation clearing, channelization, grazing, groundwater pumping, and other human uses of the natural resources (USFWS 1984). In addition, nonnative fish have been introduced in many portions of historic range in the United States. The mosquitofish (*Gambusia affinis*), which is particularly damaging to Yaqui topminnow, was first found in the United States portion of the Rio Yaqui basin in 1979 (Hendrickson *et al.* 1980, Meffe *et al.* 1983, Galat and Robertson 1992).

In the United States, Yaqui topminnow are presently found only on the SBNWR and Leslie Canyon NWR. On the main Refuge they are found in Bathhouse Spring, Black Draw (San Bernardino Creek), Bunting Spring, Cottonwood Spring, Evil Twin Pond, Hay Hollow storage tank, House Pond, Mesquite Pond and an unnamed pond at its outflow, Middle Spring, Oasis Pond, Robertson Cienega, Twin Pond, Two PhD Ponds, and Tule Spring (SBNWR memorandum May 26, 1994). Many of these stocked populations are in enhanced or artificially created habitats which are part of the recovery program. The population in Leslie Creek was stocked in 1969 with individuals taken from Astin Spring in the Black Draw drainage (Minckley and Brooks 1985). The populations are generally small, fluctuate greatly, and are in a relatively small geographic area susceptible to cataclysmic events.

Yaqui Topminnow habitat preferences include warm springs, cienegas, ponds, pools, and stream margins where current is slight. Individuals are most commonly observed in the upper portion of the water column (<80cm, Maes 1995), especially at the surface and adjacent to submerged vegetation. Diet consists of aquatic insect larvae (including mosquitos), amphipod crustaceans, detritus, and living vegetative material (Minckley 1973, Gerking and Plantz 1980).

Females are larger than males, usually 30-45mm standard length. Breeding males are black, smaller than females (<25mm standard length), and have an elongated anal fin (gonopodium) used to deliver a spermatophore to the female's urogenital opening. Reproduction occurs throughout the year where temperatures are fairly uniform. Females may have broods of 20-25 young at intervals of ~20 days (Minckley 1973). Few wild individuals survive more than a year.

Yaqui Chub

The Yaqui chub was listed as an endangered species on August 31, 1984. Critical habitat was designated for this species for "all aquatic habitat on the San Bernardino NWR." However, this was prior to the acquisition of Leslie Canyon, and Leslie Canyon is not part of the designated critical habitat. The Yaqui chub is a medium sized fish of the family Cyprinidae (Minckley 1973). Until recently, *Gila purpurea* was thought to occur in the basins of the Rios Sonora, Matape, and Yaqui in Arizona and Sonora, Mexico (Hendrickson *et al.* 1980). In 1991, it was recognized that the chub in the Rios Sonora and Matape and the Rio Yaqui system downstream from San Bernardino Creek are a different species, *Gila eremica* (DeMarais 1991). *Gila purpurea* is endemic to San Bernardino Creek in Arizona and Mexico and possibly the Willcox Playa basin in Arizona (Varela-Romero *et al.* 1990, DeMarais 1991). It currently occurs in Bathhouse Spring, Black Draw, House Pond, Mesquite Pond, North Pond, Oasis Pond, Robertson Cienega, Twin Pond, and Two PhD Ponds on the SBNWR (SBNWR memorandum May 26, 1994). Only a few individual chubs were caught in Robertson Cienega during the 1994 monitoring effort. Some of those populations have been stocked into enhanced or artificially created habitats as part of the recovery program. The population in Leslie Creek was stocked in 1969 with individuals taken from Astin Spring (Minckley and Brooks 1985). A population in Turkey Creek in the Chiricahua Mountains was stocked in 1986 and 1991 from Leslie Creek stock raised at Dexter National Fish Hatchery.

Habitat preferences for Yaqui chub vary by life stage. Young fishes prefer marginal habitat and the lower ends of riffles. Adults prefer the deepest, most permanent pools, undercut banks adjacent to large boulders, debris piles, and roots of large riparian trees (Hendrickson *et al.* 1980). Diet consists mostly of algae, insects, and detrital material (Galat and Gerhardt 1987).

Breeding males are a bluish-grey color while females are straw-yellow to light brown color (Minckley 1973). Spawning is protracted throughout the warmer months, with greater activity in spring. Reproductive potential is high and large populations develop quickly from a few adults (DeMarais and Minckley 1993). Growth to maturity is rapid, often within the first summer of life.

Beautiful Shiner

The beautiful shiner was listed as a threatened species on August 31, 1984. Critical habitat was designated for this species for "all aquatic habitat on the San Bernardino NWR." However, this was prior to the acquisition of Leslie Canyon NWR, and Leslie Canyon is not part of the designated critical habitat. The beautiful shiner is a small fish of the family Cyprinidae (Minckley 1973). It occurred in the Rio Yaqui in Arizona and in Sonora and Chihuahua, Mexico and in the Mimbres River and Guzman basin in New Mexico and Chihuahua, Mexico but has been extirpated from the Mimbres River (Hendrickson *et al.* 1980, Campoy-Favela *et al.* 1989, Sublette *et al.* 1990). Water diversion, stream downcutting, backwater draining, vegetation clearing, channelization, grazing, groundwater pumping, and other human uses of the natural resources resulted in the extirpation of the beautiful shiner from the United States. In 1990, beautiful shiner was reintroduced into the SBNWR originating from collections made in 1989 from Rio Moctezuma, Chihuahua, Mexico. Populations now exist in Evil Twin Pond, Oasis Pond, Mesquite Pond, Little Mesquite Pond, and Twin Pond (SBNWR memorandum dated May 26, 1994).

Habitat preferences for beautiful shiner in the Rio Yaqui drainage are riffles of running streams and creeks. Where flow is intermittent, pools suffice as habitat until riffles become available in the next wet season (Hendrickson *et al.* 1980). Beautiful shiners on the San Bernardino NWR prefer the subsurface zone of the water column (41-80cm) and do not appear dependent on proximity of vegetative cover (Maes 1995).

Breeding colors of male beautiful shiners exhibit a darkened dorsal fin and yellow-orange to orange coloration on remaining fins (Minckley 1973). Numbers of young-of-year fishes, in ponds on San Bernardino NWR, indicate recruitment in beautiful shiners may approach that of the red shiner (*Cyprinella lutrensis*). However, relatively few individuals live to reproductive size class (SBNWR files). Stream population trends are likely to differ from pond populations. Little else is known about the beautiful shiner.

Huachuca Water Umbel

The Huachuca water umbel (*Lilaeopsis schaffneriana* ssp. *recurva*) was listed as an endangered species on February 5, 1997. Critical habitat has not been designated for this species. The Huachuca water umbel is a herbaceous, semi-aquatic, perennial plant with slender, erect leaves that grow from creeping rhizomes. The leaves are cylindrical, hollow with no pith, and have septa (thin partitions) at regular intervals. The yellow-green or bright green leaves are generally 1-3 millimeters (mm) (0.04-0.12 inches) in diameter and often 3-5 centimeters (cm) tall (1-2 inches), but can reach up to 20 cm (8 inches) tall under favorable conditions. Three to 10 very small flowers are born on an umbel that is always shorter than the leaves. The fruits are globose, 1.5-2 mm (0.06-0.08 in.) in diameter, and usually slightly longer than wide (Affolter 1985). The

species reproduces sexually through flowering and asexually from rhizomes, the latter probably being the primary reproductive mode. An additional dispersal opportunity occurs as a result of the dislodging of clumps of plants, which then may reroor in a different site along aquatic systems.

Lilaeopsis has been documented from 22 sites in Santa Cruz, Cochise, and Pima Counties, Arizona, and in adjacent Sonora, Mexico, west of the continental divide (Warren *et al.* 1989, Saucedo-Monarque 1990, Warren and Reichenbacher 1991, Warren *et al.* 1991). Six of the 22 sites have been extirpated. The 16 extant sites occur in 4 major watersheds - San Pedro River, Santa Cruz River, Rio Yaqui, and Rio Sonora. All sites are between 1,148-2,133 meters (3,500-6,500 feet) in elevation. Nine *Lilaeopsis* populations occur in the San Pedro River watershed in Arizona and Sonora, on sites owned or managed by private landowners, Fort Huachuca Military Reservation, the Coronado National Forest, and Bureau of Land Management's Tucson Field Office. Two extirpated populations in the upper San Pedro River watershed occurred at Zinn Pond in St. David and the San Pedro River near St. David. Cienega-like habitats were probably common along the San Pedro River prior to 1900 (Hendrickson and Minckley 1984, Jackson *et al.* 1987), but these habitats are now largely gone. Surveys conducted for wildlife habitat assessment have found several discontinuous clumps of *Lilaeopsis* within the upper San Pedro River where habitat was present in 1996 prior to recent flooding (Mark Fredlake, Bureau of Land Management, unpubl. data, 1996).

Lilaeopsis has an opportunistic strategy that ensures its survival in healthy riverine systems, cienegas, and springs. In upper watersheds that generally do not experience scouring floods, *Lilaeopsis* occurs in microsites where interspecific plant competition is low. At these sites, *Lilaeopsis* occurs on wetted soils interspersed with other plants at low density, along the periphery of the wetted channel, or in small openings in the understory. The upper Santa Cruz River and associated springs in the San Rafael Valley, where a population of *Lilaeopsis* occurs, is an example of a site that meets these conditions. The types of microsites required by *Lilaeopsis* were generally lost from the main stems of the San Pedro and Santa Cruz Rivers when channel entrenchment occurred in the late 1800's. Habitat on the upper San Pedro River is recovering, and *Lilaeopsis* has recently recolonized small reaches of the main channel. In stream and river habitats, *Lilaeopsis* can occur in backwaters, side channels, and nearby springs. After a flood, *Lilaeopsis* can rapidly expand its population and occupy disturbed habitat until interspecific competition exceeds its tolerance. This response was recorded at Sonoita Creek in August 1988, when a scouring flood removed about 95 percent of the *Lilaeopsis* population (Gori *et al.* 1990). One year later *Lilaeopsis* had recolonized the stream and was again codominant with watercress (*Rorippa nasturtium aquaticum*) (Warren *et al.* 1991). The expansion and contraction of *Lilaeopsis* populations appears to depend on the presence of "refugia" where the species can escape the effects of scouring floods, a watershed that has an unaltered hydrograph, and a healthy

riparian community that stabilizes the channel. Two patches of *Lilaeopsis* on the San Pedro River were lost during a winter flood in 1994 and had still not recolonized that area as of May 1995, demonstrating the dynamic and often precarious nature of occurrences within a riparian system (Al Anderson, Grey Hawk Ranch, *in litt.* 1995).

Density of *Lilaeopsis* plants and size of populations fluctuate in response to both flood cycles and site characteristics. Some sites, such as Black Draw, have a few sparsely distributed clones, possibly due to the dense shade of the even-aged overstory of trees and deeply entrenched channel. The Sonoita Creek population occupies 14.5 percent of a 500.5 m² (5,385 ft²) patch of habitat (Gori *et al.* 1990). Some populations are as small as 1-2 m² (11-22 ft²). The Scotia Canyon population, by contrast, has dense mats of leaves. Scotia Canyon contains one of the larger *Lilaeopsis* populations, occupying about 57 percent of the 1,450 m (4,756 ft) perennial reach (Gori *et al.* 1990; Jim Abbott, Coronado National Forest, *in litt.* 1994). While the extent of occupied habitat can be estimated, the number of individuals in each population is impossible to determine because of the intermeshing nature of the creeping rhizomes and the predominantly asexual mode of reproduction. A population of *Lilaeopsis* may be composed of one or many individuals.

ENVIRONMENTAL BASELINE

Southeastern Arizona has been influenced by Europeans for hundreds of years and by Native Americans for much longer (Bahre 1991). The effects of this use, though not always obvious, has been pervasive and widespread. One element Native Americans have influenced in southeastern Arizona is the vegetation. Though their effects are debated, they may have influenced regional fire regimes (Pfefferkorn 1949, Humphrey 1958). The immigration of Europeans into the southwest has had a profound impact on the fire regime (Hastings and Turner 1965, Bahre and Hutchinson 1985).

These regional vegetation changes can be seen at San Bernardino NWR. Europeans have influenced the San Bernardino Valley since the late 17th century (Wagoner 1975). Trees and small shrubs such as mesquite (*Prosopis juliflora*), whitethorn acacia (*Acacia vernicosa*), and burroweed (*Haplopappus tenuisecta*) have probably increased at the expense of desert grassland. The abandoned agricultural fields found on the Refuge were gouged out at the expense of native vegetation. Most early accounts comment on the luxuriant grass present in the vicinity of the ranch (see Lanning 1981 and Davis 1982). Some investigators of the subject believe that native grasslands were maintained by fire (Hastings 1959, Wright 1980, Bock and Bock 1990).

The riparian and wetland areas of the Refuge have declined from what they were historically (Hastings and Turner 1965, Lanning 1981) and are part of a region-wide decline (Lowe 1964, Carothers *et al.* 1974). From early accounts, it appears that San Bernardino Creek/Black Draw had, at most, a small channel (see Lanning 1981 and Davis 1982).

Baseline water quality data for San Bernardino and Leslie Canyon were reported by Kepner (1988). The source of water for Robertson Cienega is East Border Well. Dissolved oxygen was measured at the source of West Border Well, which is 20 feet from East Border Well and should be derived from the same subterranean source. Kepner measured 5.51 milligrams/liter of dissolved oxygen at West Border Well, which was below the state standard of 6.0 mg/l for aquatic and wildlife protection. However, measurements taken at the source tend to be deoxygenated (Kepner 1988).

Status of the species within the action area

The San Bernardino National Wildlife Refuge was established in the 1980's for the conservation and recovery of fishes indigenous to the Rio Yaqui Basin. Four Yaqui fish species are federally listed as either threatened or endangered. Critical habitat has been designated on the San Bernardino NWR for two cyprinid fishes, the endangered Yaqui chub and the threatened beautiful shiner, and one ictalurid, the threatened Yaqui catfish (*Ictalurus pricei*).

In autumn of 1995, personnel from the Pinetop Fish Health Center performed a routine disease survey of fishes on the SBNWR. The survey revealed that Asian tapeworm infestation was common in the two federally listed cyprinids. Tapeworms were later found in the topminnow in two of the ponds. Topminnow which co-occur with infected chub and shiner in other ponds have not been infected.

Little is known of the effects of this exotic parasite on native fishes, although it is believed to be detrimental. Clarkson and others (1997) reported on the incidence of Asian tapeworm in the Little Colorado River and summarized known pathological effects of tapeworms on fish. Tapeworm have been documented in the Colorado River and several of its tributaries (Clarkson *et al.* 1997). They found tapeworm in the native fish humpback chub (*Gila cypha*), speckled dace (*Rhinichthys osculus*), and in the exotics fathead minnow (*Pimephales promelas*), plains killifish (*Fundulus zebrinus*), and common carp (*Cyprinus carpio*). Tapeworm were not found in co-occurring bluehead sucker (*Catostomus discobolus*), flannelmouth sucker (*C. latipinnis*), channel catfish (*Ictalurus punctatus*), or rainbow trout (*Onchorhynchus mykiss*). Asian tapeworm can effect fish physiologically through intestinal abrasion and disintegration (Hoole and Nisan 1994) or obstruction of the gastrointestinal tract (Hoffman 1980, Mitchell 1994). Chronic effects may include emaciation and anemia (Scott and Grizzle 1979); decreases in

intestinal, liver, and pancreatic enzymes (Hoole 1994); reduced growth and reproductive capacity, depressed swimming ability through increased muscle fatigue and other debilitating influences (Heckman *et al.* 1986, Hoole 1994). In addition, parasitized fish may be more susceptible to secondary infection and predation.

It is believed that bullfrogs are not tapeworm vectors (R. Clarkson, USBR, pers. comm; K. Cobble, USFWS, pers. comm.). We know of no published data where Asian tapeworms have been found in bullfrogs. If bullfrogs do carry tapeworms, it would be of great concern due to their pandemic distribution on the Refuge and their dispersal ability. The Refuge plans on checking bullfrogs for tapeworms, in cooperation with the Pinetop Fish Health Center.

If ignored, or action is delayed, this parasite could imperil many of the threatened and endangered fish in the southwestern USA and Mexico, including three other rare minnows in habitats adjacent to the refuge.

Infected fishes appear to be stunted in size. As expected, non-infected fishes appear to be larger in size and in healthy condition. Effects on fish populations may be difficult to determine since it is unknown when and how these species were originally infected. However, populations appear to be more robust where tapeworm is absent.

Listed species/critical habitat

Fishes

All the ponds are designated critical habitat as all aquatic habitat on the Refuge is designated as critical habitat. The known constituent elements for the Rio Yaqui fishes include clean, small permanent streams and spring pools without exotic fishes and backwater areas of springs with overgrown cutbanks and accumulations of detritus are necessary for feeding and shelter (USFWS 1984). The status of the fish in the action area is included in the status of the species.

Huachuca Water Umbel

Two *Lilaeopsis* populations occur in the Rio Yaqui watershed. The species was recently discovered at Presa Cucquiariichi, in the Sierra de los Ajos, several miles east of Cananea, Sonora (Tom Deecken, Coronado National Forest, unpubl. data, 1994). The Huachuca water umbel is found in small areas [generally less than 1m² (10.8 ft²)] at Oasis Pond, Black Draw, Evil Twin Pond, and Leslie Creek, Cochise County, Arizona. However, the population at Oasis Pond is currently threatened with encroachment of bulrush (*Scirpus* spp.) and bermuda grass (*Cynodon dactylon*). Renovation of House Pond on private land near Black Draw extirpated the *Lilaeopsis* population there. A population in the Rio San Bernardino in Sonora was also recently extirpated (Gori *et al.* 1990). One *Lilaeopsis* population occurs in the Rio Sonora watershed at Ojo de Agua, a cienega in Sonora at the headwaters of the river (Saucedo-Monarque 1990).

Introduction on *Lilaeopsis* into ponds on the San Bernardino NWR appears to be successful (Warren 1991). In 1991, *Lilaeopsis* was transplanted from Black Draw into new ponds and other refuge wetlands. Transplants placed in areas of low plant density expanded rapidly (Warren 1991). In 1992, *Lilaeopsis* naturally colonized a pond created in 1991. However, as plant competition increased around the perimeter of the pond, the Huachuca water umbel population decreased. This response seems to confirm observations (Kevin Cobble, San Bernardino NWR;

Peter Warren, Arizona Nature Conservancy, unpubl. data, 1993) that other species such as *Typha* will outcompete *Lilaeopsis*.

Effects of the Action

The proposed action will affect the listed fish and their habitat in several ways. The initial drawdown of water levels in the ponds will reduce available habitat, potentially strand smaller fish, and may increase negative interspecific and intraspecific interaction between the species. Removing fish from the ponds is considered harassment and therefore, take, and a few fish may die from handling stress. The treatment may also cause injury or death to a few individuals. Lastly, the placement of fish in the constructed aquatic habitats may lead to injury or death of a few individuals.

Critical habitat will remain roughly equal. The water surface area of the ponds is more than the constructed stream system. The proportion of usable habitat will probably be greater in the stream system however. The constructed stream will contain more of the constituent elements of critical habitat.

The *Lilaeopsis* populations at Mesquite, Oasis, and Evil Twin Ponds will probably be lost when the ponds are drained and limed. However, the populations will be replaced and possibly expanded at the new habitats. In addition, there will be a net increase in shoreline and potential *Lilaeopsis* habitat around constructed stream systems.

Cumulative Effects of the Proposed Action

Cumulative effects are those effects of future non-Federal (State, local government, or private) activities on endangered or threatened species or critical habitat that are reasonably certain to occur during the course of the Federal activity subject to consultation. Future Federal actions are subject to the consultation requirements established in Section 7 and, therefore, are not considered cumulative in the proposed action.

The cumulative effects that may impact listed species on the San Bernardino National Wildlife Refuge are difficult to assess. Effects that are reasonably certain to occur are associated with the expected population growth of the Douglas, Arizona and Agua Prieta, Sonora region. Associated effects may include pollution, increased visitation to the refuge, and increased resource use and degradation. Decreases in the flows of the artesian wells on San Bernardino NWR have already been documented in response to groundwater pumping in Mexico (USFWS 1995). The passage of the North American Free Trade Agreement may prove to be an additional impetus for growth in the region.

CONCLUSION

After reviewing the current status of the Yaqui topminnow, Yaqui chub, beautiful shiner, and Huachuca water umbel, the environmental baseline for the action area, the effects of the proposed action and the cumulative effects, it is the Service's biological opinion that the proposed action, as submitted, is not likely to jeopardize the continued existence of these species, and is not likely to destroy or adversely modify designated critical habitat of the Yaqui chub and beautiful shiner.

INCIDENTAL TAKE

Sections 4(d) and 9 of ESA, as amended, prohibit taking (harass, harm, pursue, hunt, shoot, wound, kill, trap, capture or collect, or attempt to engage in any such conduct) of listed species of fish or wildlife without a special exemption. Harm is further defined to include significant habitat modification or degradation that results in death or injury to listed species by significantly impairing behavioral patterns such as breeding, feeding, or sheltering. Harass is defined as actions that create the likelihood of injury to listed species to such an extent as to significantly disrupt normal behavior patterns which include, but are not limited to, breeding, feeding or sheltering. Incidental take is any take of listed animal species that results from, but is not the purpose of, carrying out an otherwise lawful activity conducted by the Federal agency or the applicant. Under the terms of section 7(b)(4) and section 7(o)(2), taking that is incidental to and not intended as part of the agency action is not considered a prohibited taking provided that such taking is in compliance with the terms and conditions of this incidental take statement.

Sections 7(b)(4) and 7(o)(2) of ESA do not apply to the incidental take of listed plant species. However, protection of listed plants is provided to the extent that ESA requires a Federal permit for removal or reduction to possession of endangered plants from areas under Federal

jurisdiction, or for any act that would remove, cut, dig up, or damage or destroy any such species on any other area in knowing violation of any regulation of any State or in the course of any violation of a State criminal trespass law.

The measures described below are non-discretionary, and must be implemented by the agency so that they become binding conditions of any grant or permit issued to the applicant, as appropriate, in order for the exemption in section 7(o)(2) to apply. The Fish and Wildlife Service has a continuing duty to regulate the activity covered by this incidental take statement.

AMOUNT OR EXTENT OF TAKE

The Service anticipates incidental take of Yaqui chub, Yaqui topminnow, and beautiful shiner will be difficult to detect for the following reasons: dead fish are difficult to find, cause of death may be difficult to determine, losses may be masked by seasonal fluctuations in numbers or other causes. All fish will undergo some form of take, either through death or harassment.

Fish trapped in vegetation, debris, or mud will die when water is removed from the ponds. It is impossible to determine how many individuals will undergo this form of take. All fish removed from the ponds will undergo take through harassment. In addition, some fish may die during handling. We estimate that not more than 50 individual Yaqui chub, 50 beautiful shiner, and 100 Yaqui topminnow in each pond (where they occur) may die during handling.

The Droncit treatment and being placed in tanks may lead to additional deaths. Take will be exceeded if greater than 25% of the Yaqui chub and beautiful shiner die during the treatment step. Yaqui topminnow will not be treated with Droncit, but will be held in the tanks as breeding stock. They will remain in the tanks until they die naturally.

The last action that may result in take is the handling associated with placing the treated Yaqui chub and beautiful shiner and captive bred Yaqui topminnow into the new habitats. We estimate that not more than 50 individual Yaqui chub, 50 beautiful shiner, and 100 Yaqui topminnow from each pond (where they occur) may die in this manner.

REASONABLE AND PRUDENT MEASURES

The Service believes the following reasonable and prudent measures are necessary and appropriate to minimize the take of the above three species.

1. Conduct the proposed action in a manner which will minimize mortality of the Yaqui topminnow, beautiful shiner, and Yaqui chub.
2. Conduct the proposed action in a manner which will minimize destruction or modification of habitat for Yaqui topminnow, Yaqui chub, and beautiful shiner.
3. Maintain complete and accurate records of listed fish species populations and status and water quality of constructed habitats.

Terms and Conditions for Implementation

In order to be exempt from the prohibitions of Section 9 of the Act, the San Bernardino NWR is responsible for compliance with the following terms and conditions, which implement the reasonable and prudent measures described above. These terms and conditions are nondiscretionary.

1. The Refuge shall implement the proposed action as written with the following terms and conditions as additions or exceptions.
2. The Refuge shall get concurrence from the Arizona Ecological Services Office to ensure that the project specifics of Phase II and III are consistent with Phase I and this opinion.
3. All movement and handling of fish shall occur during the cooler part of the day to minimize handling stress.
4. The temporary holding tanks shall be placed in an area where they are not subject to environmental extremes.
5. The temporary holding tanks will receive antibacterial treatments, supplemental salt and oxygen, and be checked at least three times per day as long as fish are in them.
6. When possible, the temporary holding tanks shall be filled with water from the same well source as where the fishes came from.
7. Monitor the new habitats weekly for six months after filling to observe their success.
8. Check for Asian tapeworm in fish in the new habitats monthly the first six months, and then annually thereafter.

9. Fence the new habitats before filling with water. This should minimize colonization and subsequent predation by bullfrogs.
10. Monitor water quality weekly for six months, and monthly thereafter to ensure that water quality is not limiting the success of the project.
11. Maintain records of numbers of fish removed, treated, and placed in the new habitats.

CONSERVATION RECOMMENDATIONS

Section 7(a)(1) of ESA directs Federal agencies to utilize their authorities to further the purposes of ESA by carrying out conservation programs for the benefit of endangered and threatened species. Conservation recommendations are discretionary agency activities to minimize or avoid adverse effects of a proposed action on listed species or critical habitat, to help implement recovery plans, or to develop information.

1. Take plugs of *Lilaeopsis* that may be destroyed and use for replanting.
2. Plant *Lilaeopsis* as soon as possible in the new habitats before other plants dominate.
3. Monitor success of *Lilaeopsis* plantings.
4. Reintroduce Mexican garter snakes (*Thamnophis equues*) and Chiricahua leopard frogs when the new habitats are suitable.
5. Check bullfrogs for Asian tapeworm.

In order for the Service to be kept informed of actions minimizing or avoiding adverse effects or benefitting listed species or their habitats, the Service requests notification of the implementation of any conservation recommendations.

REINITIATION - CLOSING STATEMENT

This concludes formal consultation on the action outlined in the request. As provided in 50 CFR §402.16, reinitiation of formal consultation is required where discretionary Federal agency involvement or control over the action has been maintained (or is authorized by law) and if: (1) the amount or extent of incidental take is exceeded; (2) new information reveals effects of the

agency action that may affect listed species or critical habitat in a manner or to an extent not considered in this opinion; (3) the agency action is subsequently modified in a manner that causes an effect to the listed species or critical habitat that was not considered in this opinion; or (4) a new species is listed or critical habitat designated that may be affected by the action. In instances where the amount or extent of incidental take is exceeded, any operations causing such take must cease pending reinitiation.

This concludes formal consultation on the actions outlined in the November 4, 1996, request for formal consultation on the San Bernardino Canyon National Wildlife Refuge, Cochise County, Arizona. If we can be of further assistance, please contact Doug Duncan or Angie Brooks at 602/640-2720.

Nancy Kaufman
Regional Director

cc: Director, Arizona Game and Fish Department
Director, Fish and Wildlife Service, Washington, D.C. (HC)

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SUMMARY
BIOLOGICAL OPINION ON ASIAN TAPEWORM ERADICATION
ON THE SAN BERNARDINO NATIONAL WILDLIFE REFUGE

Date of the opinion/report: May 29, 1997

Action agency: US Fish Wildlife Service, San Bernardino National Wildlife Refuge

Project: Biological Opinion for the San Bernardino National Wildlife Refuge
Asian Tapeworm Eradication

Listed species and critical habitats: Yaqui chub (*Gila purpurea*) and beautiful shiner (*Cyprinella formosa*) with designated critical habitat; Yaqui topminnow (*Poeciliopsis occidentalis sonoriensis*), Huachuca water umbel (*Lilaeopsis schaffneriana* ssp. *recurva*)

Biological opinion: Proposed action is not likely to jeopardize the continued existence of the fish species, is not likely to destroy or adversely modify designated critical habitat of the Yaqui chub and beautiful shiner (Page 19), and is not likely to adversely affect the Chiricahua leopard frog (*Rana chiricahuensis*).

Incidental take statement:

Level of take anticipated: The Service anticipates incidental take of the fish will be difficult to detect for the following reasons: dead fish are difficult to find, cause of death may be difficult to determine, losses may be masked by seasonal fluctuations in numbers or other causes. All fish will undergo some form of take, mostly through harassment and capture, but some will be killed.

Reasonable and prudent measures and terms and conditions: Reasonable and prudent measures: 1) conduct the proposed action in a manner which will minimize mortality of the Yaqui topminnow, beautiful shiner, and Yaqui chub; 2) conduct the proposed action in a manner which will minimize destruction or modification of habitat for Yaqui topminnow, Yaqui chub, and beautiful shiner; 3) maintain complete and accurate records of listed fish species populations and status and water quality of constructed habitats.

Conservation recommendations: In order for the Service to be kept informed of actions minimizing or avoiding adverse effects or benefitting listed species or their habitats, the Service requests notification of the implementation of any conservation recommendations.

