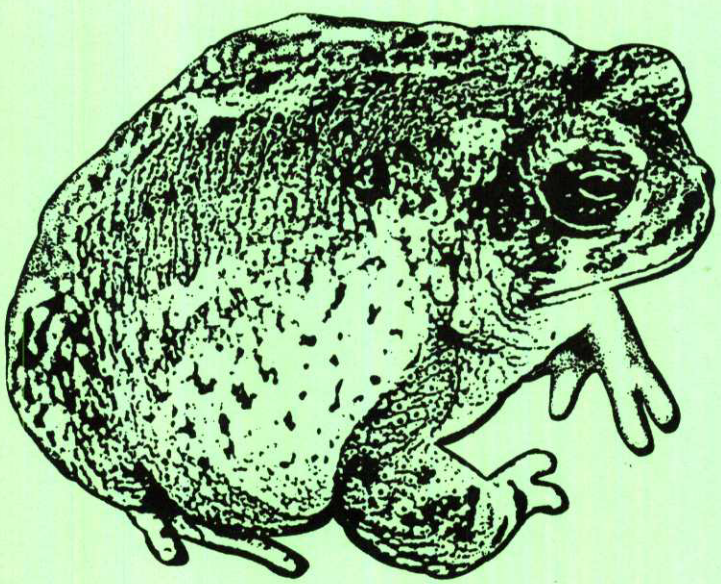
U.S. Fish & Wildlife Service

Recovery Plan for the Arroyo Southwestern Toad



ARROYO SOUTHWESTERN TOAD

(*Bufo microscaphus californicus*)

RECOVERY PLAN

Region 1
U.S. Fish and Wildlife Service

Approved: _____
Manager, California/Nevada Operations Office
U.S. Fish and Wildlife Service Region 1

Date: 7/24/99

As the Nation's principal conservation agency, the Department of the Interior has responsibility for most of our nationally owned public lands and natural resources. This includes fostering the wisest use of our land and water resources, protecting our fish and wildlife, preserving the environmental and cultural values of our national parks and historical places, and providing for the enjoyment of life through outdoor recreation. The Department assesses our energy and mineral resources and works to assure that their development is in the best interests of all our people. The Department also has a major responsibility for American Indian reservation communities and for people who live in island Territories under U.S. administration.

DISCLAIMER

Recovery plans delineate reasonable actions that are believed to be required to recover and protect listed species. Plans are published by the U.S. Fish and Wildlife Service, and sometimes are prepared with the assistance of recovery teams, contractors, State agencies, and others. Objectives will be attained and any necessary funds made available subject to budgetary and other constraints affecting the parties involved, as well as the need to address other priorities. Recovery plans do not necessarily represent the views nor the official positions or approval of any individuals or agencies involved in the plan formulation, other than the U.S. Fish and Wildlife Service. They represent the official position of the U.S. Fish and Wildlife Service only after they have been signed by the Regional Director or Director as approved. Approved recovery plans are subject to modification as dictated by new findings, changes in species status, and the completion of recovery tasks.

Literature citation of this document should read as follows:

U.S. Fish and Wildlife Service. 1999. Arroyo southwestern toad (*Bufo microscaphus californicus*) recovery plan. U.S. Fish and Wildlife Service, Portland, Oregon. vi + 119 pp.

Additional copies may be purchased from:

Fish and Wildlife Reference Service
5430 Grosvenor Lane, Suite 110
Bethesda, MD 20814-2158

telephone: 301/492-6403 or 800/582-3421
fax: 301/564-4059
e-mail: fwrs@fws.gov

Fees for plans vary depending on the number of pages.

ACKNOWLEDGMENTS

This recovery plan was prepared by Mark R. Jennings, Biological Resources Division, U.S. Geological Survey, and Grace S. McLaughlin, U.S. Fish and Wildlife Service, Ventura Fish and Wildlife Office. Mark Jennings prepared the maps. Arthur Davenport, U.S. Fish and Wildlife Service, Carlsbad Fish and Wildlife Office, assisted with the development of the draft plan; he and other Carlsbad staff members provided input for the draft and final plans. Several Ventura staff members provided comments; Kate Symonds in particular provided considerable input and assistance. We appreciate the input and comments we received from Peter H. Bloom, Peter Famolaro, Robert N. Fisher, Erik W. A. Gergus, William E. Haas, Dan C. Holland, Brian Leatherman, Ruben Ramirez, Norman Scott, Shawn Smallwood, and Samuel S. Sweet; the Angeles, Cleveland, Los Padres, and San Bernardino National Forests; Marine Corps Base Camp Pendleton, Department of the Army Ft. Hunter Liggett; the California Department of Fish and Game; the Helix and Montecito Water Districts and the Sweetwater Authority; and the Transportation Corridor Agencies.

EXECUTIVE SUMMARY

Current Status: The arroyo southwestern toad (*Bufo microscaphus californicus*) is listed as endangered. In California, it is known from 22 river basins in the coastal and desert areas of 9 counties along the central and southern coast. The range extends into northwestern Baja California, Mexico.

Habitat Requirements and Limiting Factors: The arroyo southwestern toad (arroyo toad) is endemic to primarily the coastal plain and mountains of central and southern California and northwestern Baja California. These toads breed in stream channels and use stream terraces and surrounding uplands for foraging and wintering. Direct habitat loss due to urbanization, agriculture, and dam construction is the main cause for the decline of arroyo toads. Other threats include water management activities and diversions; road construction, maintenance, and use; livestock grazing; mining; recreational activities; loss of habitat due to exotic plants; and predation by introduced species. Although the species evolved and has survived in an environment periodically impacted by fire, flood, and drought, the interactions of natural events with human alterations of the habitat may lead to the extirpation of local populations or metapopulations[1].

Recovery Priority: 9 on a scale of 1 to 18. The priority is based on its being a subspecies (rather than a full species) with a moderate degree of threat and high recovery potential. If the arroyo toad is made a full species, its priority rises to 8.

Recovery Objectives: Downlist to threatened status, then delist.

Recovery Criteria:

Downlisting to threatened status: The arroyo toad will be considered for reclassification from endangered to threatened status when management plans have been approved and implemented on federally managed lands to provide for conserving, maintaining, and restoring the riparian and upland habitats used by

---

[1] Metapopulation: a population of subpopulations in somewhat geographically isolated patches, interconnected through patterns of gene flow, extinction, and recolonization (see page 13).

arroyo toads for breeding, foraging, and wintering habitat. In addition, these measures must maintain at least 20 self-sustaining metapopulations or subpopulations of arroyo toads at the following locations (minimum number of populations for each agency and targeted river basins is indicated in parentheses): Fort Hunter Liggett Army Reserve Training Center (1: San Antonio River basin); Marine Corps Base Camp Joseph H. Pendleton (2: San Mateo/San Onofre Creek basins, Santa Margarita River basin); Los Padres National Forest (4: Sisquoc River basin, Upper Santa Ynez River basin [including Indian and Mono Creeks], Sespe Creek basin, Piru Creek basin); Angeles National Forest (3: Castaic Creek basin, Los Angeles River basin [including Big Tujunga and Alder Creeks], Little Rock Creek basin); San Bernardino National Forest (1: Mojave River basin [including West Fork of the Mojave River, Little Horsethief Canyon, and Deep Creek]); Cleveland National Forest (8: San Juan Creek basin, San Mateo Creek basin, Upper Santa Margarita River basin, San Luis Rey River basin, San Dieguito River basin, San Diego River basin, Sweetwater River basin, Tijuana River basin); and the Jacumba (In-Ko-Pah Mountains) Wilderness Study Area (1: Pinto Wash basin) managed by the Bureau of Land Management. Self-sustaining populations or metapopulations are those documented as having successful recruitment (i.e., inclusion of newly matured individuals into the breeding population) equal to 20 percent or more of the average number of breeding adults in 7 of 10 years of average to above average rainfall amounts with normal rainfall patterns. Self-sustaining populations or metapopulations require little or no direct human assistance such as captive breeding or rearing, or translocation of toads between sites.

Delisting: The arroyo toad will be considered for delisting when the genetic and phenotypic variation of the arroyo toad, throughout its range in California, is secured by maintaining 15 additional self-sustaining subpopulations or metapopulations of arroyo toads on coastal plain, coastal slope, desert slope, and desert lands, including known subpopulations and metapopulations outside of Federal jurisdiction in the Mojave River basin (San Bernardino County); the Whitewater River basin (Riverside County); the San Juan Creek basin (Orange and Riverside Counties); Santa Margarita River basin (San Diego and Riverside Counties); and the San Luis Rey River, San Dieguito River/Santa Ysabel Creek, San Diego River, Sweetwater River, Otay River/Dulzura Creek, and Tijuana River

basins (in San Diego County).

Actions Needed:

1) Stabilize and maintain populations throughout the range of the arroyo toad in California by protecting sufficient breeding and nonbreeding habitat.
2) Monitor the status of existing populations to ensure recovery actions are successful.
3) Identify and secure additional suitable arroyo toad habitat and populations.
4) Conduct research to obtain data to guide management efforts and determine the best methods for reducing threats.
5) Develop and implement an outreach program.

Costs (minimum):

Year	Year's cost
1999	$992,000
2000	469,000
2001	369,000
2002	205,000
2003	195,000
2004	155,000
2005	155,000
2006	155,000
2007	155,000
2008	155,000
2009	155,000
2010	155,000

Total Estimated Cost of Recovery (minimum): $3,315,000

Date of Recovery: Delisting could be initiated in 2010, if recovery criteria are met.

TABLE OF CONTENTS

I. INTRODUCTION

Brief Overview

On December 16, 1994, the U.S. Fish and Wildlife Service (Service) determined the arroyo southwestern toad (*Bufo microscaphus californicus*) to be an endangered species (Service 1994).

The arroyo southwestern toad (arroyo toad) was scientifically described from individual specimens collected at Santa Paula, Ventura County on May 22, 1912, and Big Tujunga Wash near Sunland, Los Angeles County on April 1, 1904 (Camp 1915). Over the next 70 years, collections and observations by zoologists found the arroyo toad in coast and desert drainages from southern California south into northwestern Baja California, Mexico (Stebbins 1951, 1985; Figure 1). Because relatively little was known about this animal and it was often confused with the California toad (*Bufo boreas halophilus*), which is very common in the same region, detailed studies of the natural history of the arroyo toad were not conducted until the 1980's (Sweet 1992). These studies revealed that the northern populations (from Monterey County to the Santa Clara River basin, Los Angeles County) exhibit habitat specialization that favors the shallow pools and open sand and gravel flood terraces of medium- to large-sized intermittent or perennial streams that are flooded on a fairly regular basis. However, additional studies and observations in the central portion of the range (Los Angeles County south of the Santa Clara River basin through San Diego County) have shown that arroyo toads also breed in smaller streams (lower order streams, as explained in figure 9, page 33), deep canyons (where breeding sites may be patchily distributed), and utilize upland habitats as juveniles, subadults, and adults (Dan C. Holland, Ph.D., Principal Investigator, Camp Pendleton Amphibian and Reptile Survey, California; *in litt.* 1997; Robert N. Fisher, Ph.D., University of California at San Diego, pers. comm. 1997). These differences in ecology may be due to the differences in landscapes and available habitat over the range of the arroyo toad.

The arroyo toad has evolved in a system that is inherently quite dynamic, with marked seasonal and annual fluctuations in climatic regimes, particularly rainfall. Natural climatic variations as well as other random events such as fires and

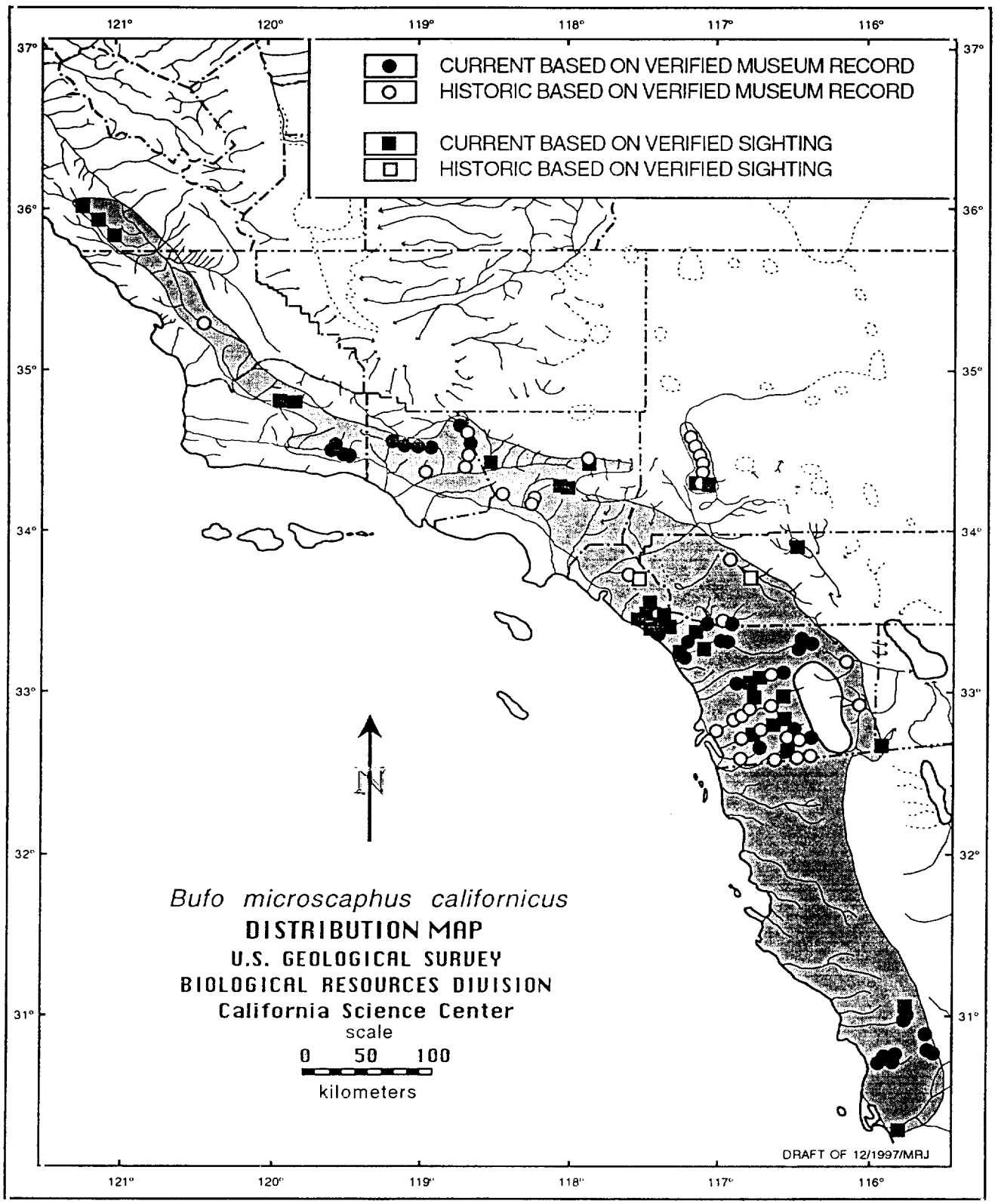


Figure 1. Historic and current distribution of the arroyo toad in southern California and northern Baja California based on 173 locations from 1,196 museum records and 37 records from other sources (modified from Sweet 1992 and Jennings and Hayes 1994).

earthquakes, coupled with the species' specialized habitat requirements, are likely to lead to annual fluctuations in arroyo toad populations. Human alterations of habitat also can have unpredictable effects on arroyo toad populations. These natural and human-related effects must be considered when determining recovery strategies, criteria, and actions.

Because arroyo toad habitats are favored sites for water storage reservoirs, flood control structures, roads, agriculture, urbanization, and recreational facilities such as campgrounds and off-highway vehicle parks, many arroyo toad populations were reduced in size or extirpated (eliminated) due to extensive habitat loss from 1920 to 1980. The loss of habitat, coupled with habitat modifications due to the manipulation of water levels in many central and southern California streams and rivers, as well as predation from introduced aquatic species, caused arroyo toads to disappear from about 75 percent of the previously occupied habitat in California (Jennings and Hayes 1994). These threats, coupled with the limited natural occurrence of the arroyo toad (thought to be only 22 populations in California in 1994) (59 FR 241: 64859 – 64866) and small populations that are susceptible to severe reduction in numbers due to collection and due to naturally occurring random events (such as extended droughts), resulted in the Service first including this animal as a Category 2 candidate species on September 18, 1985 (50 FR 181: 37958 – 37967). It was later included under the same category in subsequent Service publications of January 6, 1989 (54 FR 4: 554 – 579), and November 21, 1991 (56 FR 225: 58804 – 58836). The Service was petitioned to list the arroyo toad under the Endangered Species Act of 1973, as amended (Act), on December 30, 1992, and a proposed rule was published on August 3, 1993 (58 FR 147: 41231 – 41237). The arroyo toad subsequently was listed as endangered on December 16, 1994 (59 FR 241: 64859 – 64866).

The arroyo toad recovery priority number is 9. Priority numbers are assigned on the basis of taxonomy, the degree and imminency of threat, and actual or potential conflict with other issues, such as development. Priority number 1C is the highest priority number and 18 the lowest (Service 1983). The arroyo toad is a subspecies with a moderate degree of imminent threat and a high probability of recovery. If a recent proposal to make the arroyo toad a full species is accepted, its recovery priority rises to 8.

Description and Taxonomy

The arroyo toad is a small (adults: snout-urostyle [body] length 55 – 82 millimeters (2.2 – 3.3 inches), dark-spotted toad of the family Bufonidae (Figure 2). Usually, adult males are 55 – 65 millimeters (2.2 – 2.6 inches) snout-urostyle length and adult females are from 65 – 80 millimeters (2.6 – 3.3 inches) snout-urostyle length, although slightly larger individuals of both sexes have been documented (Samuel S. Sweet, Ph.D., University of California at Santa Barbara, *in litt.* 1998). The arroyo toad initially was described by Camp (1915) as a subspecies of the Great Plains toad (*B. cognatus*); however, Myers (1930) found that the arroyo toad differed in several important respects from the Great Plains toad and elevated it to specific status as *B. californicus*, a treatment that was followed by Pickwell (1947) and Wright and Wright (1949). Over the next 20 years, the arroyo toad also was considered a subspecies of *B. compactilis* (Linsdale 1940) and *B. woodhousii* (Shannon 1949). Since 1951, this toad has been considered a subspecies of the southwestern toad, *B. microscaphus californicus* (Stebbins 1951, 1966, 1985), with its closest relatives (*B. m. microscaphus*) found in the lower Colorado River basin (Price and Sullivan 1988). Sweet (1992) and Gergus (1994) indicated that Myers' (1930) recommendation that arroyo toad should be considered a full species is probably warranted. Gergus (1998) further examined the taxonomic status of *B. microscaphus* and concluded, based on allozyme frequencies, that the arroyo toad should be given specific status as *B. californicus*.

Adult arroyo toads have a light-olive green or gray to tan dorsum (back) with dark spots and warty skin (Stebbins 1951, 1985). The venter (underside) is white or buff and without dark blotches or spots (S. S. Sweet, pers. comm. 1997). A light-colored, V-shaped stripe crosses the head and eyelids, and the anterior portion of the oval parotoid glands (just behind the eyes) are pale (Stebbins 1951). There is usually a light area on each side of the sacral (pelvic) hump and in the middle of the back. The arroyo toad generally lacks a middorsal stripe (Stebbins 1951, 1985). However, if a middorsal stripe is present, it is present only on part of the dorsum (Mark R. Jennings unpubl. data; D. C. Holland, *in litt.* 1997).

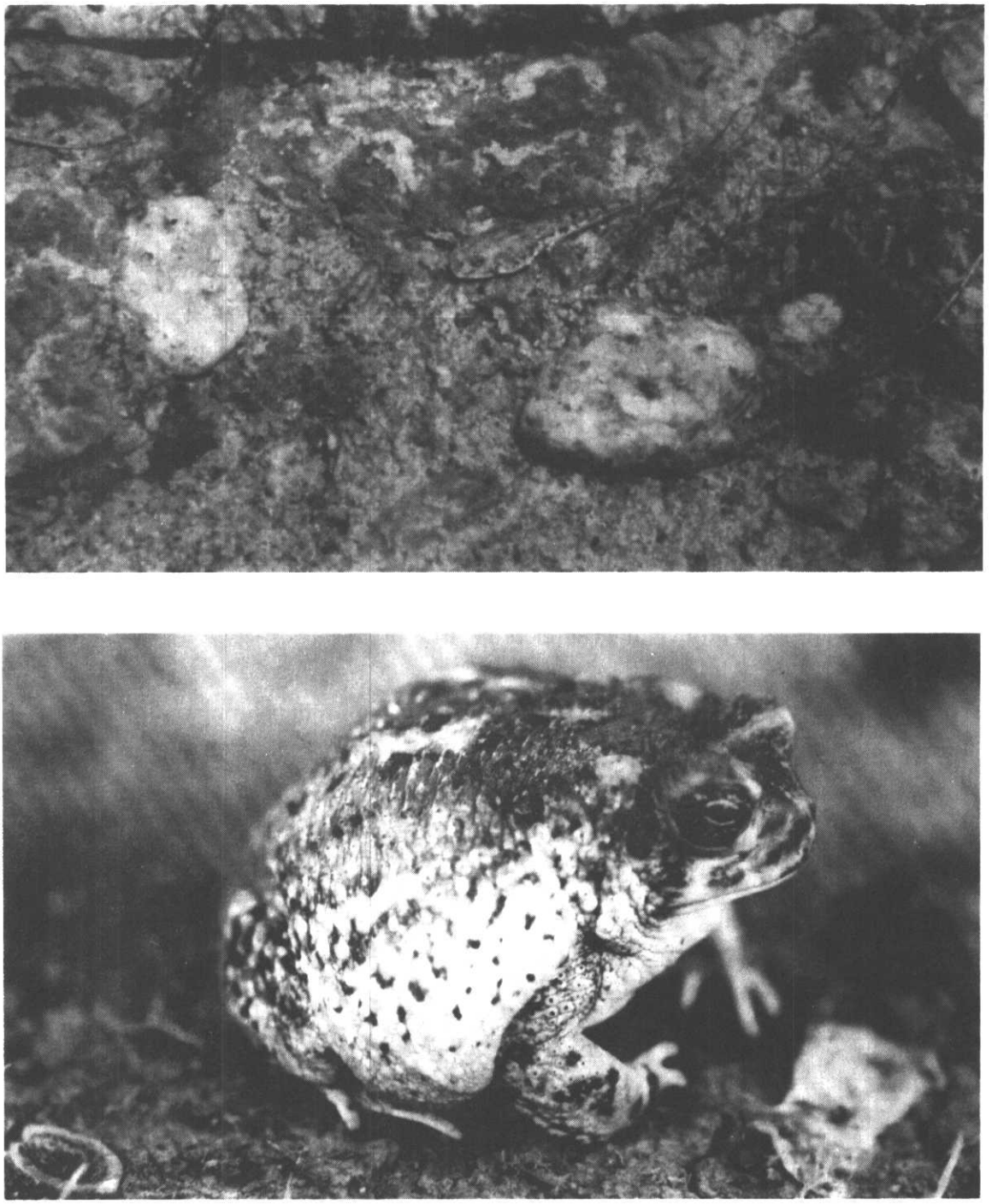


Figure 2. Larval (above) and adult female (below) arroyo toads (*Bufo microscaphus californicus*), approximately life size. Larval photo courtesy of Samuel S. Sweet, University of California, Santa Barbara. Adult photo of specimen CAS 175636 by Mark R. Jennings.

Adult males give an advertisement call during the breeding period, which is generally from late January or February to early July, although it can be extended in some years, depending on weather conditions (Maeton Freel, Los Padres National Forest, pers. comm. 1998; W. E. Haas *et al.*, Varanus Biological Services, *in litt.* 1998). The call is a soft, high, whistled trill, generally lasting from 4 to 10 seconds (Stebbins 1951, Sullivan 1992). To the untrained observer, it is often mistaken for the call of an insect. Adult and subadult males may also emit a release call (which is a series of chirps) when grasped by another male toad or when handled behind the forelimbs by humans. Females do not emit such calls (Sweet 1992).

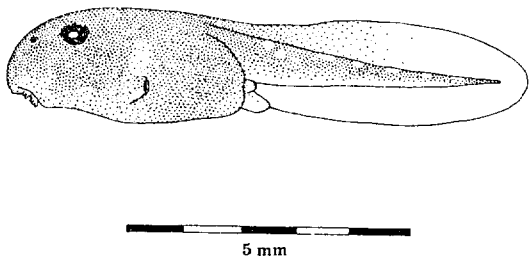
Juvenile arroyo toads have a white-gray-tan dorsum with small dark spots and gray reticulations (Sweet 1992). The venter is white. The large parotoid glands are not evident on young juveniles, but the V-shaped light mark that crosses the eyelids is prominently visible (Sanders 1950).

Larval arroyo toads have considerable variation in color depending on their age. By 2 to 3 weeks after hatching, at 9 – 10 millimeters (0.35 – 0.39 inch), the dark-colored larvae have faint gold crossbars on the upper surface of the base of the tail (Sweet 1992; Figure 3). Within a few days of this, the larvae become uniformly tan dorsally with the exception of some irregular dark crossbars (Stebbins 1951; Figure 3). Ventrally, the larvae are opaque white (Sweet 1992). Larvae usually metamorphose at 28 – 40 millimeters (1.10 – 1.58 inches) in length.

The arroyo toad lays small darkly-pigmented eggs, 1.4 – 2.2 millimeters (0.055 - 0.087 inch) in diameter, in two parallel gelatinous strings, 3.0 – 10.7 meters (10 – 35 feet) long (Sweet 1992; Figure 4). Females lay 2,000 – 10,000 (mean = 4,715) eggs in shallow water (mean = 3.5 centimeters [1.4 inches] deep) (Sweet 1992).

Arroyo toads can be distinguished from sympatric California toads (i.e., toads in the same geographic area) as follows:

1) Adult California toads usually have a middorsal stripe, lack a light-colored V on the head, usually have dark spots on the chest, are larger (60 – 120 millimeters [2.5 – 5 inches] snout-urostyle length), and tend to walk or intersperse hopping



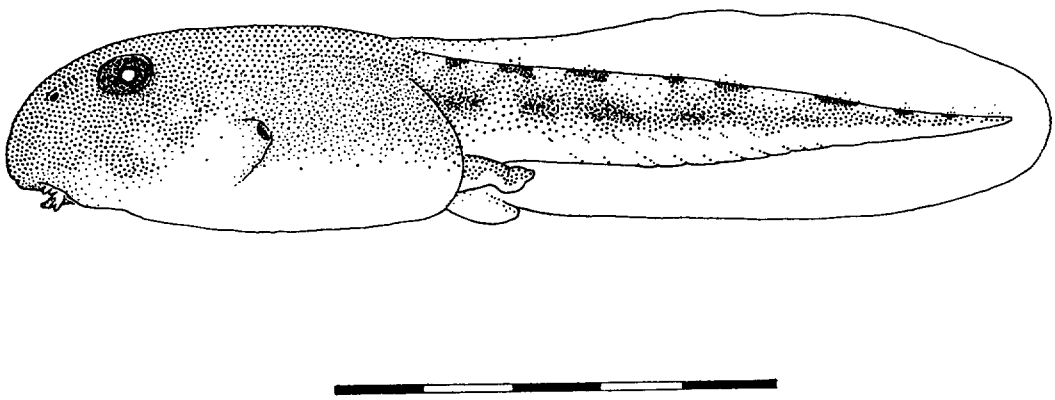


Figure 3. Arroyo toad larvae at 2 to 3 weeks (upper) and 4 weeks (lower) after hatching (from Sweet 1992).

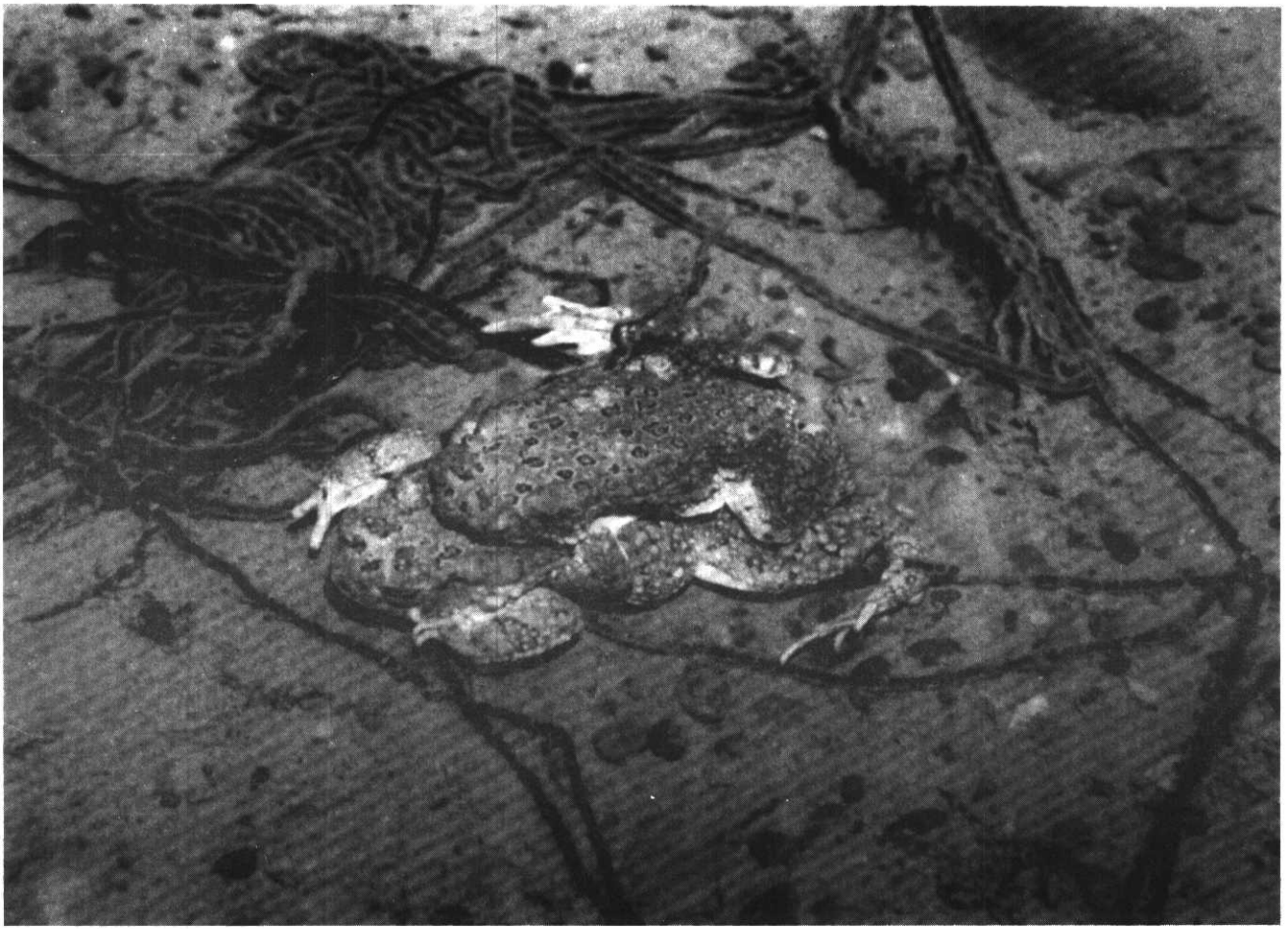


Figure 4. Egg clutches and adult arroyo toads in amplexus (from Sweet 1992). The older egg clutch (gray in color) was 7.3 meters (24 feet) long. The clutch being laid (black) was 6.4 meters (21 feet) long when complete.

with walking. Adult arroyo toads normally lack a middorsal stripe, are smaller, lack spotting on the chest, and usually hop rather than walk (Stebbins 1985, Sweet 1992).

2) The breeding call of sympatric populations of the California toad is a very soft, high-pitched, plinking or "chup" sound. The breeding call of the arroyo toad is a long, musical trill (Davidson 1995).

3) Juvenile California toads usually have large dark spots on the dorsum, have spots on the chest and lack a V-shaped stripe between the eyes. Juvenile arroyo toads have small spots on the dorsum, lack spots on the chest, and have a V-shaped stripe between the eyes (Sweet 1992).

4) Larval California toads are dark gray to jet black on the sides and back and pale cream or tan underneath, tend to aggregate (often around submerged vegetation), and are almost constantly in motion. Larval arroyo toads are usually tan with dark crossbars on the tail and opaque white underneath, tend to be solitary, and move in short bursts (Sweet 1992). They are also more blunt-nosed and have more dorso-ventrally flattened bodies (Figure 5).

5) Embryos and envelopes of California toads tend to average larger sizes (embryos 1.7 – 2.4 millimeters [0.067 – 0.095 inch]; envelopes 3.8 – 6.7 millimeters [0.15 – 0.26 inch]), more eggs (mean = 8,285), and longer clutch lengths (4.6 – 17.1 meters [15 – 56 feet], Sweet 1992, Figure 6). California toad eggs are laid in both shallow and deeper water, and usually are tangled around vegetation. Embryos and envelopes of egg clutches of arroyo toads tend to average smaller sizes (embryos 1.4 – 2.2 millimeters [0.055 – 0.087 inch]; envelopes 2.8 – 4.7 millimeters [0.11 – 0.18 inch]), fewer eggs (mean = 4,715), and shorter clutch lengths (3.0 – 10.7 meters [10 – 35 feet]). They are laid in shallower water, and usually are deposited in the open.

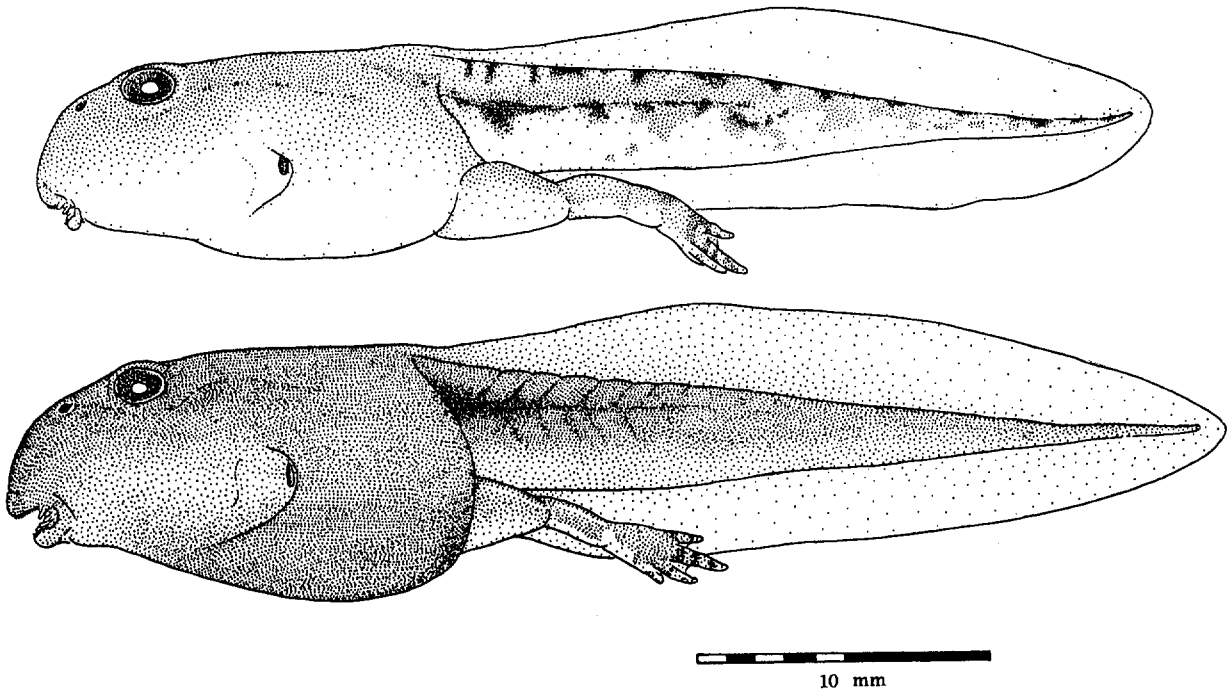


Figure 5. Larvae of the arroyo toad (upper) and California toad (lower) at 8 weeks of age (from Sweet 1992).

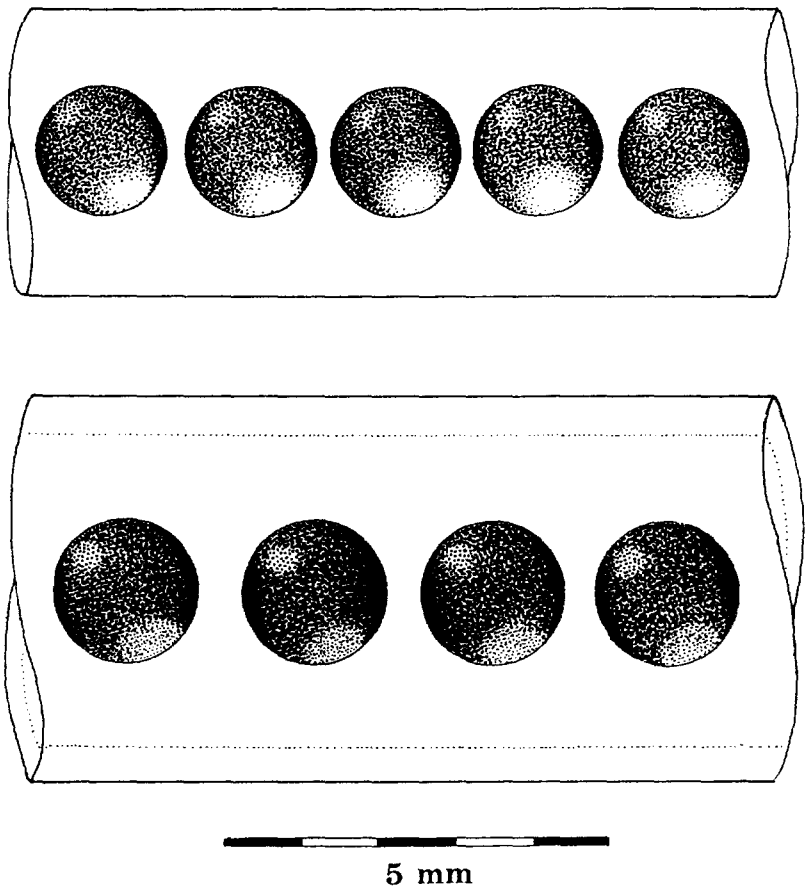


Figure 6. Embryos and envelopes of the arroyo toad (upper) and California toad (lower) (from Sweet 1992).

Distribution and Population Status

The historical range of the arroyo toad extended from the upper Salinas River system on Fort Hunter Liggett Military Reservation, Monterey County (U.S. Army Reserve Command 1996), south through the Santa Ynez, Santa Clara, and Los Angeles River basins (Myers 1930, Sanders 1950, Stebbins 1951, Sweet 1992) and the coastal drainages of Orange, Riverside, and San Diego Counties to the Arroyo San Simeon system, about 16 kilometers (10 miles) southeast of San Quintin, Baja California (Tevis 1944, Gergus *et al.* 1997; Figure 1). Apparent gaps in distribution, such as those in San Luis Obispo County, California, and northwestern Baja California may be due to misidentification of specimens or to inadequate surveys.

Although the arroyo toad occurs principally along coastal drainages, it also has been recorded at several locations on the desert slopes of the Transverse and Peninsular Mountain ranges south of the Santa Clara River, Los Angeles County (Patten and Myers 1992, Jennings and Hayes 1994).

The elevational range for the arroyo toad extends from near sea level to about 2,440 meters (8,000 feet) in Baja California (Welsh 1988; Beaman *et al.* 1995). Currently, most arroyo toad populations in the northern and central parts of the range are restricted to elevations of 300 to 1,400 meters (1,000 to 4,600 feet), perhaps due to widespread habitat loss at lower elevations. The upper elevational limits may be due to an inability to withstand cooler temperature regimes, especially during the larval stage (Sweet 1992). Differences in elevational limits in different parts of the species' range may be due to climate and also to geological features or other habitat characteristics.

Since the early part of the century, arroyo toads have been found in at least 22 river basins in California. The following discussion of the status of arroyo toads in each of these systems is covered from north to south by river basin. Population numbers and densities are not included because insufficient data are available on the species' normal population dynamics and on habitat characteristics that correlate with density. For example, densities can range from fewer than 25 to over 200 adults over different 3 to 3.5-kilometer (about 2-mile) stretches of the

same stream (Peter H. Bloom, Western Foundation of Vertebrate Zoology, Camarillo, CA; *in litt.* 1998). As data on population densities and dynamics become available from surveys, monitoring efforts, and research projects, they will be incorporated into amendments or revisions to this recovery plan.

Although arroyo toads may be found along relatively long stretches of some creeks and rivers, suitable breeding or upland habitat may not occur throughout the entire distance. The proportion of suitable habitat may change during the year and from year to year depending on climatic conditions, fires, or other natural or human-related events. Because of this, it is difficult to estimate the exact distribution of arroyo toads or the extent of suitable habitat in any particular system at a given time. As described in the section "Reasons for Decline and Current Threats," some events or activities clearly have resulted in permanent losses of habitat, while others have caused degradation or temporary habitat losses. The latter may be reversed by appropriate recovery actions.

The distribution of arroyo toads fits the definition of metapopulations in some parts of the range, but not in others. This suggests that the application of metapopulation theory to the conservation of arroyo toads will not be appropriate in all situations. A metapopulation is defined as a population of subpopulations in somewhat geographically isolated patches, interconnected through patterns of gene flow, extinction, and recolonization (Soulé 1987). While toads in the San Antonio River, Monterey County (see below), are so far distant (160 kilometers [100 miles]) from any other known arroyo toads that they effectively constitute a separate population, the same may not be true of toads in several river basins, particularly in Orange and San Diego Counties. In some areas, what were once subpopulations of larger metapopulations of arroyo toads are now effectively isolated from each other by dams and reservoirs, urbanization, or other human-caused changes. Some changes may be reversible, allowing currently isolated populations to once again become part of greater metapopulations. In other cases, the changes have been so extensive that reconnection is not an option.

In the following discussion, museum specimens are referenced. The museums are abbreviated following Leviton *et al.* (1985):

CAS	California Academy of Science, San Francisco
LACM	Los Angeles County Natural History Museum, Los Angeles, California
AMNH	American Museum of Natural History, New York, NY
UCSB	University of California, Santa Barbara
SDSNH	San Diego Natural History Museum, San Diego, California
CSPUP	California State Polytechnic University, Pomona
UMMZ	Museum of Zoology, University of Michigan, Ann Arbor
MVZ	Museum of Vertebrate Zoology, University of California, Berkeley

1) Salinas River Basin, Monterey and San Luis Obispo Counties:
Arroyo toads originally were found in the upper Salinas River basin near Santa Margarita, San Luis Obispo County, on June 12, 1936 (Miller and Miller 1936; Figure 7). Surveys of the area during the 1980's and 1990's located no arroyo toads (S. S. Sweet, pers. comm. 1997). The available arroyo toad habitat probably was affected adversely by the construction of Santa Margarita Dam, approximately 16 kilometers (10 miles) upstream from the collection site.

Arroyo toads were found in 1996 on the Fort Hunter Liggett Military Reservation along approximately 8 kilometers (5 miles) of the San Antonio River in southern Monterey County (U.S. Army Reserve Command 1996; Figure 7). This location, although upstream from Lake San Antonio, is about 64 kilometers (40 miles) downstream in the Salinas River basin from the historic Santa Margarita site. The site is approximately 160 kilometers (100 miles) north of the nearest documented extant population on the Sisquoc River. The size of the adult population along the San Antonio River is currently unknown, but arroyo toads were detected along approximately 27 kilometers (17 miles) of the river in 1997 (Heinz Hormann, U.S. Army Reserve Command, *in litt.* 1997). The elimination of grazing along the river in 1991 may have been a factor in the expansion of the population. The arroyo toads at this location currently are affected by introduced aquatic predators (such as green sunfish [*Lepomis cyanellus*] and bullfrogs [*Rana catesbeiana*]) and by military activities in the riparian zone. Management actions to protect arroyo toad habitats are being implemented.

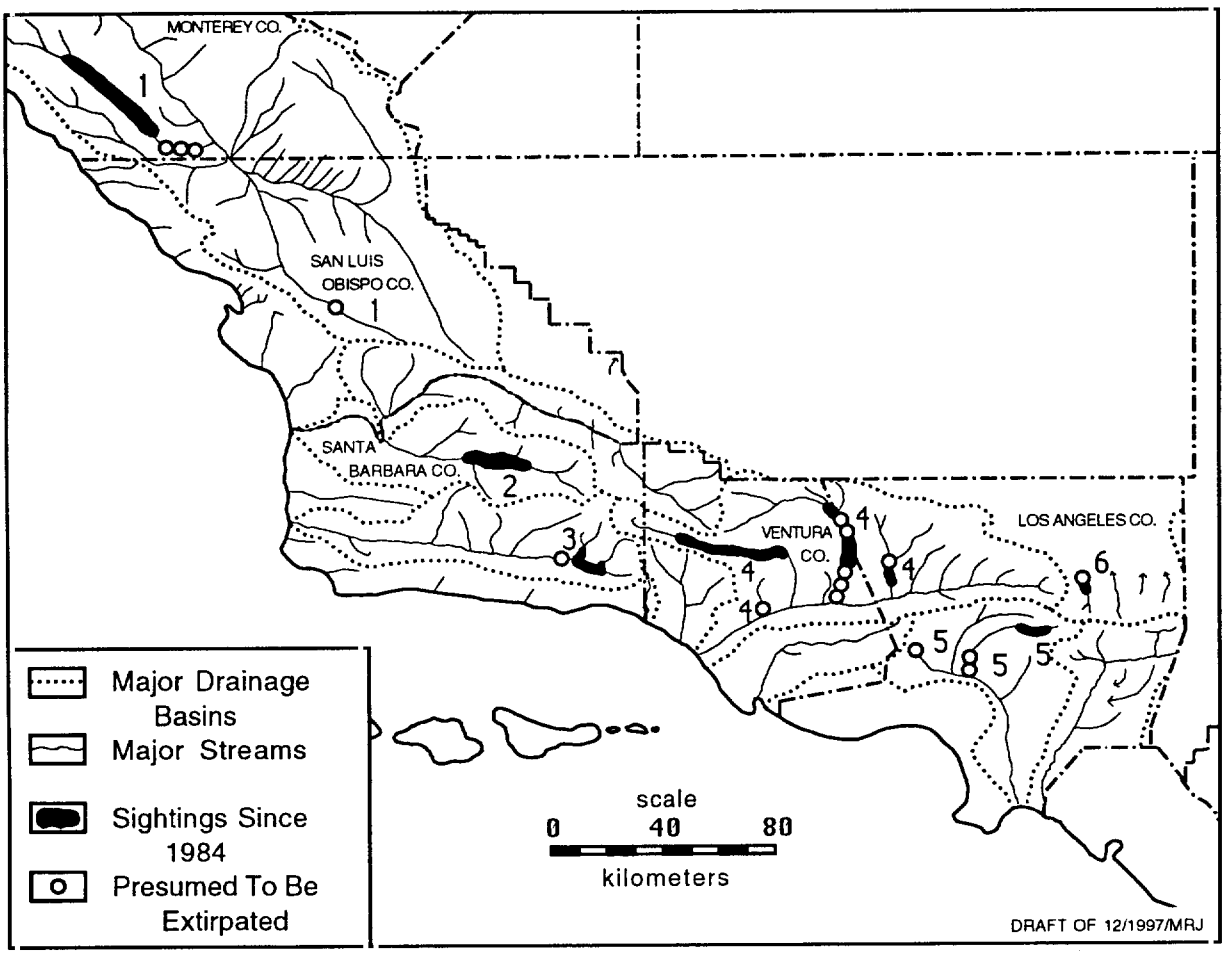


Figure 7. Historic and current distribution of the arroyo toad in Monterey, San Luis Obispo, Santa Barbara, Ventura, and Los Angeles Counties (modified from Campbell *et al.* 1996). Numbers correspond to river basins discussed in the text.

2) Sisquoc River, Santa Maria River Basin, Santa Barbara County:
Arroyo toads have been reported from the Sisquoc River, Los Padres National Forest, since June of 1991 (Campbell *et al.* 1996; Figure 7). The area of suitable habitat for the arroyo toad extends from the vicinity of the junction with Manzana Creek upstream to the vicinity of Sycamore Campground (elevation 350 to 625 meters [1,150 to 2,050 feet]), a distance of about 14.5 kilometers (9 miles). Apart from some grazing and low-intensity recreational use, this section of the Sisquoc River is essentially free from habitat disturbances and introduced aquatic predatory species that affect arroyo toad populations elsewhere (Sweet 1992). The number of adult arroyo toads present in this population is unknown. There may be arroyo toads on private lands on the lower Sisquoc River (unpublished California Natural Diversity Database records). The area where toads have been reported is affected by grazing and sand and gravel mining.

Arroyo toad populations may be located on the lower reaches of the Sisquoc River and its tributaries, such as La Brea and Mazana Creeks, and on other tributaries of the Santa Maria River such as the Huasna River, Cuyama River, and Alamo Creek. These areas should be surveyed for suitable habitat and toads.

3) Santa Ynez River Basin, Santa Barbara County:
Arroyo toads are present at scattered locations on the upper Santa Ynez River, above Gibraltar Reservoir, from Mono Creek to Fox Creek upstream of Juncal Campground, below Juncal Dam (elevation 430 to 560 meters [1,400 to 1,850 feet]), a distance of about 13.8 kilometers (8.6 miles) (Figure 7). They also are present on the lower reaches of Mono Creek (at the upper end of Gibraltar Reservoir) and Indian Creek from their confluences with the Santa Ynez River to elevations of about 520 meters (1,700 feet) and 460 meters (1,500 feet) respectively, a distance of about 5.6 kilometers (3.5 miles) (Figure 7). Arroyo toads in the upper Santa Ynez River drainages probably represent the remnants of a much larger metapopulation in the basin. The subpopulations on the main river and the various creeks were affected by the construction during the 1920's and subsequent operation of Gibraltar Dam, and by the construction during the 1930's and subsequent operation of Juncal Dam. There is a lack of sand and silt in the Santa Ynez River bed below Juncal Dam (C. Charles Evans, Montecito Water District, *in litt.* 1998), probably as a result of sediment trapping in Jameson Lake

by Juncal Dam; this has degraded the breeding and foraging habitat for arroyo toads. The dams and reservoirs, with the associated problems of altered water regimes, sediment trapping, and support of exotic species, probably are the primary cause of the decline and fragmentation of this metapopulation.

The most recent studies on these subpopulations indicate that they are currently small, with the largest number of toads found in Mono Creek. All of these arroyo toad subpopulations are threatened by off-highway vehicles and recreational use of roads and campgrounds in the area (Sweet 1992, 1993). The toads along the Santa Ynez River additionally are affected by introduced fishes (especially green sunfish, bluegill [*Lepomis macrochirus*], and fathead minnows [*Pimephales promelas*]), bullfrogs, and flow regulation of the river (Sweet 1993). Louisiana red-swamp crayfish (*Procambarus clarkii*) and bullfrogs are well-established in Jameson Lake. Racoons (*Procyon lotor*) and opossums (*Didelphis virginianus*) also may threaten local toad populations, especially when released by animal control agencies during the toad's breeding season, when toads are very susceptible to predation. Tamarisk (*Tamarix* spp.), an invasive non-native plant, has become established on some sandy terraces, reducing foraging habitat. Interactions of current small population sizes with natural events such as fires, floods, and droughts, and human-induced changes, including collecting, may lead to local extirpation of some subpopulations.

4) Santa Clara River Basin, Ventura and Los Angeles Counties:
Arroyo toads were found in the Santa Clara River basin on May 22, 1912, at Santa Paula, Ventura County (Camp 1915; Figure 7). This site (now located along Highway 150) apparently was part of a formerly extensive oak (*Quercus* spp.) woodland on the floodplain near Santa Paula Creek. The creek floodplain from 75 to 120 meters (250 to 400 feet) elevation, a distance of about 4.8 kilometers (3 miles), has been urbanized extensively and arroyo toads have been extirpated from the area (M. R. Jennings, unpubl. data).

A large number of arroyo toads persists along Sespe Creek, Los Padres National Forest, Ventura County, from about Hot Springs Canyon upstream to the mouth of Tule Creek (Figure 7; Sweet 1992). The amount of stream distance with suitable arroyo toad habitat is 24 kilometers (15 miles) and the elevational range is 690 to

1,040 meters (2,250 to 3,400 feet). The upper half of the portion of Sespe Creek inhabited by arroyo toads had large areas of excellent habitat and numerous high-quality breeding pools, while the lower portion supports few stream terraces with suitable substrates, and fewer pools appropriate for use as arroyo toad breeding sites (Sweet 1992). Sweet (1992, 1993) found through repeated surveys of Sespe Creek during the 1980's and 1990's that the arroyo toad population fluctuated between approximately 130 and 250 adults. The Lions Creek fire in 1991 reduced vegetative cover and led to severe erosion in approximately half of the upland habitat in the upper half of the creek basin, reducing the extent and quality of the upland and breeding habitat. Current impacts to this population include recreational activities such as off-highway vehicles, fishing, camping, random events such as fires and floods, and the spread of introduced aquatic predators such as green sunfish, black bullheads (*Ameiurus melas*), and bullfrogs.

Along Piru Creek, Ventura and Los Angeles Counties, arroyo toads historically were found between the mouth (elevation 205 meters [660 feet]) and Bear Gulch (elevation 945 meters [3,100 feet]; Figure 7, Sanders 1950). With the construction of Lake Piru in the 1950's and Pyramid Lake in the 1970's, arroyo toads were eliminated from much of their historic range in the drainage and now are restricted to short segments above each of the two reservoirs (Sweet 1992). The lower segment is from Blue Point Campground upstream to lower Piru Gorge (elevation 340 to 410 meters [1,100 to 1,350 feet]), a distance of 5.6 kilometers (3.5 miles), and the upper segment is from the headwaters of Pyramid Lake upstream to Bear Gulch (elevation 760 to 945 meters [2,500 to 3,100 feet]), a distance of 7.2 kilometers (4.5 miles). There is also a population of arroyo toads in the lower 1.6 kilometers (1 mile) section of Agua Blanca Creek (Sweet 1992). Upper Piru Creek generally has small populations of arroyo toads distributed in a range of good to marginal habitats, while lower Piru Creek generally has larger numbers of arroyo toads distributed over areas of good to excellent habitat that generally are undisturbed by human activities (Sweet 1992). Toads in both areas are affected by recreational activities. The upper section of Piru Creek also has been impacted by placer mining and off-highway vehicle use. The lower section of Piru Creek is affected by the introduction of Louisiana red-swamp crayfish, bullfrogs, exotic fishes (especially green sunfish, black bullhead, prickly sculpin [*Cottus asper*], and largemouth bass [*Micropterus salmoides*]), recreational

activities in and around campgrounds, flow regulation from Pyramid Lake, and grazing of the riparian zone by livestock (Sweet 1992; Campbell *et al.* 1996; D. C. Holland, *in litt.* 1997).

Along Castaic Creek, Los Angeles County, on California Department of Water Resources land and the Angeles National Forest, arroyo toads recently were found below the dam at Castaic Lake, over a distance of 3.2 kilometers (2 miles), as well as above the reservoir in the dredge spoils, over a distance of about 1.6 kilometers (1 mile) (Campbell *et al.* 1996; Frank T. Hovore, Planning Consultants Research, Santa Monica, CA; pers. comm. 1997) (Figure 7). The toads probably were more widespread in the Castaic Creek drainage between 440 to 480 meters (1,450 to 1,575 feet) elevation before the reservoir was constructed in the 1970's. Toads at both sites currently are affected by exotic aquatic predators, off-highway vehicles, flooding, and recreational activities. Toads at the lower site are threatened also by water flow regulation and potential urban development of the surrounding hillsides (Campbell *et al.* 1996).

Potential habitat for arroyo toads probably exists in the upper Santa Clara River basin, Los Angeles County, in some of the other canyons that drain from the north. Likely candidates include parts of the San Francisquito Canyon drainages and Bouquet Canyon drainages (S. S. Sweet, pers. comm. 1997) (Figure 7).

5) Los Angeles River Basin, Los Angeles County:
Arroyo toads were discovered in the Los Angeles River basin on April 1, 1904, along Big Tujunga Wash near Sunland (Camp 1915) (Figure 7). Between 1915 and 1954, dozens were collected in Big Tujunga Canyon near the present-day crossing of Interstate 210 (CAS 39868 – 39874; LACM 1040, 11513 – 11522; AMNH 14510). Although arroyo toads apparently have been extirpated from the Big Tujunga drainage below the Angeles National Forest boundary, they are present on forest lands above Tujunga Reservoir between 760 and 1,070 meters (2,500 and 3,500 feet) elevation in Upper Big Tujunga Canyon, Mill Creek, and Alder Creek drainages (Figure 7). During recent surveys, toads were found along about 10 kilometers (6 miles) of stream in the three drainages (W. J. Brown, Jr., pers. comm. 1997). Arroyo toad populations at these locations are small and are affected by recreational activities (such as hiking, fishing, and camping),

introduced bullfrogs, and the spread of giant reed (*Arundo donax*), a non-native plant.

An arroyo toad was collected on July 6, 1970, from the westernmost part of the Los Angeles basin in the Chatsworth Drain, Canoga Park, at an elevation of 242 meters (795 feet) (UCSB 9382) (Figure 7). The entire area has been urbanized and arroyo toads are now extirpated from this part of the basin (S. S. Sweet, pers. comm. 1997).

There were several reports of sightings of arroyo toads during June, 1992, in Arroyo Seco below Devil's Gate near Pasadena (e.g., see York 1992). Subsequent careful examination of the site revealed many hundreds of juvenile California toads present, but no arroyo toads (Michael C. Long, Eaton Canyon Nature Center, pers. comm. 1997). The site is within the historic range of the arroyo toad and probably contained arroyo toad habitat at the turn of the century, but appears to be unsuitable below the reservoir because of stabilization of stream flows through the drainage. However, arroyo toads were located along a small tributary of Arroyo Seco above Devil's Gate Reservoir in 1996 (Caltrans 1996) and in or near the settling ponds in the main channel above Devil's Gate Dam in 1997 and 1998 (P. Krueger, Angeles National Forest, *in litt.* 1997; M. Wickman, Angeles National Forest, *in litt.* 1998). The amount of habitat and the size of the arroyo toad population are currently unknown. Impacts include introduced predators and recreational activities (including hiking, fishing, horseback riding, and biking).

6) Little Rock Creek Basin, Los Angeles County:

Arroyo toads in this basin originally were found on May 8, 1970, at Joshua Tree Campground near the upper end of Little Rock Reservoir, Angeles National Forest, at an elevation of 1,040 meters (3,400 feet) (Figure 7) (M. C. Long, pers. comm. 1997). The toads currently appear to be restricted to a 4.8-kilometer (3-mile) stretch of stream habitat above Little Rock Reservoir and numbered approximately 20 adults in 1996 (W. J. Brown, Jr., pers. comm. 1997). The population is threatened by introduced aquatic predators (Louisiana red-swamp crayfish, various fish species, and bullfrogs) and extensive off-highway vehicle use along the creek terraces (M. R. Jennings, unpubl. data). There are also major campgrounds on the creek that attract heavy recreational use during the summer.

7) Mojave River Basin, San Bernardino County:

Although an arroyo toad was collected in the Mojave River at Victorville, by Loye Miller on July 7, 1906 (LACM 11367), the species was not recorded again from the basin until Laurence Monroe Klauber collected several specimens at Victorville while conducting herpetological surveys on April 17, 1930 (SDSNH 2481 – 2482; 2542 – 2543). Since then, arroyo toads were found to be very common in the basin from Miller Canyon, Deep Creek, and the Forks of the Mojave (elevation 1,070 meters [3,500 feet]) downstream to below Victorville (elevation 825 meters [2,700 feet]), a distance of about 37 kilometers (23 miles) (Jennings and Hayes 1994) (Figure 8). Hundreds of specimens were collected in the region now under Silverwood Lake and in the vicinity of the Mojave River Forks Dam between 1940 and 1970 (SDSNH 65641 – 65661; LACM 11371 – 11396, 11401 – 11512, 11523 – 11821, 74545 – 74548, 88007 – 88014, 91832, 125968 – 125969; CSPUP 46 – 49, 625, 638; UMMZ 113731) and this was the location of Cunningham's (1962) observations of habitat use and behavior during the late 1950's and early 1960's. Arroyo toads were also common in parts of Deep Creek from its confluence with the Mojave River to 1,310 meters (4,300 feet) elevation (Beaman *et al.* 1995).

Annual flood control activities in the Mojave River near Victorville severely altered the habitat and probably are the primary reason for the apparent extirpation of arroyo toads in that stretch of the river. With construction of the Mojave River Forks Dam in the 1960's and Silverwood Lake in the 1970's, portions of the arroyo toad habitat in the basin were eliminated through direct inundation and alteration of water flow patterns. Adult arroyo toads are seen below the dam, but heavy off-highway vehicle use may preclude sufficient successful recruitment to maintain the population. Introductions of beaver (*Castor canadensis*) in the main Mojave River also have eliminated shallow breeding areas (D. Hyde-Sato, San Bernardino National Forest, pers. comm. 1997).

Arroyo toad populations currently appear to be restricted to the West Fork of the Mojave River, Little Horsethief Creek, and the lower and middle portions of Deep Creek on the San Bernardino National Forest. There are also arroyo toads on Little Horsethief Creek downstream of the Forest boundary. All of these populations are affected by introduced fishes and bullfrogs and recreational

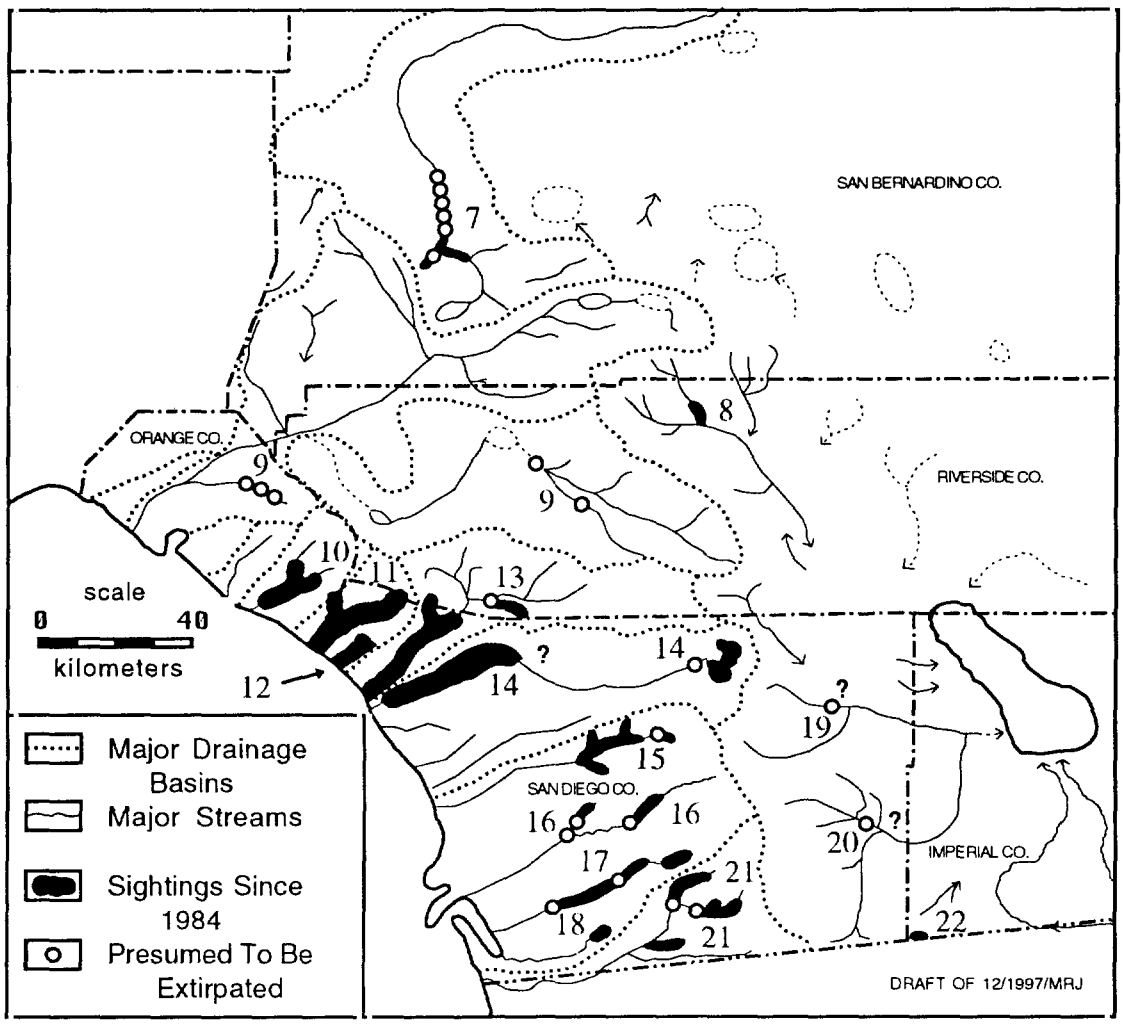


Figure 8. Historic and current distribution of the arroyo toad in Orange, Riverside, San Bernardino, San Diego, and Imperial Counties (modified from Campbell *et al.* 1996). Numbers correspond to basins mentioned in the text.

activities such as camping, fishing, and off-highway vehicles. The Little Horsethief Creek arroyo toad population is threatened by gold prospecting activities and proposed development in Summit Valley, and the Deep Creek population has been affected by grazing (S. A. Loe, San Bernardino National Forest, *in litt.* 1997).

8) Whitewater River Basin, Riverside County:
Patten and Myers (1992) found a small population of arroyo toads in the Whitewater River, 3 to 5 kilometers (2 to 3 miles) north of Interstate 10 at an elevation of about 420 meters (1,380 feet). The arroyo toads are found with California toads and red-spotted toads (*B. punctatus*). The toads are impacted by water manipulation and off-highway vehicle use. The extent of arroyo toad breeding habitat in the basin is unknown. Most of the land in the basin is managed by the Bureau of Land Management's California Desert District and the San Bernardino National Forest.

9) Santa Ana River Basin, Orange and Riverside Counties:
Arroyo toads historically were present in the Santiago Creek basin and the San Jacinto River basin. Toads first were found in Santiago Canyon on May 18, 1974, along Santiago Canyon Road, 2.8 kilometers (1.7 miles) north of Bolero Lookout, Orange County (Fred M. Roberts, Jr., U.S. Fish and Wildlife Service, Carlsbad, CA; unpubl. data) (Figure 8). Subsequent examination of the canyon during the 1970's and 1980's revealed arroyo toads in Baker Canyon and at the mouth of Silverado Canyon (R. N. Fisher, pers. comm. 1997). The arroyo toads apparently were restricted to about a 10-kilometer (6-mile) section of stream above Santiago Reservoir (Irvine Lake) at elevations between 250 and 340 meters (820 and 1,100 feet). According to P. H. Bloom (*in litt.* 1998), there have been no sightings of arroyo toads in this area during the 1990's, and the population there may have been extirpated. The entire area of arroyo toad habitat is owned by the Irvine Company and if the population is still extant, it currently is threatened by sand and gravel operations, water diversions, and groundwater pumping, agricultural activities, urban development, and introduced aquatic predators such as green sunfish.

Arroyo toads in the San Jacinto River were recorded initially on July 24, 1953, 8

kilometers (5 miles) east of Hemet, Riverside County (LACM 11374) (Figure 8). Arroyo toads at that location apparently were extirpated due to extensive habitat loss along that portion of the river due to urbanization (Jennings and Hayes 1994). An additional May, 1975, record exists for arroyo toads in lower Bautista Canyon, Riverside County, which is a tributary of the San Jacinto River (Glenn R. Stewart, Ph.D., California State Polytechnic University at Pomona; unpubl. data) (Figure 8). However, this part of Bautista Canyon also has undergone substantial urban development over the past 20 years and arroyo toads apparently have been extirpated at the site (Jennings and Hayes 1994). Habitat probably still exists along both the San Jacinto River and Bautista Creek in the San Bernardino National Forest.

10) San Juan Creek Basin, Orange and Riverside Counties:
Arroyo toads originally were found in San Juan Creek on July 12, 1974, about 1.6 kilometers (1 mile) southwest of the Lower San Juan Picnic Area, Cleveland National Forest, Orange County (F. M. Roberts, Jr., unpubl. data) (Figure 8). Subsequent surveys by the California Department of Fish and Game and the Cleveland National Forest found arroyo toads in the drainage from Interstate 5 near San Juan Capistrano, Orange County, upstream through Ronald W. Caspers Wilderness Park and the Cleveland National Forest, to the Upper San Juan Campground area, Riverside County (P. H. Bloom, pers comm. 1997; F. M. Roberts, Jr., pers. comm. 1997; Mary Thomas and Ben Matibag, Cleveland National Forest, *in litt.* 1995). There are also a few arroyo toads in the lower part of Bell Canyon (P. H. Bloom, *in litt.* 1998) and in Trabuco Creek (D. C. Holland, *in litt.* 1997), although Bloom (*in litt.*) found none in 1998. Bloom also has surveyed Cañada Gobernadora and Cañada Chiquita for several years in the mid-1990's without finding arroyo toads, has found none recently between I-5 and Cañada Chiquita, very few between there and Verdugo Canyon, but several hundred in about 6.5 kilometers (4 miles) of stream bed above Verdugo Canyon. Threats include traffic along a dirt road adjacent to Trabuco Creek (B. Leatherman, Psomas and Associates, *in litt.* 1998) and the planned completion of the Foothill Transportation Corridor, which could cross both San Juan and San Mateo Creeks (S. Letterly, Transportation Corridor Agencies, *in litt.* 1998). In addition to being affected by exotic fishes, bullfrogs, and crayfish in the creek and by recreational activities in the riparian zones, arroyo toads are being affected by

county flood control activities and sand and gravel mining operations in the lower parts of San Juan Creek (P. H. Bloom, *in litt.* 1997, 1998). The most potentially damaging activity is the annual moving of riparian gravels in the river bottom at Caspers Wilderness Park with the use of heavy equipment. There are also a few arroyo toads killed on Highway 74 and other roads within the Park each year. Tadpoles are collected in the park, primarily by children. Contaminants (pesticides, herbicides, and fertilizers) from plant nurseries and run-off from residential areas also may be affecting arroyo toads negatively (P. H. Bloom, *in litt.* 1998). Development pressure in this basin is high.

11) San Mateo Creek Basin, Orange, Riverside, and San Diego Counties: Arroyo toads were found first at the mouth of San Mateo Creek, San Diego County, on April 2, 1932, when a series of four specimens was collected by L. M. Klauber (SDSNH 7404, 7423 – 7425). The site is near the present Interstate 5 highway bridge on Marine Corps Base Camp Joseph H. Pendleton (Camp Pendleton). From 1995 through 1997, surveys documented arroyo toads from the mouth of San Mateo Creek, upstream on Cristianitos Creek, Talega Canyon, and San Mateo Canyon to the Camp Pendleton boundary (D. C. Holland, pers. comm. 1997; Figure 8). Arroyo toads also are present in Cristianitos Creek, Gabino Canyon, and La Paz Canyon, upstream from the Camp Pendleton boundary to the Girl Scout Camp (P. H. Bloom, pers. comm. 1997) (Figure 8). The toads are present also in the headwaters of San Mateo Creek and some tributaries in the San Mateo Canyon Wilderness within the Cleveland National Forest (John Stephenson, Cleveland National Forest, pers. comm. 1997; Anne S. Fege, Cleveland National Forest, *in litt.* 1998). Toads in the lower portion of the San Mateo basin currently are affected by introduced aquatic predators (especially green sunfish and bullfrogs), sand and gravel mining, road construction and traffic, livestock grazing on private lands, and military activities (especially training in the riparian zones). The completion of the Foothill Transportation Corridor could affect toads in the San Mateo basin. The toad's riparian habitat also is threatened by the invasion of exotic vegetation (e.g., tamarisk and giant reed) that is stabilizing stream terraces. Threats on national forest lands include introduced aquatic predators, road and trail traffic, and tamarisk invasion (A. S. Fege, *in litt.* 1998).

The lower portions of the San Mateo Creek basin and the following two basins, San Onofre Creek and Santa Margarita River, which are located on Camp Pendleton, may be the only remaining coastal plain lands in southern California on which the arroyo toad occurs within 10 kilometers (6 miles) of the coastline and down to the coastal marsh zone. As such, they may harbor populations with phenotypic characteristics that are now limited in representation throughout the range of the arroyo toad in California. The lack of agricultural and urban development on these lands probably has allowed these populations to persist.

12) San Onofre Creek Basin, San Diego County:
Arroyo toads were found in the lower San Onofre Creek basin, at least to 366 meters (1,200 feet) elevation in Jardine Canyon, during surveys conducted from 1995 through 1997 on Camp Pendleton, (D. C. Holland, pers. comm. 1997) (Figure 8). Currently, the known extent of arroyo toad breeding habitat is about 11 kilometers (7 miles) along San Onofre Creek and 5 kilometers (3 miles) along Jardine Canyon (D. C. Holland, pers. comm. 1997). The size of the adult population is unknown. Overland movement of arroyo toads between the San Mateo Creek and San Onofre Creek systems may be possible, but has not been documented. Like the San Mateo basin toads, the San Onofre basin arroyo toads currently are affected by introduced fishes (especially green sunfish) and bullfrogs, and military activities (especially training in the riparian zones), as well as the invasion of exotic vegetation (*e. g.*, tamarisk and giant reed) that is stabilizing stream terraces.

13) Santa Margarita River Basin, San Diego and Riverside Counties:
Arroyo toads have been found in the Santa Margarita River basin since June, 1929, when L. M. Klauber collected a series of specimens from the river 3.2 kilometers (2 miles) northwest of Fallbrook (SDSNH 12049 – 12059; MVZ 11206 – 11211). Over the next 68 years, arroyo toads have been found over much of the basin below elevations of 610 meters (2,000 feet). Specific streams include the main Santa Margarita River from 2.1 kilometers above the mouth to 150 meters (500 feet) elevation, De Luz Creek from the confluence with the Santa Margarita River to 120 meters (400 feet) elevation, Roblar Creek from the confluence with the Santa Margarita River to 110 meters (350 feet) elevation, Sandia Creek, Temecula Creek from Vail Lake to Aguanga, and Arroyo Seco

Creek from Vail Lake to above Dripping Springs Campground (Figure 8).

Arroyo toads in all of the above drainages are being affected negatively by introduced aquatic predators (fishes, crayfish, and bullfrogs), roads and road crossings, and introduced plants. Over half of the Santa Margarita River, as well as the lower part of De Luz Creek and all of Roblar Creek are under the management of Camp Pendleton. About half of the Arroyo Seco Creek drainage is managed by the Cleveland National Forest. The rest of the arroyo toad habitat in the Santa Margarita River basin is on private lands or under the management of Fallbrook Water District. As indicated previously, toads on military lands are impacted by military activities, especially training maneuvers in the riparian zones. Toads on private lands are affected by livestock grazing, manipulation of stream flows, off-highway vehicles, and agricultural activities. Toads on the Cleveland National Forest are affected by recreational activities, especially in the vicinity of campgrounds, trails, and recreational areas.

14) San Luis Rey River Basin, San Diego County:
Arroyo toads initially were found in the San Luis Rey River on May 23 – 24, 1927, when J. R. Slevin collected a large series of specimens on the river 4.8 kilometers (3 miles) west of Bonsall (CAS 62908 – 62915). Over the next 70 years, arroyo toads have been found in many parts of the basin, including the main and West Forks San Luis Rey River, Pala Creek, and Agua Caliente Creek. Historically, arroyo toads were noted from near the mouth of the San Luis Rey River (L. M. Klauber, unpubl. field notes, April 2, 1932) to Indian Flats Campground in the Cleveland National Forest (CAS 173699 – 173700), a distance of about 32 kilometers (20 miles) and an elevational range of 25 to 1,280 meters (80 to 4,200 feet). Today, arroyo toads have scattered breeding sites within the main river down to the city of Oceanside, and another disjunct breeding site above Lake Henshaw to Indian Flats Campground (elevation 825 to 1,280 meters [2,700 to 4,200 feet]). Additionally, arroyo toads currently inhabit the West Fork of the San Luis Rey River to above the Barker Valley Trail (elevation 1,250 meters [4,100 feet]), and Agua Caliente Creek to above Warner Springs (M. R. Jennings, unpubl. data). Arroyo toads have been found at the Lost Valley Boy Scout Camp (approximately 1400 meters [4600 feet]). The habitat there has been degraded by recreational activities (W. E. Haas *et al., in litt.* 1998). The status of

the Pala Creek population is currently unknown. There are also arroyo toads in other streams of the San Luis Rey River basin, especially above Lake Henshaw. The basin is largely in private lands in the lower section, Indian Reservations in the middle and upper sections, and the Cleveland National Forest in the upper section. Toads in the main river below Lake Henshaw are threatened by urban development and are affected by agricultural activities, water diversions, flood control activities, sand and gravel mining, and introduced plants and animals (especially aquatic species). Toads in the basin above Lake Henshaw are threatened by urban development, and affected by water diversions, livestock grazing, introduced predators (especially bullfrogs), recreation, and road use. Many of these activities occur on the Vista Irrigation District and private lands. Grazing has been excluded from riparian areas on the Cleveland National Forest.

15) San Dieguito River/Santa Ysabel Creek Basin, San Diego County:
Arroyo toads originally were found in the San Dieguito River/Santa Ysabel Creek basin on April 26, 1935, when Wallace F. Wood collected a specimen in Witch Creek (MVZ 29833). Since then, arroyo toads have been found in Guejito Creek, Santa Maria Creek, Pamo Valley (Temescal Creek), San Pasqual Valley, Santa Ysabel Creek, and Witch Creek (Campbell *et al.* 1996; Dave Bacon, Cleveland National Forest, *in litt.* 1997; W. E. Haas *et al., in litt.* 1998) (Figure 8). Although the creation of Lakes Sutherland and Hodges eliminated some of the historical arroyo toad habitat in the basin through flooding, and contributed to the loss or degradation of additional habitat due to the interruption of sediment deposition and hydrologic changes, extensive stretches of suitable habitat remain along the above creeks. In addition to the losses of riverine and riparian habitats, upland habitats have been lost to and are threatened by development. Much of the available arroyo toad habitat is on private lands except for the Pamo and San Pasqual Valleys, which are owned by the City of San Diego. These locations currently are impacted by introduced plants and animals, livestock grazing, water diversions, agricultural activities, and off-highway vehicle use, and are threatened by proposed urban development. The area needs further surveys to document the current extent of arroyo toad populations.

16) San Diego River Basin, San Diego County:
Arroyo toads were found initially in the San Diego River basin at Lakeside on

May 14, 1923, when a California Academy of Sciences expedition collected a single specimen (CAS 58080). During the next 2 decades, arroyo toads were found in San Vicente Creek (SDSNH 13805 – 13821, 14345 – 14352) and at El Capitan (SDSNH 21295 – 21299). Both locations now are inundated by reservoirs that have eliminated a portion of the historic arroyo toad habitat in the basin. Arroyo toads are present in the San Diego River above El Capitan Lake, at least to the mouth of Cedar Creek (J. Stephenson, pers. comm. 1997), and above San Vicente Reservoir (Figure 8). The size of the adult population is unknown. Foot, equestrian, and motorcycle traffic on trails to Cedar Creek Falls from surrounding communities contribute to habitat degradation and disturbance of toads (A. Davenport, U.S. Fish and Wildlife Service, Carlsbad, California, pers. comm. 1998). High water flows in Boulder Creek from Cuyamaca Reservoir at certain times of the year (D. R. Kaiser, Helix Water District, La Mesa, California, *in litt.* 1998) may adversely affect arroyo toads in the San Diego River above El Capitan Reservoir (K. Marsden, U.S. Fish and Wildlife Service, Carlsbad, pers. comm. 1998). Arroyo toads probably are present in other streams (such as Conejo and King Creeks) within the basin on the Capitan Grande Indian Reservation. Impacts to the populations include introduced water control operations, aquatic predators, livestock grazing, off-highway vehicles, and recreational activities.

17) Sweetwater River Basin, San Diego County:

Arroyo toads first were found in the Sweetwater River near Dehesa during June, 1930, when a series of 10 specimens was collected by L. M. Klauber (CAS-SU 2601 – 2610) (Figure 8). Since then, arroyo toads have been collected and observed on the main Sweetwater River east of Loveland Reservoir and in Cuyamaca State Park (M. R. Jennings, unpubl. data), in Viejas Valley Creek (Campbell *et al.* 1996), and in Peterson Creek (W. E. Haas *et al., in litt.* 1998). Extensive urbanization downstream from Sweetwater Reservoir has probably eliminated all habitat in that area. The creation of Sweetwater and Loveland Reservoirs eliminated or degraded some of the historic habitat for arroyo toads within the basin, but arroyo toads are still common upstream from Loveland Reservoir and in Cuyamaca State Park, and are present between Sweetwater Reservoir and Loveland Reservoir. Continued development, including golf courses, between Sweetwater and Loveland Reservoirs threatens the arroyo toads in that area. Current arroyo toad habitat is managed primarily by the Cleveland

National Forest, the California Department of Parks and Recreation, and the Sweetwater Authority (a water district), with a few private inholdings. The California Department of Fish and Game manages an ecological preserve in Sloan Canyon; there are no arroyo toads within the preserve, but there are some within the drainage below the preserve. The status of the Viejas Creek arroyo toad population, within the Viejas Indian Reservation, is currently unknown. Arroyo toads at many sites within the drainage are affected by introduced plants and animals, and by recreational activities.

18) Otay River Basin, San Diego County:

Arroyo toads initially were found in the Otay River basin on April 14, 1930, when F. E. Walker collected a series of five specimens on Dulzura Creek at Dulzura, San Diego County (SDSNH 13358 – 13362) (Figure 8). Arroyo toads probably are present within the drainage, although Upper and Lower Otay Lakes, which were constructed before World War II, have eliminated some habitat. This population is entirely on private lands and currently is impacted by livestock grazing, introduced aquatic predators (especially fishes, bullfrogs, and African clawed frogs [*Xenopus laevis*]), introduced plants, sand and gravel mining, recreational activities, and off-highway vehicles.

19) San Felipe Creek Basin, San Diego County:

William Edward Duellman observed arroyo toads at the "Country Club at Borrego," San Diego County (L. M. Klauber, unpubl. field notes, July 25, 1950) (Figure 8). This record should be verified with field surveys of the Borrego Springs area. Surveys also should be conducted in Borrego Palm Canyon, Banner Creek and Coyote Creek.

20) Vallecitos Creek Basin, San Diego County:

There is a single record for the Vallecitos Creek basin, consisting of three tadpoles collected on April 12, 1954, by Robert C. Stebbins, 16 kilometers (10 miles) southeast of the Vallecito Stage Station, San Diego County (MVZ 61061) (Figure 8). The status of this population is currently unknown and should be verified.

21) Tijuana River-Cottonwood Creek Basin, San Diego County and Baja California:

Arroyo toads were found initially in the Tijuana River-Cottonwood Creek basin on May 12, 1923, when a single specimen was collected at Campo (along Campo Creek, CAS 57897) (Figure 8). Since then, arroyo toads have been found in several drainages in the basin including Pine Valley, Noble, Cottonwood, Kitchen, Potrero, and Morena Creeks and Scove Canyon. Although Barrett Lake and Lake Morena have eliminated and degraded some of the historic habitat, arroyo toads are still present in Cottonwood Creek above Lake Morena and in Pine Valley Creek. Today, the remaining arroyo toad habitat is threatened by development of private lands, and affected by water diversions, livestock grazing on private lands, roads across streams (such as at Pine Valley), off-highway vehicles, recreational activities, travel by illegal immigrants, Border Patrol activities, and introduced plants and aquatic predators (Wells and Turnbull 1998). Many creeks in the basin need to be surveyed for potential arroyo toad habitat and toads. The status of the arroyo toad in the Tijuana basin in Mexico is unknown.

22) Pinto Wash Basin, Imperial County:

A population of 50 juvenile arroyo toads was found in the Pinto Wash basin, Imperial County, by Jerrold J. Feldner during May, 1992 (Campbell *et al.* 1996). The site is at the base of the canyon at about 150 meters (500 feet) elevation, near the San Diego-Imperial County line on the Jacumba (In-Ko-Pah Mountains) Wilderness Study Area, managed as part of the El Centro Resource Area of the California Desert District, Bureau of Land Management (Figure 8). The amount of arroyo toad habitat is unknown. Current threats include off-highway vehicle use and travel by illegal immigrants.

Life History and Ecology

The arroyo toad has specialized requirements for breeding habitats. Specifically, it requires shallow, slow-moving stream habitats, and riparian habitats that are disturbed naturally on a regular basis, primarily by flooding. This specialization makes their life history and ecological traits different from the typical pattern associated with other species in the genus *Bufo* in the western United States, which often use ponds and other standing water rather than stream and river

systems (Sweet 1992). The following discussion is adapted from Sweet (1992), Jennings and Hayes (1994), and Campbell *et al.* (1996). Adult toads are those that have reached sexual maturity and are capable of reproducing, juveniles are recently metamorphosed toads in their first year, and subadults are after-hatching-year toads that are not sexually mature.

In the northern portion of the range, arroyo toads are found in foothill canyons and intermountain valleys where medium- to large-sized rivers are bordered closely by low hills, riverbed gradients are low, and the surface stream flows frequently pool or are intermittent for at least a few months of the year (Miller and Miller 1936, Stebbins 1951, Sweet 1992). In southern California (central portion of the arroyo toad's range), they also occur on the coastal plain and on a few desert slopes.

For breeding, adult arroyo toads use open sites such as overflow pools, old flood channels, and pools with shallow margins on streams that, in the northern portion of the range, are third to sixth order (Sweet 1992) (Figure 9). In the central portion of the range, toads are found on first to sixth order streams (D. C. Holland, *in litt.* 1997; A. S. Fege, *in litt.* 1998). Such habitats rarely have closed canopies over the lower banks of the stream channel due to regular flood events. Heavily shaded pools are generally unsuitable for larval and juvenile arroyo toads because of lower water and soil temperatures and poor algal mat development (Sweet 1992). Episodic flooding is critical to keep the low stream terraces relatively vegetation free and the soils friable enough for juvenile and adult toads to create burrows (Jennings and Hayes 1994).

Shallow pools (less than 30 centimeters [12 inches] deep) with clear water are favored by adults for breeding (Sweet 1992, 1993). Breeding sites generally have flow rates less than 5 centimeters per second (0.2 foot per second) and bottoms composed of sand or well-sorted fine gravel, although a significant component of large gravel or cobble may be present (D. C. Holland, *in litt.* 1997; A. S. Fege, *in litt.* 1998). Areas that are used by juveniles consist primarily of sand or fine gravel bars with varying amounts of large gravel or cobble with adjacent stable sandy terraces and oak flats. Areas that are damp and have some (less than 10 percent) vegetation cover such as American brooklime (*Veronica americana*) are favored by juvenile toads because they possess the refuge and thermal

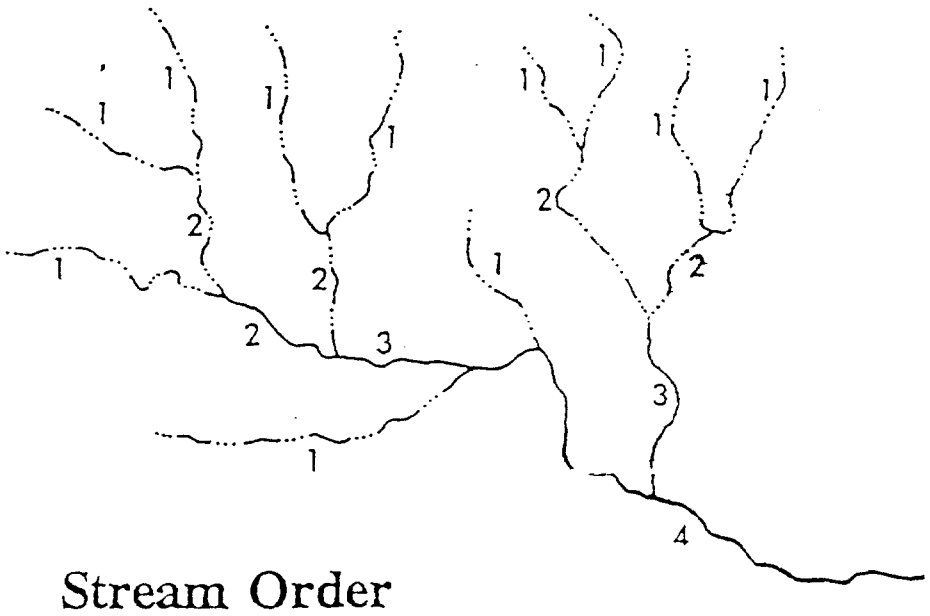


Figure 9. Concept of stream order. The smallest tributaries are first-order streams; two combine to form a second-order stream, and two second-order streams combine to form a third-order stream, etc. (from Sweet 1992).

characteristics required for juvenile survival and rapid growth (Sweet 1992). Bare sand and gravel bars may support large numbers of juvenile toads, but survivorship can be reduced due to high levels of predation (Sweet 1992).

The adjacent sandy terraces may be sparsely to heavily vegetated with brush and trees such as mulefat (*Baccharis* spp.), California sycamore (*Platanus racemosa*), cottonwoods (*Populus* spp.), coast live oak (*Quercus agrifolia*), and willow (*Salix* spp.). The understory of stream terraces may consist of scattered short grasses, herbs, and leaf litter, with patches of bare or disturbed soil, or have no vegetation at all. For foraging, subadult and adult arroyo toads often are found around the drip lines of oak trees. These areas lack vegetation, yet have appropriate levels of prey (Sweet 1992). When active at night, toads often can be observed near ant trails feeding on passing ants and other prey.

Subadult and adult toads may range widely into the surrounding uplands, commonly up to 0.5 kilometer (0.3 mile) and as much as 2.0 kilometers (1.2 miles) from the stream (D. C. Holland, *in litt.* 1997; W. E. Haas *et al., in litt.* 1998). The distance toads are found from the breeding sites depends on the topography and the extent of suitable habitat. Dispersal movements may be even further — over 3 kilometers (2 miles) (W. E. Haas *et al., in litt.* 1998). The uplands are often coastal sage scrub, chaparral, grassland, or oak woodland. Substantial areas of fine sand, into which adult toads burrow, must be present, but can be interspersed with gravel or cobble deposits. Although California toads will use small mammal burrows in areas where soils are compacted, arroyo toads apparently will not (W. E. Haas *et al., in litt.* 1998).

Little is known currently about overwintering habitats and threats to adult toads during the nonbreeding season. Factors influencing survival between breeding seasons may include dessication, starvation, predation by native and introduced species, and activities that disturb nonbreeding habitats (Sweet 1992). In the central portion of the range (Orange, Riverside and San Diego Counties), arroyo toads may be active all year. Activity usually is associated with rainfall and moderate temperatures (above 7 degrees Celsius [45 degrees Fahrenheit]). All age classes of post-metamorphic toads may be active on rainy nights and on some nights of very high relative humidity (W. E. Haas *et al., in litt.* 1998).

Adult arroyo toads begin breeding in late March in the northern portion of the range (Sweet 1992) and as early as January in the coastal areas of southern California (D. C. Holland, *in litt.* 1997). Breeding may continue into early July depending on when individual females reach reproductive condition and when the males stop calling (Sweet 1992). Males usually begin calling when water temperatures reach 14 degrees Celsius (57 degrees Fahrenheit) and may breed with several females during the course of the season (Sweet 1992; M. R. Jennings, unpubl. data). Calling activity generally begins within one hour after sunset and may continue after sunrise, but the peak calling period usually occurs several hours after sunset (W. E. Haas *et al., in litt.* 1998). The receptive females seek out calling males based on the size of the male and the sound of his call (Sweet 1992, 1993). The males usually call at the edge of pools in shallow water less than 5 centimeters (2 inches) deep, although they may call from sandbars out of the water (D. C. Holland, *in litt.* 1997), and are particularly susceptible to predation at this time (Sweet 1992). Amplexus (embracing of the female by the male) and egg-laying generally occur at the site where the male was calling. However, in rare instances, the female may carry the male up to 1 meter (3.3 feet) away from his calling site (Sweet 1992). Female arroyo toads apparently release their entire clutch of 2,000 to 10,000 eggs as a single breeding effort and probably are unable to produce a second clutch during the mating season. If conditions are unsuitable, females may not obtain sufficient resources for egg production and will forgo breeding during that year. The eggs are laid on substrates of sand, gravel, cobble, or mud generally located away from vegetation in the shallow margins of the pool (Sweet 1992).

Embryos usually hatch in 4 to 6 days at water temperatures of 12 to 16 degrees Celsius (54 to 59 degrees Fahrenheit). Larvae may take 8 to 14 days to become free-swimming, depending on the water temperature (Sweet 1992). Larvae are solitary, excellent swimmers and, once mobile, distribute themselves randomly or evenly along the shallow bottom of the breeding pool. Mature larvae swim in short bursts, often remaining motionless for 1 to 4 minutes between movements (Sweet 1992).

The larval period for arroyo toads lasts about 65 to 85 days, depending on water temperatures (Sweet 1992). Larvae do not consume macroscopic vegetation, but

are highly specialized foragers. They feed by inserting their heads in the substrate and ingesting loose organic material such as detritus, interstitial algae, bacteria, and diatoms (Sweet 1992, Jennings and Hayes 1994). For several days before metamorphosis, arroyo toad larvae cease feeding and aggregate in shallow water along the edges of gravel or sand bars, often under or along stranded algal mats. Metamorphosis may occur at any time between April and the beginning of September, depending on the time of breeding, weather, and water quality. Peak metamorphosis occurs from the end of June to mid-July in the northern part of the toad's range (Sweet 1992, 1993) and from late April to mid-May in southern California (D. C. Holland, *in litt.* 1997). Most newly metamorphosed individuals are 12 – 15 millimeters (0.5 – 0.6 inch) in length, but may be as small as 10 – 11 millimeters (0.4 inch) in poor quality habitats or as large as 17 millimeters (0.7 inch) in high quality habitat. If conditions permit, juvenile arroyo toads remain along the margins of the breeding pools for up to 6 months (Sweet 1992; D. C. Holland, *in litt.* 1997).

Juvenile arroyo toads remain in the saturated substrate at the edges of breeding pools for 1 to 3 weeks. They often are exposed on the barren sand because they lack sufficient size to burrow into the substrate. During this period, many toads are lost due to predation unless they can find some cover such as cobble, algal mats, or pieces of debris to hide under (Sweet 1992). The juvenile toads are diurnal for the first 4 to 5 weeks (Cunningham 1962) and subsist largely on ants (*Liometopum occidentale*). On this diet and with the high substrate temperatures, the juvenile toads grow rapidly. Upon reaching a length of 16 – 17 millimeters (0.6 – 0.7 inch) they begin to create shallow burrows in loose sand and may move farther away from the pool onto sand and gravel bars with some vegetation (Sweet 1992).

Upon reaching lengths of 17 – 23 millimeters (0.7 – 0.9 inch), juvenile toads are able to dig burrows 2 – 5 centimeters (0.8 – 2.0 inches) deep and completely bury themselves in the sand (Sweet 1992). At this time, juvenile toads change to a nocturnal activity pattern and spend the daylight hours in their burrows (Cunningham 1962). At night, they forage for nocturnal ants and beetles. If the substrate is not friable enough, juvenile toads often disperse farther away from the breeding pool into nearby stands of willows and mulefat thickets. Suitable sandy

habitat can be highly localized resulting in dense concentrations of juvenile toads. Such sites generally are well-shaded (Sweet 1992).

Upon reaching a size of 28 – 30 millimeters (1.1 – 1.2 inch) in about 8 to 9 weeks, juvenile arroyo toads begin to shift their behavior and disperse away from streamside habitat into nearby willows (Sweet 1992), although they may remain streamside until they reach sizes greater than 35 millimeters (1.4 inches) (D. C. Holland, *in litt.* 1997). The timing of dispersal, which may be delayed until October or November, is affected by local drying conditions and the presence of suitable microhabitat for burrowing. Juvenile toads may take refuge underground within the riparian zone and disperse farther away following the dampening of stream terraces by fall and winter rains (Sweet 1992). Nocturnal activity is normal for adults and larger juveniles, but they occasionally may be observed during the day. Juvenile toads reach 30 – 40 millimeters (1.2 – 1.6 inches) and occasionally 50 millimeters (2.0 inches) by the fall of their natal year and do not begin growing again until the following spring (Sweet 1992).

Male arroyo toads usually reach adulthood in 2 years. Females become sexually mature in 2 to 3 years, when they attain lengths greater than 54 millimeters (2.1 inches) (Sweet 1992, 1993). However, males may reach adulthood at 1 year if conditions are favorable (Sweet 1993). Females generally average larger sizes than males. Data on longevity are largely unavailable, although age-size distributions indicate that many individuals live only about 5 years (Sweet 1992, 1993). Longevity may vary with local conditions.

Little is known of the seasonal and annual movements or physiological ecology of adults, but recent data suggest that many subadults and some adult males move along streams as much as 0.8 kilometer (0.5 mile) and over 1.0 kilometer (0.6 mile) in a few cases (Sweet 1993). In San Diego County, adult arroyo toads regularly are found within 0.5 kilometer (0.3 mile) and up to 2.0 kilometers (1.2 miles) perpendicularly from streams (D. C. Holland, *in litt.* 1997; W. E. Haas *et al., in litt.* 1998). Extended movement away from streams may be facilitated by microclimates wherein lower temperature and high humidity on foggy days in the spring and summer creates moist substrates in upland habitats where adult arroyo toads can subsist (D. C. Holland, *in litt.* 1997; S. S. Sweet, *in litt.* 1997).

Recapture rates of marked individuals from one breeding season to the next have been as low as 15 to 50 percent (Sweet 1993; *in litt.* 1997). Insufficient data exist to characterize accurately overwintering activities and habitat use.

All life stages of the arroyo toad are susceptible to predation (Sweet 1992; D. C. Holland, *in litt.* 1997; W. E. Haas *et al., in litt.* 1998). Although not ingested, disturbance and fragmentation of egg strands by mallards (*Anas platyrhynchos*) can reduce hatching rates. Predators of larvae include giant water bugs (*Abedus indentatus*), two-striped and common garter snakes (*Thamnophis hammondii* and *T. sirtalis*), green sunfish, largemouth bass, fathead minnows, and bullfrogs. Predators of juveniles and adults include killdeer (*Charadrius vociferus*), two-striped garter snakes, bullfrogs, green-backed herons (*Butorides striatus*), and great blue herons (*Ardea herodias*). Other potential predators of larvae, juvenile, or adults include black bullheads, prickly sculpins, African clawed frogs, western pond turtles (*Clemmys marmorata*), racoons, opossums, American crows (*Corvus brachyrhynchos*), and common ravens (*C. corax*).

Reasons for Decline and Current Threats

Amphibian declines are occurring on a global basis. For some species, the causes are apparent, but for others, the reasons for the declines are unknown. Habitat loss and degradation are the primary causes for declines of many species, and appear to be the major reason for the reduction in arroyo toad populations. A number of other causes, including disease, pollution, and introduced species, are known or thought to contribute to the loss of many frogs, toads, and salamanders. Pollution can have both direct and indirect effects, and can effect amphibians in areas far from where it originates. For example, pesticides and other contaminants can be deposited high up in mountainous regions in snow and rain, and the reduction in the protective ozone layer from highly volatile compounds has affected areas from North America to Australia. Contaminants also can affect the immune system, leaving animals more susceptible to diseases, or reproduction, resulting in fewer healthy adults entering the breeding population. Although many of these threats are not yet understood, there are threats we do understand and can work to reduce. By reducing the known threats, we may be

better able to deal with the impacts of those we do not yet understand.

The distribution of the arroyo toad appears to be restricted naturally as the result of specific habitat requirements for breeding and development. These natural restrictions, coupled with the small sizes of many arroyo toad populations, make them particularly vulnerable to the negative effects of human-induced changes to their habitats (Jennings and Hayes 1994). The following discussion of the reasons for arroyo toad declines and current threats to populations is modified from Sweet (1992, 1993) and Campbell *et al.* (1996).

There are several human-related activities that affect the hydrology of arroyo toad stream habitats and destroy or severely modify the dynamic nature of the riparian systems upon which arroyo toads depend for reproduction, development, and survival. Arroyo toad breeding habitat is created and maintained by the fluctuating hydrological, geological, and ecological processes operating in riparian ecosystems and the adjacent uplands within a Mediterranean climate. These riparian/wash habitats as well as adjacent upland habitats are essential for this species' survival. Periodic and unpredictable flooding that reworks stream channels and channel sediments and alters pool location and form, coupled with upper terrace stabilization by vegetation, is required to keep a stream segment suitable for all life stages of the arroyo toad. Human activities that affect water quality, influence the amount and timing of nonflood flows or frequency and intensity of floods, affect riparian plant communities, or alter sedimentation dynamics can reduce or eliminate the suitability of stream channels for arroyo toad breeding habitat. Degradation or loss of surrounding uplands reduces and eliminates foraging and overwintering habitat. The effects of such activities may not become apparent until many years later when the habitat finally becomes sufficiently degraded that arroyo toads can no longer reproduce and survive. These negative human activities include urbanization and agriculture within and adjacent to riparian habitats, dam building and the resulting reservoirs, water flow manipulations, sand and gravel mining, suction dredge mining, road placement across and within stream terraces, livestock grazing, off-highway vehicle use of roads and stream channels, the placement of campgrounds in arroyo toad habitat (especially on stream terraces), and the use of stream channels and terraces for other recreational activities.

Besides physical habitat alteration, the stabilization of water flows and riparian vegetation also benefits a number of exotic species of plants and aquatic predators, as discussed below. These plants and animals, once they become established, tend to become widespread and build up large populations, which result in the loss of arroyo toads either indirectly through the degradation of habitat or directly through predation. The invasion of exotic plants can alter the fire regimes, leading to intense fires in the riparian zones. Some habitat changes may favor seemingly benign native species such as the California toad, which is able to survive in a variety of habitats. In habitats with small breeding populations of arroyo toads, increased densities of California toads can interfere with the calling activities of male arroyo toads (Awbrey 1972, Sweet 1992). In laboratory studies, juvenile California toads out-competed juvenile arroyo toads for prey (Sweet 1993).

In the following discussion, each of the above physical and biological factors is discussed in detail. Examples are provided where such factors have eliminated arroyo toad populations and where they currently threaten or impact remaining populations.

Agriculture and Urban Development

Agriculture, mining, and urban development of stream terraces and adjacent uplands have destroyed large areas of arroyo toad habitat that formerly supported these animals. In addition to the outright destruction of the stream terraces, water is pumped out of the ground or diverted to support irrigation of farmlands and developments such as golf courses. Groundwater pumping has reduced flows in many creeks and rivers on the coastal plain, adding to the negative impacts of upstream dams and reservoirs, discussed below. Natural streambeds often are channelized and stabilized for flood control. These modifications can extend the negative effects of streamside development both upstream and downstream, and may be particularly significant by destroying the arroyo toad's potential dispersal routes between closely-spaced tributary streams within a watershed or between closely spaced watersheds (such as in San Mateo and San Onofre Creeks in San Diego County). Examples of losses due to urban development include Santa Paula Creek at Santa Paula, Ventura County; Chatsworth Drain in Canoga Park, Los Angeles County; the Big Tujunga River below Interstate 210, Los Angeles

County; Santiago Creek, Orange County; and the lower San Luis Rey River, San Diego County. Development and agricultural activities also alter runoff patterns, degrade water quality, change erosion and sedimentation rates (Campbell *et al.* 1996; D. C. Holland, *in litt.* 1997), and may provide habitat for, and lead to the colonization and establishment of, exotic plants and animals detrimental to arroyo toads (see the discussion below).

Flood control activities associated with agriculture and urban development may be conducted on a yearly basis (such as in lower San Juan Creek, Orange County) or during "emergency conditions" without adequate involvement by regulatory agencies (including the Army Corps of Engineers and the Service). Rip-rapping of stream banks may decrease or eliminate suitable habitat, act as a barrier to movements, alter flow regimes, or provide habitat for exotic species.

Agricultural runoff often contains contaminants such as herbicides, pesticides, and fertilizers that may affect arroyo toads directly or indirectly. Contaminants may kill toads, affect development of larvae, or affect their food supplies or habitat. There is a potential for losses from the application of granular fertilizers, particularly ammonium nitrate, which is highly caustic and has caused mass injuries and mortality to frogs and newts in Europe (Schneeweiss and Schneeweiss 1997). Increased flows in streams due to runoff from agricultural fields or urban areas (golf courses and lawns) or discharges of effluents from sewage treatment plants can have effects similar to those of persistent releases from dams (see below). The effects may be exacerbated due to the higher levels of nutrients usually present in such discharges. Habitat may be altered as much as 2 kilometers (1.2 miles) downstream. Changes in the invertebrate communities may lead to decreased survival of arroyo toad tadpoles due to competition or predation, and may reduce the food supply of post-metamorphic toads (D. C. Holland, *in litt.* 1997).

Mining

Suction dredge mining and prospecting activities have become important issues on several creeks in the national forests. Suction dredge mining causes significant alteration of aquatic habitats and degradation of water quality. This form of placer mining often occurs in and adjacent to breeding pools, which are destroyed by

filling with sediment and the physical rearrangement of the substrate. Such activities can increase siltation more than 1 kilometer (0.6 mile) downstream and can quickly kill many arroyo toad larvae. Siltation in arroyo toad breeding pools can asphyxiate eggs and newly hatched larvae (Sweet 1992). Suction dredge mining also can create deep pools in the stream that often hold water all year and become refugia for introduced predators of arroyo toad eggs and larvae (see the discussion below). Prospecting activities occurring on some streams, such as Little Horsethief Creek in the San Bernardino National Forest, including the digging of "glory holes" (pits up to 1.3 meters [4 feet] in diameter and 0.7 meter [2 feet] deep) in the stream beds and digging dry pits into the banks of the creeks, with subsequent sifting of the removed materials in the stream, building temporary dams to facilitate such activities, and the collateral use of off-highway vehicles, can have serious negative effects on arroyo toads and their habitat (S. A. Loe, *in litt.* 1997; Debby Hyde-Sato, San Bernardino National Forest, pers. comm. 1997). Sand and gravel mining within and adjacent to rivers and creeks can destroy and degrade breeding and upland habitat. These activities also occur on private lands throughout southern California.

Dams and Reservoirs

The creation of reservoirs has destroyed a significant portion of the arroyo toad's estimated historic range by flooding suitable breeding and adjacent upland habitats (Jennings and Hayes 1994). Within the arroyo toad's current range, at least 25 impoundments, discussed in the distribution section, have flooded over 200 kilometers (124 miles) of suitable breeding habitat as well as adjacent overwintering habitat. Introduced beaver also build dams, which may raise water levels in arroyo toad breeding pools, making them unsuitable. Similarly, small temporary dams built by swimmers, miners, and prospectors may alter pools sufficiently to reduce or eliminate breeding success in some areas.

Besides destroying habitat through inundation, reservoirs affect the quality of arroyo toad habitat downstream by regulating water flows, thereby altering stream hydrology. Alterations include halting the scouring and deposition processes necessary to produce and maintain arroyo toad breeding pools and open terrace structures. Trapping of sediment above a dam can render long stretches downstream unsuitable for breeding and rearing habitat as the fine sands are

stripped away and not replaced. Prime examples of this are downstream from Gibraltar and Jameson Reservoirs on the Santa Ynez River, Pyramid Lake on Piru Creek, El Capitan Lake on the San Diego River, and Lake Morena on Cottonwood Creek. Restriction or elimination of flow also reduces summer water levels resulting in premature drying of breeding pools and the failure of arroyo toad reproductive efforts. Releases of surplus water and unseasonal releases disrupt the natural processes that produce required pool and terrace habitat and alter water depth and temperature. Unseasonal releases may prevent successful reproduction or recruitment by altering breeding pool characteristics or by washing away arroyo toad eggs or larvae. Examples of the latter have occurred on Piru Creek in Ventura County and Cottonwood Creek in San Diego County (Sweet 1992, Campbell *et al.* 1996).

Persistent releases throughout the normal dry season can also cause changes in vegetation by encouraging the growth of riparian species, some native (e.g., willow, sycamore, cattails [*Typha* spp.]) and some introduced (e.g., tamarisk and giant reed), in low frequency flood zones. This growth stabilizes the banks, deepens channels beyond a depth suitable for breeding pools, and shades the water, thus lowering water temperatures below the level required for larval growth and survival. When floods do occur in areas where giant reed exists, it can spread very quickly from root masses transported by the high water. Reservoir releases also maintain introduced aquatic predators (see discussion below). Virtually all known current arroyo toad populations downstream from reservoirs are affected or threatened by these factors.

Reservoirs also may act as barriers to instream movements of any surviving arroyo toad populations. If arroyo toads survive the construction and filling of the reservoir, then the individuals of a formerly interconnected population that were scattered along the drainage may be isolated from one another in major tributaries upstream of the reservoir and in the main channel downstream from the dam (Jennings and Hayes 1994). Due to the inherently dynamic and patchy nature of arroyo toad habitat, individuals may have moved up or downstream as conditions changed. Such movements likely are precluded by dam building, reservoir filling, and subsequent alteration of flow regimes. These limitations greatly increase the chance of extinction of the remaining arroyo toad population through random

naturally occurring events such as fires, floods, and drought, as well as increased predation of larval toads from introduced aquatic predators that thrive in reservoirs and downstream channels (see the discussion below). The isolated remnants of the population may be precluded from recolonizing any part of the remaining habitats that lost arroyo toads (Campbell *et al.* 1996). This logic follows the theory of island biogeography, which states that small isolated populations are much more likely candidates for extirpation than populations (large or small) that are interconnected with one another (MacArthur and Wilson 1963).

Roads

Both paved and unpaved roads can have negative effects on arroyo toads, especially when the roads are on stream terraces close to arroyo toad breeding habitats. Although arroyo toads crossing or foraging on paved roads are subject to high mortality at times, especially on rainy nights, (D. C. Holland, *in litt.* 1997; W. E. Haas *et al., in litt.* 1998), the loss of arroyo toads to traffic is particularly apparent on unpaved dirt roads where increased food availability causes toads to congregate at night to feed. Many subadult and adult toads can be killed by even one or a few vehicles. Roads are especially a problem in campgrounds near arroyo toad breeding sites, where night traffic can kill many adult toads, especially on holiday weekends or during hunting seasons when campgrounds have high levels of traffic even after all campsites are filled. Toads may use roads and trails as dispersal routes, exposing them to traffic risks at significant distances from the breeding habitats (W. E. Haas *et al., in litt.* 1998). Toads also burrow into sandy roadbeds during the day, when they also may be crushed by vehicular and foot traffic (Nancy Sandburg, Los Padres National Forest, pers. comm. 1997; S. S. Sweet, *in litt.* 1997). Wet season burrows tend to be very shallow and are often in areas accessible to foot or vehicular traffic, as well as livestock (W. E. Haas *et al., in litt.* 1998).

The problems associated with roads are not limited to those near campgrounds. On Camp Pendleton, San Diego County, and Fort Hunter Liggett, Monterey County, roads on stream terraces and stream crossings are utilized by military vehicles, often during maneuvers or training sessions at various times of the day and night, throughout the year. These activities can lead to high mortalities of

toads within areas of arroyo toad habitat (D. C. Holland, pers. comm. 1997). Construction of major roads such as the Foothill Transportation Corridor can have significant direct and indirect effects on arroyo toads and their habitat.

Livestock Grazing

Grazing by livestock affects arroyo toads directly and indirectly through impacts on habitat features (Sweet 1992, 1993). Livestock can trample egg clutches, larvae, and metamorphs in breeding pools, and juveniles and adult toads may be crushed as livestock walk through alluvial terraces. These impacts can become pronounced as livestock may also concentrate in riparian zones in large numbers after fires destroy, at least temporarily, upslope vegetation (M. Freel, *in litt.* 1997). However, as the upslope vegetation recovers, cattle will move back into those areas (D. Bacon, *in litt.* 1997). Sand bars and terrace habitats often are altered by the activities of livestock herds, rendering them unsuitable for juvenile arroyo toads. The increase in surface area caused by churning of the substrate may cause premature drying of breeding pools by increasing evaporation rates on the bars and subsequent wicking of water from the pools (S. Sweet, *in litt.* 1997). Grazing may change the stream morphology by altering erosion and flow processes (Campbell *et al.* 1996). Excessive grazing on upstream slopes can increase siltation, degrading water quality downstream and negatively affecting arroyo toad reproduction. Livestock grazing in the riparian habitats used by arroyo toads occurs primarily on private lands in Orange County (e.g., San Juan, Gabino, La Paz, Cristianitos, and Talega Creeks) and San Diego County (e.g., Witch, Temescal, and Guejito Creeks), on private inholdings on lower Piru and Agua Blanca Creeks (Los Angeles and Ventura Counties) within the boundaries of the Los Padres National Forest, and on private land along the Sisquoc River and its tributaries (Santa Barbara County) just outside the Forest boundary.

Recreational Activities

Numerous recreational activities occur in arroyo toad breeding and upland habitats. These include off-highway vehicle use, camping, fishing, hunting, hiking, waterplay, and horseback riding. There also are recreational cabin developments along some arroyo toad streams. The effects of many of these activities are similar, although the intensity and timing may vary. Extensive use of breeding sites and adjacent areas can jeopardize the existence of a population,

and even moderate use can have significant deleterious effects. Continued pressure on populations can reduce recruitment to levels that will not sustain the population through years of low or moderate reproduction, such as during droughts or following other adverse conditions.

Off-highway vehicle use of arroyo toad habitat, both upland and within the streambeds, is incompatible with the species' survival because it causes direct mortality and degrades habitat through erosion, siltation, soil compaction, and possibly through hydrocarbon pollution (Sweet 1992). Tire tracks and ruts can isolate or drain portions of pools used as breeding or foraging areas, decreasing survival of eggs and tadpoles (S. S. Sweet, *in litt.* 1997). Off-highway vehicle use in some areas can be extremely heavy and may result in the extirpation of local arroyo toad populations and other sensitive species. For instance, off-highway vehicle use of the Mojave River above Victorville and below the Mojave Forks Dam was probably a significant factor in the near elimination of toads from that part of the drainage (Jennings and Hayes 1994). Sweet (1992, 1993) observed off-highway vehicles in arroyo toad breeding sites on the Los Padres National Forest that resulted in the deaths of arroyo toad egg clutches, larvae, and juveniles.

In three of the four southern California national forests (i.e., Los Padres, Angeles, and Cleveland), campgrounds frequently are located on or near (within 50 to 100 meters [165 to 330 feet]) arroyo toad habitat (i.e., on the stream terrace; Sweet 1992). Recreational cabin developments and some privately owned campgrounds occur both outside Federal lands and on inholdings surrounded by Federal lands. These developments can focus large numbers of people and intensive use on limited habitats. Because it can be difficult at times even for trained personnel to avoid negative effects to toads, just a moderate number of people can cause serious impacts. A few people using or moving through a breeding site can disrupt egg masses and crush larvae. Use of these areas in the early summer to fall when young toads are diurnal, essentially sedentary, and living on sand bars can cause losses from trampling. People building small dams or digging out pools to create deeper pools for swimming and waterplay can alter stream morphology, which can affect larval survival. Vehicular or foot traffic can crush subadults and adults foraging at night in open campground areas and on access roads.

Recreationists, especially children, may collect or kill some toads (M. R. Jennings, unpubl. data; P. H. Bloom, *in litt.* 1998); so do poachers intent on selling the animals. Collection of adult toads during breeding seasons may alter sex ratios, decreasing reproductive potential for some populations, or may eliminate some populations. Light and noise pollution from campgrounds and streamside developments (such as along Pine Valley Creek in San Diego County) may reduce the calling rate of male arroyo toads (Sweet 1992, Jennings and Hayes 1994), potentially reducing reproductive effort. Because little is known about arroyo toad overwintering ecology, the effects of fall and winter use of campgrounds on stream terraces and in adjacent uplands are unknown.

Fishermen also pose a problem for larval and adult arroyo toads, and hunters have similar effects in some areas (Sweet 1992; D. C. Holland, *in litt.* 1998). Trampling and the disturbance of stream side gravels is likely to occur, since many fishermen in southern California fish for native or stocked trout (*Onchorynchus mykiss*) in streams during the toad's breeding and larval development seasons, when eggs and larvae are present in pools and juveniles are vulnerable on open sand and gravel bars. The problem is exacerbated by fishermen walking along open sand and gravel bars or in the shallow portions of the streams to access suitable sites. Even a few trips up and down streamside gravel bars or pools can kill many toads. The problem is particularly apparent near campgrounds where individuals often walk back and forth from the stream to the campground several times a day and inadvertently kill toads with each trip. This problem is most apparent in heavily used areas that are convenient to public access. Such areas include Sespe Creek, Piru Creek, Castaic Creek, and Little Rock Creek. In general, people are attracted to and recreate in the open sandy areas of drainages; their activities conflict with the needs of arroyo toads for breeding and development.

Hikers, mountain bikers, and equestrians also can have serious detrimental effects on arroyo toad breeding habitats if activities are concentrated in the stream courses and riparian areas. Mountain biking can increase erosion on streamside trails and lead to siltation of breeding pools. Hobbling or tethering horses in riparian areas will have effects similar to those caused by cattle, and allowing horses to play in streams can lead to the death of tadpoles and toads, and decrease

recruitment (Kate Symonds, U.S. Fish and Wildlife Service, Ventura, pers. comm. 1998; T. C. Farley, California Department of Fish and Game, *in litt.* 1998).

Introduced Plants and Animals

The introduction of aquatic predatory organisms that did not co-evolve with arroyo toads can cause substantial reductions in the size of extant arroyo toad populations and may have contributed to extirpation of some populations of the species (Jennings and Hayes 1994), such as along the upper Santa Ynez River where bullfrogs and crayfish now are well established in former arroyo toad habitat. The introduction of aquatic species not native to southern California watercourses has been facilitated by construction of the California Aqueduct and other sources of interbasin transport. Currently, the California Aqueduct is linked directly to the Santa Ynez River, Santa Clara River, San Jacinto River, and Mojave River basins, and more connections are proposed. Predatory species, many of which have used the aqueduct to colonize these river basins, include green sunfish, largemouth bass, black bullhead, prickly sculpin, stocked rainbow trout, oriental gobies (*Tridentiger* spp.), red shiners (*Cyprinella lutrensis*), and crayfish. Several of these species have been shown to feed on arroyo toad larvae in laboratory trials (Sweet 1992), and could cause high larval mortality in arroyo toad breeding pools in the wild. They tend to build up large populations in the artificial reservoirs that have been created in arroyo toad habitats. In many cases these populations extend from the reservoirs into the streams. These species could also harbor disease organisms to which arroyo toads may be susceptible.

In addition to these predators, introduced bullfrogs and African clawed frogs (which are aggressive colonizers) are present on many streams that support arroyo toad populations. Bullfrogs are documented predators of arroyo toads, and African clawed frogs are potential predators. Artificially sustained flow regimes and activities that create ponds (including the introduction of beaver into central and southern coastal montane regions) make habitat more suitable for bullfrogs and African clawed frogs than for arroyo toads (Sweet 1992; M. R. Jennings, unpubl. data). Adult bullfrogs have been observed to eat juvenile and adult arroyo toads in the wild (Sweet 1993, Griffiths 1998) and they are suspected of causing the localized decline of several native amphibians in California (Jennings and Hayes 1994). The spread of African clawed frogs in southern California may also

be increased unwittingly by the planting of mosquitofish by vector control agencies, due to the presence of African clawed frog larvae in several mosquitofish source ponds in San Diego County (R. N. Fisher, pers. comm. 1997). Mosquitofish may have negative effects on arroyo toads, although this has not yet been documented. Introduced species also may compete with larval and post-metamorphic arroyo toads for food.

In addition to the above aquatic predators, there also are introduced terrestrial predators such as the opossum that have built up large populations in southern California, including some in areas still inhabited by arroyo toads. For example, opossum tracks are very common along the Santiago, Cristianitos, Gabino, La Paz, and San Juan Creek drainages in Orange County and they probably eat arroyo toads if the opportunity arises (P. H. Bloom, *in litt.* 1997). The development of rural areas also increases the amount of garbage available to native animals that thrive in such situations. These include American crows, common ravens, and raccoons, which may become very efficient at feeding on arroyo toads. Although native, raccoons are often relocated by animal damage control personnel. Large numbers released in limited areas over a short time span can have a serious detrimental effect on arroyo toads and other sensitive species (M. Freel, pers. comm. 1997).

An additional negative effect of development and human-produced garbage is the establishment of introduced Argentine ants (*Linepithema humile*, formerly *Iridomyrmex humilis*). It is not known if the ants are a direct threat to arroyo toads, but they colonize disturbed areas and build up large colonies. In doing so, they also eliminate the native ant fauna that is a major food source of the arroyo toad (Ward 1987, Holway 1995, Human and Gordon 1997). Argentine ants are well established in some arroyo toad habitats such as the lower portion of the Santa Margarita River (M. R. Jennings, unpubl. data).

In addition to the introduced predators, introduced plants can have a negative effect on arroyo toads and their habitat. Tamarisk and giant reed colonize newly created flood terraces and soon become an impenetrable mass of vegetation. They also stabilize stream terraces and help to deepen flood channels, resulting in habitat unsuitable for arroyo toads. Dense stands may have higher rates of

evapotranspiration than native vegetation, increasing the rate at which breeding pools dry. Such stands may also alter fire regimes within the riparian zones. The spread of introduced plants is a major threat to arroyo toad populations on Castaic Creek in Los Angeles County, and San Onofre and San Mateo Creeks, the lower Santa Margarita River, the San Luis Rey River, and other drainages in San Diego County (S. S. Sweet, pers. comm. 1997; D. C. Holland, *in litt.* 1998; P. H. Bloom, pers. comm. 1999).

Other introduced plants that make riparian and upland habitats unsuitable for arroyo toads include white sweetclover (*Melilotus alba*) and iceplant (*Mesembryanthemum* spp.) (S. S. Sweet, pers. comm. 1997). White sweet-clover becomes so well established that it often acts as a debris trap covering most or all of the available sandy stream terraces required by toads for burrowing. Iceplant tends to take over large areas of upland coastal sage, grasslands, and chaparral, eliminating the native flora over time. It creates dense thickets of foliage that arroyo toads cannot get through or use for cover. Iceplant also supports very few native invertebrates, the potential food items of arroyo toads.

The problems of introduced plants and animals negatively affecting arroyo toads are becoming very serious. Almost all the known sites where arroyo toads are present have at least one introduced plant or animal, and many have several. The problem is particularly acute with introduced plants at lower elevations in Orange and San Diego Counties. The situation will continue to degrade in favor of the exotics unless methods can be found to control the growth and colonization of these species.

Natural and Unnatural Disturbances

Because arroyo toad habitats have been and are being affected by human activities, small isolated populations are at risk due to natural disturbances such as extended droughts, fires, and rare large floods. Drought, especially of prolonged duration, results in a temporary loss of suitable habitat, particularly breeding pools. The number and intensity of floods decreases during droughts, limiting the formation and filling of breeding pools in flood channels. Adult and juvenile toads are affected directly by droughts when suitable foraging conditions occur for shorter time periods. Female toads in particular may be adversely affected by

drought. Two months of intensive feeding effort are required for vitellogenesis (yolk production) (Sweet 1992). Under drought conditions, females may not be able to obtain adequate energy reserves for egg production before the male toads cease calling, leading to reproductive failure for that season. If the life span of the arroyo toad averages 5 years or less (Sweet 1992, 1993), prolonged droughts could prevent successful breeding or recruitment long enough to extirpate some populations. Natural cycles of drought and flood can have beneficial effects by reducing or eliminating populations of introduced species that did not evolve under similar conditions.

Large floods are rare but can affect arroyo toads by excessive scouring and sedimentation, washing out adult habitat on upper alluvial benches, altering the quality of breeding pools and juvenile arroyo toad habitat. Such floods can be beneficial in that dense vegetation may be removed from stream banks and terraces, providing additional breeding and foraging habitat. Unseasonal floods can wipe out an entire watershed's reproductive effort by scouring eggs or larvae out of breeding pools, or depositing silt in downstream breeding pools. The impacts are compounded by human activities such as water releases and flood control structures (see the discussion above). Urban developments can increase the frequency and intensity of floods, and the runoff is likely to contain contaminants such as hydrocarbons, fertilizers, and pesticides. These effects need to be addressed in large scale urban and industrial expansion planning efforts.

Periodic fires affect arroyo toads by causing direct mortality and destruction of streamside or terrace vegetation. Erosion increases following both natural and human-caused fires, including large debris flows that can be triggered by small amounts of rain (less than 15 millimeters [0.6 inch]) (Winter 1995). Such erosion can cause major changes in stream morphology and composition, reducing the number and size of pools. Those changes can affect the amount of habitat available for amphibian breeding and rearing, reducing reproductive output and recruitment (S. S. Sweet, *in litt.* 1997; Gamradt and Kats 1997). The actual effects of individual fires on arroyo toads and their habitat will depend on several factors, including the time of year, time since last burn, soil type, topography, and rainfall.

Although fire is a natural occurrence in coastal California, and thus a characteristic of the environment in which the arroyo toad evolved, human activities have altered the normal patterns of fire, both spatially and temporally. Historically, the erosion following fires may have been an important source of sediments for the stream systems (Shawna L. Bautista, Angeles National Forest, *in litt.* 1998), reestablishing eroded sandbars and gravel banks. The loss of habitat to dam construction, agriculture, and urban development has altered the habitat mosaic inhabited by toads and has decreased the availability of areas suitable for use by arroyo toads following fires. Because riparian zones have been affected by fire suppression, the invasion of exotic plant species, and increased human activities, fires now tend to be more frequent in those zones, especially near established campgrounds and recreational areas. This altered regime may have negative impacts on the stability of breeding pools, sand and gravel bars, and streamside terraces. Altered fire regimes in the surrounding uplands may affect the suitability of soils for burrowing and the capacity of vegetation to provide cover for migrating toads as well as their prey base. Prescribed burns may be appropriate as a management tool under some circumstances, such as where past fire suppression efforts have allowed an abnormal build-up of fuels.

In 1991, the Lions Fire on upper Sespe Creek of the Los Padres National Forest, which started in the riparian zone, severely altered habitat for the single largest extant population of arroyo toads known at that time and the only population known to have successfully reproduced in the northern part of its range from 1989 to 1991 (Sweet 1992, 1993). The result of the fire was extensive erosion from the terraces, filling of breeding pools, and loss of arroyo toad reproduction through 1995 (S. S. Sweet, *in litt.* 1997). Reproduction occurred in 1996, 1997 (Los Padres National Forest survey records), and 1998 (McLaughlin, pers. obs.). In 1998, Lion and Beaver campgrounds were closed to the public due to extensive landslides on a nearby State highway as a result of El Niño conditions. The lack of human disturbance was undoubtedly a factor in the large numbers of tadpoles and metamorphic toads observed in the vicinity of both campgrounds.

Conservation Measures

A number of tools are available to effect conservation of the arroyo toad; some have been utilized to a greater extent than others. Below is a summary of agencies at the Federal, State, county, and local levels, that have jurisdiction over lands supporting these species, the authorities available for conserving arroyo toads and their habitats, and some of the conservation actions that have been implemented.

FEDERAL

- Fish and Wildlife Service

The arroyo southwestern toad was listed as endangered in accordance with section 4 of the Act on December 16, 1994 (59 FR 241: 64859 – 64866). Section 4 further directs the Service to develop and implement recovery plans for listed species; this document was developed according to that direction and following "Guidelines for Planning and Coordinating Recovery of Endangered and Threatened Species" (Service 1990). Once a species has recovered and is removed from the list, the Service must, in cooperation with the State of California, "effectively monitor for not less than five years" the species' status, and the Service must be prepared to restore the species to the list if necessary. Section 5 of the Act authorizes the Department of the Interior to acquire habitat essential to preserving listed species, and section 6 directs the Service to cooperate with the State of California to maintain adequate programs for their conservation. Through Section 7 of the Act, Federal agencies are required to use their authorities to carry out programs for the conservation of listed species and to consult with the Service when a Federal action may have an effect on listed species. Section 9 of the Act provides for protection of listed species, and section 10 permits exceptions to the protections granted under section 9. The exceptions are permitted in the form of scientific, recovery, and incidental take permits, and other circumstances as detailed in section 10.

The Service funded the National Biological Service (now the Biological Resources Division of the U.S. Geological Survey) to review the available literature on arroyo toads and provide an accessible summary reference for land managers and planners concerned with potential impacts to the arroyo toad (Campbell *et al.* 1996). The document provides a good review of the known

locations and breeding habitat requirements, but includes little information on upland habitat requirements. It does suggest areas in which research is needed.

The Service has conducted numerous formal and informal consultations pursuant to section 7 of the Act with the Army Corps of Engineers (Corps), Department of the Army, Marine Corps, and the Forest Service across the range of the arroyo toad. These consultations resulted in measures to avoid or reduce impacts to the arroyo toad, including bullfrog reduction or eradication, exotic plant removal, habitat restoration and enhancement, cattle exclusion, road and off-highway vehicle trail closures or relocations, campground and recreation area closures and relocations, road crossing improvements and monitoring, upland habitat preservation, and project changes for avoidance of breeding habitat or season.

- Forest Service

In addition to the requirements of Federal agencies set forth in section 7 of the Act, the Forest Service Manual (FSM) establishes policies relating to the management of National Forest lands and resources, including the conservation and management of listed species. National Forest lands are to be managed to encourage species recovery so that they can be reclassified or delisted (FSM 2670.21), and "top priority" is to be placed on the "conservation and recovery of endangered, threatened, and proposed species and their habitats," including avoiding adverse impacts to listed species and their habitats, and protecting individual organisms or populations from harm or harassment (FSM 2670.31). Individual Forests address the management of listed and sensitive species through their Land and Resource Management Plans, and other avenues, such as the Los Padres National Forest Riparian Conservation Strategy and Memorandum of Understanding with the Service for addressing management issues, including reducing impacts to arroyo toads and other riparian-associated resources. The four southern California national forests are currently planning for multispecies conservation for forest and woodland species and habitats, including the arroyo toad.

The earliest efforts to determine the life history and threats to arroyo toads on the Los Padres National Forest were begun in 1980 and were funded privately, by the University of California, Santa Barbara, and by the U.S. Forest Service (Sweet

1992, 1993). The Los Padres National Forest also has participated in some preliminary bullfrog removal and food habits studies in Jameson Lake. In addition to those studies, there have been surveys of known arroyo toad habitats on the Angeles, San Bernardino, and Cleveland National Forests (1992-1998). Wells and Turnbull (1998) documented the presence of low numbers of arroyo toads at scattered locations along approximately 4.3 kilometers (2.6 miles) of Pine Valley Creek in the Upper Cottonwood Creek/Tijuana River basin. Cleveland National Forest plans to continue studies of that population.

The Forest Service has been undertaking measures to promote the conservation and recovery of the arroyo toad. Consultations by the Forest Service with the Army Corps of Engineers and the Service for road maintenance operations should result in avoiding or minimizing impacts to arroyo toads and other listed or sensitive species. Methods to avoid the negative effects of roads on arroyo toads include replacing channel culverts with more appropriate stream crossings. Roadside toad fences and safe road crossings near arroyo toad breeding habitat may reduce mortality. Seasonal closures of campgrounds and roads in arroyo toad habitats on the Los Padres have resulted in increased breeding success in the Upper Santa Ynez River basin. Other measures include restricting access by installing temporary or permanent fencing, closing or rerouting roads and trails, and outreach efforts such as informational signs. Some of these actions have resulted in improvements in arroyo toad reproduction.

The Forest Service regulates prospecting and mining on the Los Padres National Forest by requiring a Notice of Intent to be filed and a Plan of Operation to be developed to ensure protection of the arroyo toad and other sensitive species. Upper Piru Creek is under consideration for adoption into the Wild and Scenic Rivers program. Because of this, it has been withdrawn, at least temporarily, from mineral entry (M. Freel, pers. comm. 1999). Although a permanent withdrawal can take several years to implement, the strategy could be used to protect arroyo toads and other sensitive species on additional drainages subject to mining and prospecting activities.

The Angeles National Forest closed portions of Little Rock Creek to protect the arroyo toad from April 1 to October 1, beginning in 1996. Unfortunately, there

were many violations of the closures, with nearly 200 citations being issued in a single week. As a result, the Forest closed approximately 3000 acres (1200 hectares) of the watershed in January 1999, to all use, year-round, until February 2003. This closure will affect one campground and two off-highway vehicle routes. The closure will be maintained or modified based on the results of survey and monitoring efforts (M. Rogers, *in litt.* 1999).

The San Bernardino National Forest has instituted programs to reduce or eliminate off-highway vehicle use on the Mojave River, Deep Creek, and Little Horsethief Creek, to control livestock use of the Deep Creek drainage, and to control prospecting and mining activities in Little Horsethief Creek. These actions were undertaken both to protect arroyo toads and to enhance the health of the riparian systems. These actions have reduced negative effects to the arroyo toads and their habitat, but it is too soon to assess the effects on reproduction and recruitment.

The Los Padres, Angeles, and Cleveland National Forests have consulted with the Service regarding grazing on their lands; these consultations have resulted in the adjustment of allotment boundaries, closing of allotments, and fencing of sensitive habitats. Some of these measures were put into effect before the consultations were completed. Approximately 40 miles of riparian habitat within the Cleveland National Forest, including several known arroyo toad breeding localities, has been excluded from grazing (A. S. Fege, *in litt.* 1998). Efforts are being made to remove or reduce exotic plant and animal populations in several areas, including the Upper Santa Ynez basin on the Los Padres National Forest, and San Francisquito Creek on the Angeles National Forest. Forest Service personnel have also worked with animal control agencies to reduce the releases of raccoons and opossums in arroyo toad habitats.

- Department of Defense

The Department of Defense Directive 4715.1, Environmental Security, establishes policy for environmental security within the Department of Defense (Defense) and establishes various Boards and Councils to ensure the policies are carried out. The Directive established policies that include, in part, integrating environmental factors into the Defense decision-making process; complying with applicable

United States statutes, regulations, Executive orders, binding international agreements, other legal requirements, and United States environmental policies; protecting, preserving, and, when required, restoring and enhancing the quality of the environment; reducing risk to the environment by identifying, evaluating, and where necessary, remediating contamination resulting from past Defense activities; preventing pollution and minimizing adverse environmental impacts; conserving, and restoring where necessary, the natural heritage represented on Defense installations within the United States; cooperating with and involving appropriate United States Federal, State, inter-State, Indian Nation and local officials, and public stakeholders in the implementation of environmental security programs; and integrating environmental values into Defense acquisition, procurement, maintenance, and repair processes for systems, equipment, facilities, and land.

The Department of Defense Instruction 4715.3, Environmental Conservation, implements policy, assigns responsibilities, and prescribes procedures under the Directive for the integrated management of natural and cultural resources on property under Defense control; authorizes the publication of "A Resource Manager's Guide to Volunteer and Partnership Programs" and "A Guide to Integrated Natural Resources Management;" establishes the Conservation Committee that reports to the Environmental Safety and Occupational Health (ESOH) Policy Board, and designates "Executive Agents" to lead Defense implementation of key conservation issues. The Instruction applies to all Defense organizational entities, including the Army, Navy, Air Force, and Marine Corps (Military Services); and to all Defense activities, installations, and lands in the U.S. and its territories. Although the primary mission of Defense is to support realistic military training and testing activities, programs, and facilities, policies implemented under this instruction direct, in part, that 1) conservation programs ensure that the natural resources are sustained in a healthy condition for scientific research, education, and other compatible uses by future generations; 2) facilities and installations shall achieve, monitor, and maintain compliance with all applicable Executive orders and Federal natural resources statutory and regulatory requirements; 3) internal and external conservation self-assessments shall be conducted at appropriate intervals; 4) natural resources shall be managed to protect and enhance those resources for multiple use, sustainable yield, and

biological integrity; 5) land use practices and decisions shall be based on scientifically sound conservation procedures and techniques, and use scientific methods and an ecosystem approach; 6) biologically significant or sensitive natural resources or species shall be inventoried and managed to protect these resources and to promote biodiversity; 7) threatened and endangered species management and recovery efforts on Defense lands and waters shall be consistent with other legal mandates during consultation, species recovery planning, and management activities; 8) opportunities to conserve Federally listed species and the ecosystems on which those species depend shall be identified. The Instruction also specifies many other policies to conserve, maintain, restore, and rehabilitate ecosystems.

The Military Services have developed further guidelines, such as the Marine Corps Environmental Compliance and Protection Manual. The Manual establishes Marine Corps policy and responsibilities for compliance with procedural and statutory requirements for managing natural resources at Marine Corps installations. Among other things, the Manual identifies Federal Acts and Executive Orders that relate to natural resource protection and management, summarizes the requirements under those regulatory mechanisms, and provides guidance on how those requirements will be met.

Camp Pendleton completed a consultation that included ongoing training, maintenance, and specific projects on October 30, 1995 (Service 1995). This consultation addressed the impacts of these activities only on riparian and estuarine/beach ecosystems. One of the main goals of the consultation is to maintain the natural processes of the wetland habitats. The biological opinion provides instructions focused on avoidance, minimization, and mitigation measures. For all unavoidable impacts to these ecosystems, the primary mitigation measure is the removal of giant reed. Camp Pendleton is currently in the early stages of a programmatic consultation involving species that use upland habitat, including the arroyo toad.

Surveys for arroyo toads and other amphibians have been conducted on Fort Hunter Liggett (1996-1998) and Camp Pendleton (1995-1998). The Camp Pendleton surveys were especially important in documenting differences in habitat

use between populations in the northern and central portions of the range. Toads in the central portion use smaller streams and deeper canyons, have different activity patterns (breeding as early as January, juveniles remaining at streamside longer), and exhibit different movement patterns (may move further from streams) (D. Holland, *in litt.* 1997; pers. comm. 1999) than toads in more northerly areas (Santa Barbara and Ventura Counties) where they have been studied intensively (Sweet 1992, 1993).

Grazing on Fort Hunter Liggett was halted in 1991 due to drought conditions. In 1996, arroyo toads were found at two locations approximately 8 kilometers (5 miles) apart on the San Antonio River (U.S. Army Reserve Command 1996). In 1997, arroyo toads were found at about a dozen locations along approximately 28 kilometers (17 miles) of the river (H. Hormann, *in litt.* 1997). The cessation of grazing along the river is believed to be the most significant factor in the recovery and expansion of the arroyo toad population (U.S. Army Reserve Command 1996, Service 1997).

- Army Corps of Engineers

The Army Corps of Engineers (Corps) has jurisdiction for implementing section 404 of the Clean Waters Act of 1972 (CWA) and section 10 of the Rivers and Harbors Appropriation Act of 1899 (RHAA). Along with the Environmental Protection Agency, the Service, and the Natural Resources Conservation Service, the Corps has the authority to identify and delineate wetlands. The Corps and Environmental Protection Agency have the authority to make jurisdictional determinations under Section 404, and the Corps has the authority to issue permits regarding dredging, filling, and construction in wetlands and waterways, including those inhabited by arroyo toads. Under section 7 of the Act, The Corps must consult with the Service before issuing a permit for any action that may affect arroyo toads or their habitat.

STATE

The State of California has several departments whose jurisdiction includes arroyo toads and their habitats.

- The California Department of Fish and Game (Department) funded a project to determine the overall status of various species of amphibians and reptiles in the State, including the arroyo toad (Jennings and Hayes 1994). This study helped determine the overall historic range and current status of arroyo toad populations in southern California through 1994, and resulted in the arroyo toad being designated as a Species of Special Concern by the State, which affords it consideration under the California Environmental Quality Act Section 15380. The arroyo toad is designated a "protected amphibian" under the Fish and Game Code, which prohibits any take without a special permit (T. C. Farley, *in litt.* 1998). The Department also funded surveys for arroyo toads in potential habitats during the summers of 1992 and 1993. Those efforts located arroyo toad populations in Castaic Creek, San Juan Creek, and the Santa Margarita River (Campbell *et al.* 1996).

The Department recognizes suction dredge mining as a threat to arroyo toad populations and habitats. Permits for mining activities are issued by the Department, which also has the authority to designate streams as "Class A, no dredging permitted at this time." Currently, the Department is preparing an environmental impact review of mining activities statewide. The Department has been requested by the Cleveland National Forest to designate streams with known arroyo toad populations as Class A (Fege, *in litt.* 1998), in addition to the National Forest's own conservation efforts. Federal and State agencies need to work together to determine which streams should be closed to mining and prospecting activities.

Arroyo toads currently are being addressed in the Department's Natural Community Conservation Planning (NCCP) process. Specifically, they are included in the Orange County Central/Coastal Subregion NCCP/Habitat Conservation Plan (HCP) and the San Diego County Multi-Species Conservation Plan (MSCP) (discussed below under County Agencies).

- California Department of Parks and Recreation policies include a directive "in concert with other agencies and organizations, to acquire and preserve outstanding examples of native California species; and to acquire and perpetuate significant natural plant communities, associations, and examples of rare, endangered, and

endemic, or otherwise sensitive native California plants, as indicated on State and Federal lists." (State Park and Recreation Commission 1994). Arroyo toads do occur on lands owned and managed by Parks and Recreation at Cuyamaca Rancho State Park, and may occur on other Park lands, particularly Lake San Antonio Recreation Area (Monterey County), Castaic Lake State Recreation Area (Los Angeles County), Silverwood Lake State Recreation Area (San Bernardino County), and Palomar Mountain State Park and Anza-Borrega State Park and Wilderness Area (San Diego County). Other Park lands also may harbor arroyo toads.

COUNTIES

The arroyo toad occurs in 9, possibly 10, counties in California. Regulations and provisions for addressing threatened and endangered species vary from county to county. Listed species can be addressed at both county-wide levels, such as in the development of General Plans, and on a project-by-project basis. There are no large scale planning efforts in the northern portion of the species' range comparable to those in the central portion of the range. Even if such efforts were occurring, they would have little impact on northern arroyo toad populations, as nearly all of them are on Federal lands. However, many populations or subpopulations of arroyo toads in Orange, Riverside, and San Diego Counties are found on private, city, or State lands and are addressed through the State NCCP and Federal HCP processes.

The arroyo toad has been identified as a "conditionally covered" species by the Orange County Central/Coastal Subregion NCCP/HCP. "Conditional coverage" allows for projects to proceed within the Central/Coastal subregion that will impact "smaller [arroyo toad] populations (including the lower Limestone Canyon population [unconfirmed]), reintroduced populations, or populations that have expanded due to NCCP reserve management" (pg. II-231, Orange County Central/Coastal NCCP/HCP). However, such projects are still required to be consistent with a mitigation plan that minimizes impacts and affords appropriate feasible protections, and/or arroyo toad relocation coupled with compensatory habitat management and enhancement that maintain the carrying capacity of toads at the relocation site. The NCCP/HCP does not cover habitats that support major arroyo toad populations that play essential roles in the species' distribution in this

subregion.

Two NCCP subregional plans are underway in western San Diego County. The northwestern Multiple Habitat Conservation Plan (MHCP) is in the planning process. The southwestern plan, the Multiple Species Conservation Plan (MSCP), proposes to conserve the known locations of the arroyo toad within Santa Ysabel Creek in San Pasqual Valley, San Vicente Creek above San Vicente Reservoir, Sweetwater River, Otay River, and Cottonwood Creek in Marron Valley. Area-specific management directives for these plans must address the conservation of the arroyo toad by protecting and maintaining sufficient suitable low gradient sandy stream habitat to meet breeding requirements, preserving sheltering and foraging habitats within 1 kilometer (0.6 mile) of occupied breeding habitat within preserved lands, controlling nonnative predators, and controlling human impacts within designated preserves.

OTHER LOCAL JURISDICTIONS

- Water Districts

Several water districts manage lands, dams, and reservoirs within the range of the arroyo toad, and within occupied drainages. These include Montecito Water District (Santa Barbara County), United Water Conservation District (Ventura County), Castaic Water District (Los Angeles County), Vista Irrigation District, Helix Water District, the City of San Diego, and Sweetwater Authority (San Diego County). The operations of other water districts also may affect arroyo toads and their habitat.

Montecito Water District, the Los Padres National Forest, and the Service have been working on modifications to water diversion schedules associated with Jameson Lake and nearby creeks. Recent coordination between Castaic Water District, the California Departments of Water Resources and Fish and Game, the Angeles and Los Padres National Forests, and the Service have resulted in releases from Pyramid Dam on Piru Creek that more closely mimic natural flows in lower Piru Creek. The modified releases have benefitted arroyo toads in lower Piru Creek (S. S. Sweet, pers. comm. 1997). The Cleveland National Forest and the City of San Diego are cooperating in determining water release patterns from Lake Morena that will minimize negative effects on arroyo toads (A. S. Fege, *in*

litt. 1998), but no data are available yet to evaluate the results of the modified regimes.

The Sweetwater Authority, which manages lands and water in the Sweetwater River basin, has been conducting surveys for arroyo toads (W. E. Haas *et al., in litt.* 1998), monitoring breeding and upland areas, and removing exotic plants and animals. They are participating in the NCCP process, with the goals of maintaining and optimizing the "water operations while allowing for the protection of multiple habitats and species," and are developing a Watershed Management Program with the participation of various stakeholders in the basin (Dennis Bostad, Sweetwater Authority, Chula Vista, California, *in litt.* 1998).

POTENTIAL CONSERVATION MEASURES

In addition to the types of tasks described in the recovery task narrative in Part II, there are general guidelines that are appropriate for many projects. The following steps and measures should be taken on all projects within the current and historic range of the arroyo toad where habitat conditions are suitable for the species. Each project must be evaluated to assess the need for further conservation measures or restrictions.

As early as possible in the project design phase, assess the potential for the work site to support the arroyo toad or other sensitive species. Such assessments shall be conducted by qualified biologists using approved methods or protocols.

Request input from the Service and other relevant regulatory agencies early in the project design phase. Staff from these agencies can provide project proponents with technical assistance on measures to reduce the project's impacts on arroyo toads and habitat. For certain types of projects, proper project design or timing may avoid effects to the extent that authorization for incidental take is not necessary. Therefore, the project proponent may save considerable time in receiving approval from the Service. Projects that are well designed from the early stages can be efficient for both the proponent and the Service by reducing the time, number of meetings, and the number of

times project proposals are reviewed. Well-designed projects also may benefit the species.

Measures to avoid or reduce impacts by projects vary on a case-by-case basis. However, the following measures have become standard for a majority of projects that are conducted in arroyo toad habitat. The Service may modify some of the measures as appropriate for each given case, and additional measures may be included as appropriate. Adherence to these recommendations does not preclude the need for take authorization. The take authorization or permit issued by the Service may incorporate some or all of the protection measures presented in this document. The take authorization or permit may include measures specific to the needs of the project, and those requirements supersede any requirements found in this document.

1) A qualified biologist shall conduct a training session for all project personnel prior to proposed activities. At a minimum, the training shall include a description of the arroyo toad and its habitats, the general provisions of the Endangered Species Act (Act), the need to adhere to the provisions of the Act, the penalties associated with violating the provisions of the Act, the general measures that are being implemented to conserve the listed species as they relate to the project, and the access routes to and project site boundaries within which the treatments may be accomplished.

2) Access to sites shall be via pre-existing access routes to the greatest extent possible. Project-related vehicle travel should be limited to daylight hours as arroyo toads use roadways primarily during night time hours.

3) The footprint of disturbance shall be minimized to the maximum extent feasible.

4) A water pollution control plan shall be developed that describes sediment and hazardous materials control, dewatering or diversion structures, fueling and equipment management practices, and other factors deemed

necessary by reviewing agencies.

5) The upstream and downstream limits of project disturbance plus lateral limits of disturbance on either side of the stream shall be clearly defined and marked in the field and reviewed by the biologist prior to initiation of work.

6) Projects should be designed to avoid the placement of equipment and personnel within the stream channel or on sand and gravel bars, banks, and adjacent upland habitats used by toads.

7) Projects that cannot be conducted without placing equipment or personnel in sensitive habitats should be timed to avoid the breeding season of the arroyo toad (generally March through August) when eggs and tadpoles are present. To minimize further effects to breeding populations and to reduce sedimentation and erosion, such projects should be timed so that work within or near the stream channel is conducted during the dry season when flows are at their lowest or are nonexistent.

8) When stream flows must be diverted, the diversions shall be conducted using sandbags or other methods requiring minimal instream impacts. Silt fencing or other sediment trapping materials shall be installed at the downstream end of construction activity to minimize the transport of sediments off-site. Settling ponds where sediment is collected shall be cleaned out in a manner that prevents the sediment from re-entering the stream. Care shall be exercised when removing silt fences, as feasible, to prevent debris or sediment from returning to the stream.

9) Equipment storage, fueling, and staging areas shall be located on upland sites with minimal risks of direct drainage into riparian areas or other sensitive habitats. All necessary precautions shall be taken to prevent the release of cement or other toxic substances into surface waters. All project related spills of hazardous materials shall be cleaned up immediately and contaminated soils removed to approved disposal areas.

10) Erodible fill material should not be deposited into water courses. Brush, loose soils, or other similar debris material shall not be stockpiled within the stream channel or on its banks.

11) The project biologist shall visit the work site periodically throughout the duration of the project to ensure that all practicable measures are being employed to avoid incidental disturbance of stream habitat and any listed species. The project biologist should be empowered to halt work activity if necessary and to confer with staff from the Service to ensure the proper implementation of species and habitat protection measures.

12) The removal of native vegetation should be minimized. The work site should be returned to pre-existing contours and revegetated with appropriate native species.

13) Bullfrogs and other exotic species which prey upon or displace listed species should be permanently removed from the wild.

14) To avoid attracting predators of the arroyo toad, the project site shall be kept as clean of debris as possible. All food related trash items shall be enclosed in sealed containers and regularly removed from the site(s). Pets of project personnel shall not be allowed on-site where they may come into contact with any listed species.

15) To minimize the injury to or mortality of individual arroyo toads, the Service may authorize qualified project biologists to relocate individual arroyo toads out of harm's way to nearby suitable habitat. Such authorization would be granted only through a biological opinion, prepared by the Service, pursuant to section 7 of the Act, or through the issuance of an incidental take permit by the Service, pursuant to section 10(a)(1)(B) of the Act. Recovery permits are not appropriate to authorize the take associated with the relocation of listed species to avoid project-related effects.

If dead or injured arroyo toads are located, initial notification must be made within three working days, in writing, to the Service's Division of Law Enforcement in Torrance, California (370 Amapola Avenue, Suite 114, Torrance, California 90501), and by telephone and in writing to the Ventura Field Office in Ventura, California, (2493 Portola Road, Suite B, Ventura, California 93003, 805/644-1766). The report shall include the date, time, location of the carcass, a photograph, cause of death, if known, and any other pertinent information.

Care shall be taken in handling injured animals to prevent additional injury. Injured animals may be released to the wild after receipt of concurrence from the Service. Care shall be taken in handling dead specimens to preserve biological material in the best possible state for later analysis.

The remains of intact arroyo toads shall be placed in appropriate museums or collections, such as the California Academy of Sciences Herpetology Department in San Francisco, the San Bernardino County Museum in Redlands, The Los Angeles County Museum of Natural History in Los Angeles, or the San Diego Natural History Museum in San Diego. Other institutions also may be appropriate. Arrangements regarding proper disposition of potential museum specimens shall be made with the appropriate institution by the project monitor prior to implementation of the action.

Recovery Strategy

The recovery strategy for the arroyo toad is focused on providing sufficient breeding and upland habitat to maintain self-sustaining populations of arroyo toads throughout the historic range of the species in California, and minimizing or eliminating impacts and threats to arroyo toad populations. Self-sustaining populations are those documented as having successful recruitment (i.e., inclusion of newly matured individuals into the breeding population) equal to 20 percent or more of the average number of breeding adults in 7 of 10 years of average to above average rainfall amounts with normal rainfall patterns. Such recruitment would be documented by statistically valid trend data indicating stable or

increasing populations. The level of recruitment is based on the currently available information, which indicates that arroyo toads may live for only about 5 years, and that losses of overwintering adults can be high. Having 20 percent or greater recruitment in 7 of 10 good rainfall years should provide a sufficient population base to maintain the population through adverse conditions such as during drought years, high flow years, or following fires. Years with appropriate rainfall will be determined by the review of available climatological data.

Self-sustaining populations require little or no direct human assistance such as captive breeding or rearing, or translocation of arroyo toads between sites. Indirect assistance may continue to be needed, such as patrolling or closing of roads, campgrounds, or recreational areas, or maintaining stream crossings or fencing. Protected areas must be large enough to allow a dynamic spatial and temporal distribution of suitable breeding, foraging, dispersal, and migration habitats in the event of random natural or human-related events such as fires, floods, and droughts. Protection and management of areas on a watershed basis is the most effective means of achieving such distributions of habitat. This plan prescribes specific tasks necessary to maintain healthy aquatic, riparian, and adjacent upland ecosystems that provide habitat for arroyo toads.

The recovery strategy for the arroyo toad consists of five parts: 1) stabilize and maintain populations throughout the range of the arroyo toad in California by protecting sufficient breeding and nonbreeding habitat, 2) monitor the status of existing populations to ensure recovery actions are successful, 3) identify and secure, by appropriate management and monitoring, additional suitable arroyo toad habitat and populations, 4) conduct research to determine the population dynamics and ecology of the species to guide management efforts and determine the best methods for reducing threats, and 5) develop and implement an outreach program. The five parts of the strategy will work as follows:

1) In-stream and riparian habitats that support breeding of arroyo toads, as well as upland habitats that provide foraging and overwintering habitat, need to be managed to maintain and enhance existing populations throughout the range of the arroyo toad in California. Management actions may include, but are not limited to altering water use and control activities, recreational use patterns,

and livestock grazing, and may also include reducing or eliminating introduced plant and animal populations. In addition, ecosystem based conservation plans need to be developed for those portions of the river basins not on Federal lands.

2) Populations should be monitored to assess the effectiveness of the management actions.

3) Potential arroyo toad habitat should be surveyed to locate currently unknown arroyo toad populations. Appropriate management of newly found arroyo toad populations and habitats should be planned and implemented as soon as possible after discovery. Arroyo toads and their habitats may be protected through outright acquisition by Federal, State or local agencies or private, non-governmental organizations, dedication of conservation easements, watershed management plans, habitat conservation plans, and similar avenues. Such plans will include goals, objectives, specific actions and monitoring requirements.

4) Research is needed to determine differences in the arroyo toad's life history traits and ecologic parameters in different parts of its range, to guide management efforts and the development of conservation agreements and plans, and to evaluate the impacts of human activities on arroyo toad populations. Research to determine the criteria for arroyo toad presence in drainages can provide information necessary to guide habitat enhancement and restoration efforts.

5) Development of an outreach program will garner support for the Service's recovery efforts and reduce negative human-related effects on arroyo toad habitats and populations.

An important component of the recovery strategy for the arroyo toad is adaptive management. Adaptive management can be defined as an iterative or feedback approach to managing ecosystems, where the precise methods of achieving the desired objectives are unknown or uncertain, with the goal of improving the outcome (Holling 1978, Walters 1986). Under adaptive management, the

possibility for changes to the original plan is understood. The basic framework of adaptive management consists of six parts: 1) assessment of the available information; 2) establishment of goals, objectives, and criteria; 3) determination and implementation of tasks to achieve the objectives; 4) establishment of a monitoring program; 5) evaluation of the results of the monitoring activities; and 6) changing the tasks as appropriate. Tasks that are not successful should be modified or deleted. Only those tasks that are successful should be continued and incorporated into future plans.

This recovery plan is based on the best available information. The recovery objectives (downlisting and delisting) are intended to be accomplished by the implementation of specific recovery tasks, some of which will provide information on which future management actions and recovery tasks will be based. Although some site-specific tasks have been detailed below, it is impossible at this time to determine appropriate actions for each known arroyo toad population and potential site. Site-specific tasks will be determined on a case-by-case basis through appropriate planning and consultation processes. Monitoring of toad populations will allow determination of the most effective and appropriate methods for protecting, stabilizing and rehabilitating arroyo toad habitats and managing the populations. Monitoring in an adaptive management context focuses on early identification of undesirable trends and provides the guidance, through contingency plans and a flexible management approach, to determine the appropriate remedial action to reverse an undesirable situation or trend. Review of the monitoring data will allow land managers to continue appropriate activities or to make necessary changes in management direction.

Recovery Units

Arroyo toads survive in areas that are ecologically and geographically distinct from one another, and the threats in those areas differ. To better address the recovery needs of the arroyo toad in each of theses areas, we have established three recovery units, identified as Northern, Southern, and Desert, that reflect the ecological and geographic separations, and cover the known and historic range of the species. Stabilizing and expanding the populations in these units will preserve the species' genetic diversity as well as the distinct ecological environments in which the species is found. The recovery units are based on U.S. Geological

Survey hydrologic subregion and accounting unit boundaries as delineated on the "Hydrologic Unit Map — 1978, State of California (South Half)." All units are in Region 18 (California), and are in subregions 6 (Central California Coastal), 7 (Southern California Coastal), 9 (Northern Mojave-Mono Lake), and 10 (Southern Mojave-Salton Sea).

The Northern Recovery Unit encompasses arroyo toad populations and habitat in Monterey, San Luis Obispo, Santa Barbara, and Ventura Counties, and on the coastal slopes of Los Angeles County. All of the arroyo toad locations currently receiving protection and management are on Federal lands. There are unconfirmed reports of arroyo toads on a few private lands. The threats to arroyo toads in the Northern Recovery Unit are of low to moderate intensity, and management efforts have been successful in reducing some of the negative impacts. Continued monitoring of the populations and modification of management efforts to increase protection is warranted.

The Southern Recovery Unit encompasses arroyo toad populations and habitat in the coastal drainages of Orange, San Bernardino, Riverside, and San Diego Counties. Arroyo toads occur on Federal, State, County, City, water district, and private lands in these counties. The threats are moderate to high, and will continue to increase as the demands for suitable development sites continue. As the human population grows, the negative effects from increased water needs and recreational desires will put more pressure on the remaining habitats, even those sites receiving some protection.

The Desert Recovery Unit includes arroyo toad populations and habitat on streams and rivers that drain the northern and eastern slopes of the San Gabriel, San Bernardino, and peninsular mountain ranges in Los Angeles, San Bernardino, Riverside, San Diego, and Imperial Counties. These streams flow into closed desert basins, including the Antelope Valley, Mojave basin, and the Salton Sea basin. Of the four known populations, two are believed to occur entirely on Federal lands, one on both Federal and private lands, and one is believed to be entirely on private lands. The threats are moderate and are primarily from recreational activities, with some threat of development. Historically known

populations in what is now Anza-Borrego State Park may have been extirpated due to groundwater withdrawal.

Table 1. Recovery units for the arroyo toad.

Northern Recovery Unit

Subregion 6, Central California Coastal (all one accounting unit)

County	River Basin[1]	Stream	Management
Monterey	Salinas	San Antonio River	Fort Hunter Liggett
San Luis Obispo	Salinas	Upper Salinas River[2]	Private
Santa Barbara	Santa Maria	Sisquoc River[3]	Private and U.S. Forest Service (USFS)
	Santa Ynez	Upper Santa Ynez	USFS, Montecito WD
		Indian Creek	USFS
		Mono Creek	USFS
		Agua Caliente	USFS

Subregion 7: Southern California Coastal; accounting unit 1: Ventura-San Gabriel Coastal

County	River Basin	Stream	Management
Ventura	Santa Clara	Sespe Creek	USFS
		Piru Creek	USFS, United Water Conservation District, Private
		Agua Blanca Creek	USFS
		Castaic Creek	USFS, Castaic WD
		San Francisquito and Bouquet Creeks[4]	USFS
Los Angeles (coastal)	Los Angeles	Big Tujunga Creek	USFS
		Mill Creek	USFS
		Alder Creek	USFS
		Arroyo Seco	USFS

Southern Recovery Unit

Subregion 7: Southern California Coastal; accounting unit 2: Santa Ana

County	River Basin	Stream	Management
Orange	Santa Ana	Santiago Creek	Private, USFS
Riverside	Santa Ana	San Jacinto River	Private, USFS
		Bautista Creek	Private, USFS

Subregion 7: Southern California Coastal; accounting unit 3: Laguna-San Diego Coastal

County	River Basin	Stream	Management
Orange	Aliso-San Onofre	San Juan Creek	Private, County, USFS
		Bell Canyon	Private, County
		Trabuco Creek	Private
		San Mateo	Private, Camp Pendleton, USFS
		Cristianitos Ck	Private, Camp Pendleton
		Gabino Canyon	Private
		La Paz Canyon	Private
		Talega Canyon	Private, Camp Pendleton
		San Onofre	Camp Pendleton
Riverside	Aliso-San Onofre	San Juan Creek	USFS
		San Mateo	USFS
	Santa Margarita	Santa Margarita R.	Private, USFS
		Temecula Creek	Private, USFS
		Arroyo Seco Creek	Private, USFS

San Diego	Santa Margarita	Santa Margarita R	Camp Pendleton
		De Luz Creek	Camp Pendleton
		Roblar Creek	Camp Pendleton
		Sandia Creek	Private
	San Luis Rey-Escondido	San Luis Rey River	Private, Indian Reservations, USFS
		Keys Creek	Private
		Pala Creek	Private, Indian Reservation
		Agua Caliente Creek	Private, water districts
	San Diego	San Dieguito River	Private, water districts, USFS
		Santa Ysabel Creek	Private, USFS
		Guejito Creek	Private
		Temescal Creek	City of San Diego, USFS
		Santa Maria Creek	Private
		Witch Creek	Private, USFS
		San Diego River	Private, water districts, USFS, Indian Reservations
		Sweetwater River	Private, water districts, California State Parks, USFS
		Viejas Creek	Private, USFS, Indian Reservations
		Peterson Creek	USFS
		Otay River	Private, water districts
		Dulzura Creek	Private, water districts
	Cottonwood - Tijuana	Cottonwood Creek	Private, water districts, USFS
		Pine Valley Creek	Private, USFS
		Potrero Creek	Private, USFS
		La Posta Creek	Private, USFS

Desert Slope Recovery Unit

Subregion 9: Northern Mojave-Mono Lake; accounting unit 2: Northern Mojave, in part

County	River Basin	Stream	Management
Los Angeles	Antelope-Fremont	Little Rock Creek	Private, USFS
San Bernardino	Mojave River	Little Horsethief Creek	Private, USFS
		Deep Creek	Private, USFS
		Mojave River	Victor Valley Water District, Army Corps

Subregion 10: Southern Mojave-Salton Sea; accounting unit 2: Salton Sea, in part

County	River Basin	Stream	Management
Riverside	Salton Sea	Whitewater River	Private
San Diego		San Felipe Creek	California State Parks
		Vallecitos Creek	California State Parks
Imperial		Pinto Wash	Bureau of Land Management

[1] Basin names correspond to U.S. Geological Survey cataloguing units.
[2] Possible rediscovered or reestablished population on the upper Salinas River.
[3] Potential habitat also exists along the Huasna River and Alamo Creek - private
[4] Potential habitat exists on these creeks

II. RECOVERY

Objectives

This recovery plan defines two objectives: first, to recover the arroyo toad sufficiently to warrant reclassification to threatened status; and second, to recover the species sufficiently to warrant delisting.

Recovery Criteria

Downlisting: The arroyo toad will be considered for reclassification from endangered to threatened status in each recovery unit when management plans have been approved and implemented on federally managed lands to provide for securing the genetic and phenotypic variation of the arroyo toad in each recovery unit by conserving, maintaining, and restoring the riparian and upland habitats used by arroyo toads for breeding, foraging, and wintering habitat. For each recovery unit, the minimum number of self-sustaining metapopulations or populations to be managed, and the targeted river basins, are as follows:

Northern Recovery Unit (7 populations or metapopulations):

Fort Hunter Liggett Army Reserve Training Center

1 population: San Antonio River

Los Padres National Forest

4 populations or metapopulations: Sisquoc River population, Upper Santa Ynez River basin metapopulation (including Indian and Mono Creeks), Sespe Creek population, upper and lower Piru Creek populations

Angeles National Forest

2 populations or metapopulations: Castaic Creek population, Los Angeles River basin metapopulation (including Upper Big Tujunga, Mill, and Alder Creeks)

Southern Recovery Unit (10 populations or metapopulations):

Marine Corps Base Camp Joseph H. Pendleton

2 metapopulations: San Mateo and San Onofre Creeks, Santa Margarita River

Cleveland National Forest

8 populations or metapopulations: San Juan Creek basin, San Mateo Creek basin, Upper Santa Margarita River basin, San Luis Rey River basin, San Dieguito River basin, San Diego River basin, Sweetwater River basin, Tijuana River-Cottonwood Creek basin

Desert Recovery Unit (3 populations or metapopulations)

Angeles National Forest

1 population: Little Rock Creek

San Bernardino National Forest

1 metapopulation: Mojave River basin (including West Fork of the Mojave River, Little Horsethief Canyon, and Deep Creek)

Bureau of Land Management

1 population: Pinto Wash basin, in the Jacumba (In-Ko-Pah Mountains) Wilderness Study Area.

Self-sustaining metapopulations or populations are those documented as having successful recruitment (i.e., inclusion of newly matured individuals into the breeding population) equal to 20 percent or more of the average number of breeding adults in 7 of 10 years of average to above average rainfall amounts with normal rainfall patterns. Such recruitment would be documented by statistically valid trend data indicating stable or increasing populations. In addition, self-sustaining populations require no direct human assistance (such as captive breeding or rearing, or translocation of toads between sites). This does not include activities such as patrolling or closing of roads, campgrounds or recreational areas, or maintaining stream crossings or fencing.

Delisting criteria: The arroyo toad will be considered for delisting when the genetic and phenotypic variation of the arroyo toad throughout its range in California is secured by maintaining 15 additional self-sustaining populations of arroyo toads in coastal plain, coastal slope, desert slope, and desert river basins, including known populations outside of Federal jurisdiction. For each recovery unit, the minimum population numbers and targeted river basins are as follows:

Northern Recovery Unit

There is potential for finding previously unknown populations or of reestablishing populations on rehabilitated habitat in the upper Salinas River, tributaries to the Santa Maria and Sisquoc Rivers, and tributaries to the upper Santa Clara River such as San Francisquito and Bouquet Creeks. At least one additional population should be protected in the northern recovery unit before delisting the arroyo toad.

Southern Recovery Unit

It is essential that at least one existing population on non-Federal lands in each of the following systems (for a minimum of eight protected populations) is protected and managed in order to delist the arroyo toad: 1) San Juan Creek, 2) Santa Margarita River, 3) San Luis Rey River, 4) San Dieguito River/Santa Ysabel Creek, 5) San Diego River, 6) Sweetwater River, 7) Otay River/Dulzura Creek, and 8) Tijuana River-Cottonwood Creek basins. Additional populations, particularly any found in the Santa Ana/San Jacinto River basin, should be protected as appropriate. There may also be opportunities for reestablishing populations, or of finding previously unknown sites.

Desert Recovery Unit

Protection of the two known populations on private and other non-Federal lands in the Mojave River and Whitewater River basins is essential for delisting the arroyo toad. Historically, populations were found in the San Felipe Creek and Vallecitos Creek basins in what is now Anza-Borrego State Park. These drainages, as well as Coyote Creek and other potential desert slope sites should be surveyed and protected as appropriate.

Conserving 15 additional populations, distributed so that each of the above drainages has at least one population, should conserve the full range of genetic and phenotypic variation now found within the species. If populations are rediscovered in historically-occupied drainages, or if new populations are found through survey efforts, those should receive high priority for securing and managing sufficient habitat to maintain viable populations of arroyo toads.

Recovery Task Narrative

Task 1 Secure Populations.

Populations should be secured by protecting, maintaining, restoring, and enhancing breeding and upland habitats by conducting the following:

Task 1.1 Develop and implement management plans.

The objective of the management plans should be to minimize or eliminate impacts to arroyo toads and their habitats on Federal lands (including Forest Service, Military Reservation, and Bureau of Land Management lands) and to reduce conflicts between the needs of the species and the activities of the agencies.

Management plans may include, but are not limited to, tasks that:

Task 1.1.1 Minimize or eliminate impacts to arroyo toads and their breeding habitat near campgrounds to prevent the killing or injury of all life stages of arroyo toads. Actions may include posting of informational signs, fencing of essential areas, seasonally closing or restricting use of campgrounds, closing or relocating campgrounds, as appropriate.

Task 1.1.2 Seasonally close roads and trails in or near, or otherwise limit access to, arroyo toad breeding habitats during the spring and summer to prevent the killing of subadult and adult toads on roads and trails. Such restrictions or closures could apply to regular and off-highway vehicle, bicycle, horse, and foot traffic.

Task 1.1.3 Control mining and prospecting activities in drainages with arroyo toad populations to prevent habitat degradation, death of and injury to toads.

Task 1.1.4 Restrict fishing and other recreational activities in arroyo toad breeding habitats when arroyo toads are present in the stream channel and on the sand and gravel bars (late spring and summer). State and Federal agencies will work together to establish appropriate guidelines for closures or restrictions in

specific areas. Minimizing fishing and other activities will help eliminate trampling of eggs, larvae, and juvenile toads in riparian areas when they are most vulnerable to such activities.

Task 1.1.5 Monitor and remove exotic vegetation (iceplant, tamarisk, and giant reed) in affected drainages. Determine if the removal benefits arroyo toad populations.

Task 1.1.6 Replace inadequate stream crossings on roads within arroyo toad habitats with appropriate crossings (See task 4.4).

Task 1.1.7 Minimize impacts from livestock grazing in arroyo toad habitats. This will prevent the trampling of toads and degradation of their habitat. Where plans already exist, monitor the arroyo toad populations and the results of the management actions and maintain or alter those actions as appropriate.

Task 1.1.7.1 Develop and implement a livestock management plan on the Los Padres National Forest.

Task 1.1.7.2 Develop and implement a livestock management plan on the San Bernardino National Forest.

Task 1.1.7.3 Develop and implement a livestock management plan on the Cleveland National Forest.

Task 1.1.7.4 Develop and implement a livestock management plan on Fort Hunter Liggett.

Task 1.1.7.5 Develop and implement a livestock management plan on Camp Pendleton.

Task 1.1.8 Identify breeding sites (e.g., stock ponds, reservoirs, etc.) of introduced fishes and aquatic predators such as bullfrogs in or near arroyo toad habitat. Eliminate or minimize the production of introduced species at those sites by appropriate management

actions. Prevent further introductions of nonnative aquatic animals into arroyo toad habitats. Work with mosquito abatement districts to prevent the introduction of mosquitofish and African clawed frogs into arroyo toad habitats.

Task 1.2 Coordinate the activities of law enforcement agencies. Work with the Border Patrol and other law enforcement agencies to reduce negative effects to arroyo toad populations. Specific problems include driving in creeks, building roads on stream terraces, building fences, and using spotlights and floodlights in the drainages during the arroyo toad active season(s).

Task 1.3 Manage dams, water releases, and diversions.

In drainages that have arroyo toad populations, manage stream flows downstream from dams and diversions consistent with arroyo toad reproduction and survival and to the maintenance of arroyo toad habitat. Appropriate stream flows will be determined based on reviews of historic rainfall records and hydrologic data. Such efforts will require cooperation among appropriate Federal, State, and local agencies. Monitor the arroyo toad populations and the results of the management actions and maintain or alter those actions as appropriate.

Task 1.3.1 Determine and maintain a compatible pattern of stream flow downstream from Jameson Lake and associated water diversions.

Task 1.3.2 Determine and maintain a compatible pattern of stream flow downstream from Pyramid Lake.

Task 1.3.3 Determine and maintain a compatible pattern of stream flow downstream from Castaic Lake.

Task 1.3.4 Determine and maintain a compatible pattern of stream flow downstream from Lake Henshaw.

Task 1.3.5 Determine and maintain a compatible pattern of stream flow downstream from Lake Sutherland.

Task 1.3.6 Determine and maintain a compatible pattern of stream flow downstream from Lake Cuyamaca.

Task 1.3.7 Determine and maintain a compatible pattern of stream flow downstream from El Capitan Reservoir.

Task 1.3.8 Determine and maintain a compatible pattern of stream flow downstream from Loveland Reservoir.

Task 1.3.9 Determine and maintain a compatible pattern of stream flow downstream from Barrett Lake.

Task 1.3.10 Determine and maintain a compatible pattern of stream flow downstream from Morena Reservoir.

Task 1.4 Reduce adverse effects to arroyo toads and their habitat.

With the assistance of non-Federal land management agencies (including State, county, and local agencies and governments, water management districts, non-profit organizations, land conservancies, and private landowners) reduce adverse effects to arroyo toads and their habitat by establishing environmental or conservation easements or conservation agreements; by developing multi-species conservation plans, habitat conservation plans, and land and watershed management plans; and by acquiring land. Such agreements and plans may include, but are not limited to, actions such as those detailed in Task 1.1 and its subtasks (modifying recreational use, controlling mining and prospecting, controlling exotic species, establishing appropriate time frames for road maintenance and flood control activities, developing appropriate water management plans, and minimizing impacts from livestock grazing).

Task 2 Monitor the Status of Arroyo Toad Breeding Populations.

Populations must be monitored to determine if recovery actions are achieving desired results. If valid trend data indicate that the populations are increasing, then management direction should continue. If the data indicate that populations are stable, management direction and actions may be altered slightly or continue. If populations are declining and the declines are due to management activities, management actions should be altered to halt the declines. Monitoring programs may act as an "early warning system" in the event of region- or range-wide population declines.

Task 2.1 Develop a comprehensive arroyo toad monitoring protocol.

Monitoring needs to be done in a manner to provide sufficient baseline information on the status of each adult population, and in a consistent fashion throughout the range of the species.

Task 2.2 Conduct monitoring of the adult populations at least every other year for 12 years.

Task 2.3 Assess the results of population monitoring and management actions and modify management direction as necessary.

Task 3 Identify and Secure Additional Populations and Suitable Habitat.

Surveys need to be conducted on many streams throughout the range of the arroyo toad in California. When additional populations and unsecured habitat are found, they may be secured through a variety of mechanisms, including those listed in Task 1.4.

Task 3.1 Develop an arroyo toad survey protocol.

A comprehensive survey protocol complete with habitat characteristics and a field card showing all life stages of the species should be developed. This will assist biologists in determining if there is a likelihood for arroyo toads to be found in a project area, and if they do exist there. The protocol should include guidance on conducting surveys in a manner to reduce impacts to arroyo toads and their habitat, and to other sensitive species. It should also include guidance on assessing threats to target species and the habitat.

Task 3.2 Survey areas within the potential range of the arroyo toad.

Surveys for suitable habitat and the presence or absence of arroyo toads should be conducted throughout the historic range of the species, including but not necessarily limited to the specific drainages identified below.

Task 3.2.1 Upper Salinas River basin.

Task 3.2.1.1 Main Salinas River upstream from King City.

Task 3.2.1.2 San Antonio River.

Task 3.2.1.3 Nacimiento River.

Task 3.2.2 Cuyama River above Twitchell Reservoir.

Task 3.2.2.1 Main Cuyama River

Task 3.3.2.2 Huasna Creek

Task 3.2.3 Santa Ynez River basin.

Task 3.2.3.1 Cachuma Creek.

Task 3.2.3.2 Santa Cruz Creek.

Task 3.2.3.3 Horse Canyon.

Task 3.2.3.4 Redrock Canyon.

Task 3.2.4 Upper Santa Clara River basin.

Task 3.2.4.1 Elizabeth Creek

Task 3.2.4.2 San Francisquito Canyon drainages.

Task 3.2.4.3 Bouquet Canyon drainages.

Task 3.2.4.4 Mint Canyon drainages.

Task 3.2.5 Upper Santa Ana/San Jacinto River basin.

Task 3.2.5.1 San Jacinto River upstream from Hemet.

Task 3.2.5.2 Bautista Creek.

Task 3.2.6 San Juan Creek basin.

Task 3.2.6.1 Arroyo Trabuco.

Task 3.2.6.2 Cañada Chiquita.

Task 3.2.6.3 Cañada Gobernadora.

Task 3.2.7 Santiago Creek Drainage.

Task 3.2.7.1 Fremont Canyon.

Task 3.2.7.2 Black Star Canyon.

Task 3.2.7.3 Baker Canyon.

Task 3.2.7.4 Silverado Canyon.

Task 3.2.8 Temecula Creek above Vail Lake, Upper Santa Margarita River basin.

Task 3.2.9 San Luis Rey River basin.

Task 3.2.10 San Dieguito River/Santa Ysabel Creek basin.

Task 3.2.11 San Diego River basin.

Task 3.2.12 Sweetwater River basin.

Task 3.2.13 Otay River basin.

Task 3.2.14 Cottonwood Creek drainage basin.

Task 3.2.15 San Felipe Creek basin.

Task 3.2.16 Borrego Springs and Coyote Creek area.

Task 3.2.17 Vallecito Creek basin.

Task 3.2.18 Pinto Wash basin.

Task 3.3 Identify and implement necessary management actions.

When new populations or subpopulations and habitats are found as a result of surveys or by other means, management actions necessary for securing them should be implemented. Such actions may include but are not limited to modifying recreational use, controlling mining and prospecting, controlling exotic species, determining appropriate road maintenance and flood control activities, developing appropriate water management plans, minimizing impacts from livestock grazing, and monitoring.

Task 4 Conduct Research.

Research should be conducted to determine ecological parameters associated with arroyo toad presence and population dynamics throughout its range in California. Research to determine the effects of human activities on arroyo toads and their habitat will help guide management efforts and determine the best methods for reducing threats. Such research also could provide information of interest to those addressing the problems of amphibian declines worldwide. Incorporate new information into Tasks 1 and 2.

Task 4.1 Determine and quantify differences.

Apparent differences in the life history, ecology, and population dynamics of the arroyo toad relative to latitude and elevation, including overwintering habitat use and mortality factors, should be quantified to assist in developing site-specific management plans.

Task 4.2 Quantify the ecological parameters.

The biotic and abiotic factors associated with arroyo toad presence within basins throughout the species range in California should be determined and correlated with arroyo toad population dynamics.

Task 4.3 Evaluate potential for reestablishment.

Evaluate currently unoccupied habitat within the range of the arroyo toad for potential as reestablishment sites and methods for relocating and establishing arroyo toads. Several drainages that historically had arroyo toads may be suitable for reestablishment. Because adequate surveys for the species have begun only recently,

it is possible that some unoccupied streams within the current range of the species, particularly those in occupied basins, had arroyo toads until recently and, with appropriate management, may support viable arroyo toad populations or subpopulations.

Task 4.4 Conduct research on exotic species.

Task 4.4.1 Investigate the interactions of exotic species with arroyo toads. Interactions can include, but are not limited to, predation, competition, toxic effects, and habitat alteration.

Task 4.4.2 Experiment to find effective methods of removing exotic species from arroyo toad habitats. Experimentally remove exotic aquatic species from arroyo toad habitats and monitor the projects long enough to determine the effects on both the exotic species populations and the arroyo toad populations.

Task 4.5 Reduce roadkill of arroyo toads.

Determine the best types of stream crossings and road barriers for protecting arroyo toads.

Task 4.6 Determine if arroyo toads are moving between drainages.

Movements of arroyo toads between drainages may play a role in metapopulation dynamics and allow recolonization of streams from which toads have been temporarily extirpated by natural or human-related causes.

Task 4.7 Assess impacts of different grazing regimes on arroyo toads.

Some grazing regimes may not cause significant negative impacts to arroyo toads and their habitats.

Task 4.8 Assess impacts of recreational activities on arroyo toads.

Different recreational activities probably have varying levels of effects on arroyo toads and their habitat. By understanding the magnitude of the risks posed by different activities and their intensity and timing, better management guidelines can be developed.

Task 4.9 Assess the effects of fire on arroyo toads.

Research may include, but is not limited to, the effects of fire on vegetation patterns, arroyo toad reproduction and recruitment, the suitability of habitat for arroyo toads, etc.

Task 4.10 Conduct genetic research.

Collect tissue samples from known and new arroyo toad populations to determine genetic differences and similarities within and among populations. Such analyses could help determine appropriate populations or subpopulations to use for re-establishment stock.

Task 5 Develop Information and Education Programs.

Public and agency support is essential to recovery of the arroyo toad. Information brochures should clearly explain the impacts to arroyo toads from introduced aquatic and terrestrial species; off-highway vehicles, fishing, camping, and other recreational uses of streambeds and riparian zones; livestock grazing; collection; dam construction and flow regulation; mining; and other activities. Brochures should detail actions that minimize adverse impacts to arroyo toads and highlight successful examples of mitigation and remediation.

Task 5.1 Develop educational brochures.

Educational brochures can be made available to agencies with regulational jurisdiction over arroyo toad habitat and to users of lands on which arroyo toads occur. This outreach effort should help reduce negative effects on arroyo toads.

Task 5.2 Provide educational programs.

Educational programs for visitors to National Forests, and State and county parks where arroyo toads occur should include information on the species' biology and role in the ecosystem, the threats to the species, and problems that amphibians are facing on a larger scale.

III. LITERATURE CITED

Awbrey, F. T. 1972. "Mating call" of a *Bufo boreas* male. Copeia, 1972(3): 579 – 581.

Beaman, K. R., S. J. Myers, and C. McGaugh. 1995. San Bernardino National Forest Arrowhead and Big Bear Ranger districts: report on surveys for arroyo toads on Deep Creek. Unpublished report for the San Bernardino National Forest by Tierra Madre Consultants, Inc., Riverside, California, under contract (TMC 95-023). 20 pp.

Caltrans. 1996. Biological Assessment, Route 2 Angeles Crest Highway Seismic Retrofit, Project #162 07-171201. Prepared by California Department of Transportation (Caltrans). November 1996.

Campbell, L. A., T. B. Graham, L. P. Thibault, and P. A. Stine. 1996. The arroyo toad (*Bufo microscaphus californicus*), ecology, threats, recovery actions, and research needs. U.S. Department of the Interior, National Biological Service, California Science Center, Technical Report (NBS/CSC-96-01). ii + 46 pp.

Camp, C. L. 1915. *Batrachoseps major* and *Bufo cognatus californicus*, new amphibia from southern California. University of California Publications in Zoology 12 (12): 327 – 334.

Cunningham, J. D. 1962. Observations on the natural history of the California toad, *Bufo californicus* Camp. Herpetologica 17 (4): 255 – 260.

Davidson, C. 1995. Frog and toad calls of the Pacific coast: vanishing voices. Library of Natural Sounds, Cornell Laboratory of Ornithology, Ithaca, New York. 26 pp.+1 cassette.

Gamradt, S. C., and L. B. Kats. 1997. Impact of chaparral wildfire-induced sedimentation on oviposition of stream-breeding California newts (*Taricha torosa*). Oecologia 110: 546 – 549.

Gergus, E. W. A. 1994. Systematics and biogeography of *Bufo microscaphus* (Anura: Bufonidae), with a preliminary report on americanus group phylogeny. Unpublished M.S. Thesis, San Diego State University, San Diego, California. 72 pp.

Gergus, E. W. A. 1998. Systematics of the *Bufo microscaphus* complex: allozyme evidence. Herpetologica 54 (3): 317 – 325.

Gergus, E. W. A., L. L. Grismer, and K. Beaman. 1997. Geographic distribution. *Bufo californicus*. Herpetological Review 28 (1): 47.

Holway, D. A. 1995. Distribution of the Argentine ant (*Linepithema humile*) in northern California. Conservation Biology 9 (6): 1634 – 1637.

Human, K. G., and D. M. Gordon. 1997. Effects of Argentine ants on invertebrate biodiversity in northern California. Conservation Biology 11 (5): 1242 – 1248.

Jennings, M. R., and M. P. Hayes. 1994. Amphibian and reptile species of special concern in California. Final report to the California Department of Fish and Game, Inland Fisheries Division, Rancho Cordova, California. Contract 8023. iii + 255 pp.

Leviton, A. E., R. H. Gibbs, Jr., E. Heal, and C. E. Dawson. 1985. Standards in herpetology and ichthyology: Part I. Standard symbolic codes for institutional resource collections in herpetology and ichthyology. Copeia 1985 (3): 802 – 832.

Linsdale, J. M. 1940. Amphibians and reptiles in Nevada. Proceedings of the American Academy of Arts and Sciences 73 (8): 197 – 257.

MacArthur, R. H., and E. O. Wilson. 1963. An equilibrium theory of insular zoogeography. Evolution 17 (4): 373 – 387.

Miller, L., and A. H. Miller. 1936. The northward occurrence of *Bufo californicus* in California. Copeia 1936 (3): 176.

Myers, G. S. 1930. The status of the southern California toad, *Bufo californicus* (Camp). Proceedings of the Biological Society of Washington 43 (11): 73 – 78.

Patten, M. A., and S. J. Myers. 1992. Geographic distribution. *Bufo microscaphus californicus*. Herpetological Review 23 (4): 124.

Pickwell, G. 1947. Amphibians and reptiles of the Pacific states. Stanford University Press, Stanford, California. xiv + 236 pp.

Price, A. H., and B. K. Sullivan. 1988. *Bufo microscaphus*. Catalogue of American Amphibians and Reptiles, 415.1 – 415.3.

Sanders, R. M. 1950. A herpetological survey of Ventura County, California. Unpublished M.S. Thesis, Stanford University, Stanford, California. 140 pp.

Schneeweiss, N. and U. Schneeweiss. 1997. Amphibienverluste infolge mineralische Dungung auf Agrarflachen [Amphibian mortality resulting

from fertilization of agricultural fields]. Salamandra 33: 1 – 8. [In German, translated by W. T. Leja..]

Shannon, F. A. 1949. A western subspecies of *Bufo woodhousii* hitherto erroneously associated with *Bufo compactilis*. Bulletin of the Chicago Academy of Sciences 8 (15): 301 – 312.

Stebbins, R. C. 1951. Amphibians of western North America. University of California Press, Berkeley and Los Angeles, California. ix + 539 pp.

_____. 1966. A field guide to western reptiles and amphibians. Houghton-Mifflin Company, Boston, Massachusetts. xiv + 279 pp.

_____. 1985. A field guide to western reptiles and amphibians. Second edition, revised. Houghton-Mifflin Company, Boston, Massachusetts. xiv + 336 pp.

Sullivan, B. K. 1992. Calling behavior of the southwestern toad *(Bufo microscaphus)*. Herpetologica, 48 (4): 383 – 389.

Sweet, S. S. 1989. Observations on the biology and status of the arroyo toad, *Bufo microscaphus californicus*, with a proposal for additional research. Unpublished report. 23 pp.

_____. 1992. Ecology and status of the arroyo toad (*Bufo microscaphus californicus*) on the Los Padres National Forest of southern California, with management recommendations. Report to United States Department of Agriculture, Forest Service, Los Padres National Forest, Goleta, California. ii + 198 pp.

_____. 1993. Second report on the biology and status of the arroyo toad (*Bufo microscaphus californicus*) on the Los Padres National Forest of southern California. Report to United States Department of Agriculture, Forest Service, Los Padres National Forest, Goleta, California. ii + 73 pp.

Tevis, L., Jr. 1944. Herpetological notes from Lower California. Copeia 1944 (1): 6 – 18.

U.S. Army Reserve Command. 1996. Biological assessment of the effects of activities conducted at Fort Hunter Liggett, Monterey County, California, on federal endangered, threatened, proposed, and candidate species. Fort Hunter Liggett, California. v + 81 pp. + appendices.

U.S. Fish and Wildlife Service. 1983. Endangered and threatened species listing and recovery priority guidelines. Federal Register 48 (221): 43104.

U.S. Fish and Wildlife Service. 1994. Endangered and threatened wildlife and

plants; determination of endangered status for the arroyo southwestern toad. Federal Register 59 (241): 64859 – 64866.

U.S. Fish and Wildlife Service. 1995. Endangered Species Act consultation on the proposed riparian and estuarine programmatic conservation plan, Marine Corps Base Camp Pendleton, San Diego County, California (1-6-95-F-02). Carlsbad Fish and Wildlife Office, Carlsbad, California. 58 pp. + appendices.

U.S. Fish and Wildlife Service. 1997. Programmatic biological opinion on the effects of activities conducted at Fort Hunter Liggett, Monterey County, California (1-8-96-F-40). Ventura Fish and Wildlife Office, Ventura, California. 33 pp.

Ward, P. S. 1987. Distribution of the Argentine ant (*Iridomyrmex humilis*) in natural habitats of the lower Sacramento River Valley and its effects on the indigenous ant fauna. Hilgardia 55 (2): 1 – 16.

Welsh, H. H., Jr. 1988. An ecogeographic analysis of the herpetofauna of the Sierra San Pedro Mártir region, Baja California: With a contribution to the biogeography of Baja California herpetofauna. Proceedings of the California Academy of Sciences, 4th series 46 (1): 1 – 72.

Winter, K. 1995. Warner fire biological report. Unpublished report for Cleveland National Forest. 5 pp.

Wright, A. H., and A. A. Wright. 1949. Handbook of frogs and toads of the United States and Canada. Comstock Publishing Company, Ithaca, New York. xii + 640 pp.

York, J. 1992. Arroyo toad found in arroyo. Newsletter of the Southwestern Herpetologists Society, 22 (7): 3.

Part IV. Implementation Schedule

The schedule that follows is a summary of actions and estimated costs for the arroyo toad recovery program. It is a guide to meet the objectives of the revised recovery plan as elaborated in Part II, Narrative Section. This schedule indicates task priorities, task numbers, task descriptions, duration of tasks, the responsible agencies, and, lastly, estimated costs. These actions, when accomplished, should bring about the recovery of the species and protect its habitat. It should be noted that the estimated monetary needs for some tasks remain to be determined and, therefore, Part IV reflects the minimum estimated financial requirements for the recovery of the species.

Definitions and Abbreviations Used in the Implementation Schedule:

Priorities in column one of the following implementation schedule are assigned as follows:

1 = An action that must be taken to prevent extinction or to prevent the species from declining irreversibly in the foreseeable future.

2 = An action that must be taken to prevent a significant decline in species' population, habitat quality, or some other significant negative impact short of extinction.

3 = All other actions necessary to provide for full recovery of the species.

Key to Abbreviations:

BLM	—	Bureau of Land Management
BP	—	Border Patrol
BRD	—	Biological Resources Division, U.S. Geological Survey
CDFG	—	California Department of Fish and Game
CDPR	—	California Department of Parks and Recreation
CDWR	—	California Department of Water Resources
CSD	—	City of San Diego
CWD	—	Castaic Water District
FERC	—	Federal Energy Regulatory Commission
FHLMR	—	Fort Hunter Liggett Military Reservation
FNWA	—	Fallbrook Naval Weapons Annex
HWD	—	Helix Water District
MCBCP	—	Marine Corps Base Camp Pendleton
MWD	—	Montecito Water District
SA	—	Sweetwater Authority (a water district)
TBD	—	To Be Determined
USFS	—	U.S. Forest Service
USFWS	—	U.S. Fish and Wildlife Service
USMR	—	U.S. Military Reservations
VID	—	Vista Irrigation District

* Denotes lead agency.

Task duration: The estimated number of years to complete the task. For tasks that already are under implementation and are likely to continue for the foreseeable future, the duration is listed as "ongoing." For tasks that are not yet implemented but will continue into the foreseeable future, the duration is designated as "continuous."

Implementation Schedule for arroyo southwestern toad recovery

Priority Number	Task Number	Task Description	Task Duration (Yrs)	Responsible Party	Total Cost Through FY 2010	Cost Estimates, thousands of dollars, by fiscal year 1999	2000	2001	2002	2003	Annual Cost Estimates 2004 – 2010
Need 1: Protect, maintain, and enhance breeding and upland habitats.											
2	1.1.1	Minimize or eliminate impacts to arroyo toads and their breeding habitat near campgrounds to prevent the killing or injury of all life stages of arroyo toads.	Continuous	USFS	120	10	10	10	10	10	10
2	1.1.2	Annually close roads in or near arroyo toad breeding habitat during the spring and summer to prevent the killing of subadult and adult toads on roads.	Continuous	USFS*, water districts	120	10	10	10	10	10	10
2	1.1.3	Control mining and prospecting activities in drainages with arroyo toad populations to prevent habitat degradation, death of and injury to toads.	Ongoing	CDFG*, USFS	120	10	10	10	10	10	10
2	1.1.4	Restrict fishing activities in arroyo toad breeding habitats when arroyo toads are present in the stream channel on the sand and gravel bars.	Continuous	CDFG*, USFS	12	1	1	1	1	1	1
2	1.1.5	Monitor and remove exotic vegetation where found. Determine if the removal benefits arroyo toads.	Continuous	USFS*, CDFG, FNWA, MCBCP	TBD	TBD	TBD	TBD	TBD	TBD	

Priority Number	Task Number	Task Description	Task Duration (Yrs)	Responsible Party	Total Cost Through FY 2010	Cost Estimates, thousands of dollars, by fiscal year 1999	2000	2001	2002	2003	Annual Cost Estimates 2004 – 2010
2	1.1.6	Replace inadequate stream crossings on roads within known arroyo toad habitats with appropriate crossings.	TBD	USFS*	TBD	TBD	TBD	TBD	TBD	TBD	
				USMR	TBD	TBD	TBD	TBD	TBD	TBD	
2	1.1.7.1	Develop and implement a livestock management plan to minimize, as necessary, impacts to arroyo toads on Los Padres National Forest.	Ongoing	USFS	68	20	20	10	2	2	2
2	1.1.7.2	Develop and implement a livestock management plan to minimize, as necessary, impacts to arroyo toads on San Bernardino National Forest.	Ongoing	USFS	68	20	20	10	2	2	2
2	1.1.7.3	Develop and implement a livestock management plan to minimize, as necessary, impacts to arroyo toads on Cleveland National Forest.	Ongoing	USFS	68	20	20	10	2	2	2
2	1.1.7.4	Develop and implement a livestock management plan to minimize, as necessary, impacts to arroyo toads on Fort Hunter Liggett.	Ongoing	USFS	68	20	20	10	2	2	2
2	1.1.7.5	Develop and implement a livestock management plan to minimize, as necessary, impacts to arroyo toads on Camp Pendleton.	Ongoing	USFS	68	20	20	10	2	2	2
2	1.1.8	Identify and eliminate breeding sites of introduced fishes and aquatic predators near arroyo toad habitat, and control or eliminate exotic species.	5	CDFG*	260	50	50	50	20	20	10
				USFS	260	50	50	50	20	20	10

Priority Number	Task Number	Task Description	Task Duration (Yrs)	Responsible Party	Total Cost Through FY 2010	Cost Estimates, thousands of dollars, by fiscal year 1999	2000	2001	2002	2003	Annual Cost Estimates 2004 – 2010
2	1.2	Coordinate with the Service regarding the activities of law enforcement agencies to reduce impacts to arroyo toads.	Continuous	BP*	12	1	1	1	1	1	1
				USFWS	12	1	1	1	1	1	1
2	1.3.1	Determine and maintain a compatible pattern of stream flows downstream from Jameson Lake and associated water diversions.	Ongoing	CDWR*, MWD, USFS	12	1	1	1	1	1	1
2	1.3.2	Determine and maintain a compatible pattern of stream flows downstream from Pyramid Lake.	Ongoing	CDWR*, CWD, USFS, CDFG	12	1	1	1	1	1	1
2	1.3.3	Determine and maintain a compatible pattern of stream flows downstream from Castaic Lake.	Continuous	CDWR*, CWD, USFS, CDFG	12	1	1	1	1	1	1
2	1.3.4	Determine and maintain a compatible pattern of stream flows downstream from Lake Henshaw.	Continuous	CDWR*, VID, CDFG, USFS	12	1	1	1	1	1	1
2	1.3.5	Determine and maintain a compatible pattern of stream flows downstream from Lake Sutherland.	Continuous	CDWR*, CSD, CDFG, USFS	12	1	1	1	1	1	1
2	1.3.6	Determine and maintain a compatible pattern of stream flows downstream from Lake Cuyamaca.	Continuous	CDWR*, HWD, CDFG, USFS	12	1	1	1	1	1	1

Priority Number	Task Number	Task Description	Task Duration (Yrs)	Responsible Party	Total Cost Through FY 2010	Cost Estimates, thousands of dollars, by fiscal year 1999	2000	2001	2002	2003	Annual Cost Estimates 2004 – 2010
2	1.3.7	Determine and maintain a compatible pattern of stream flows downstream from El Capitan Reservoir.	Continuous	CDWR*, CSD, CDFG, USFS	12	1	1	1	1	1	1
2	1.3.8	Determine and maintain a compatible pattern of stream flows downstream from Loveland Reservoir.	Continuous	CDWR*, SA, CDFG, USFS	12	1	1	1	1	1	1
2	1.3.9	Determine and maintain a compatible pattern of stream flows downstream from Barrett Lake.	Continuous	CDWR*, CSD, CDFG, USFS	12	1	1	1	1	1	1
2	1.3.10	Determine and maintain a compatible pattern of stream flows downstream from Morena Reservoir.	Continuous	CDWR*, CSD, CDFG, USFS	12	1	1	1	1	1	1
2	1.4	Reduce adverse effects to arroyo toad habitat through appropriate means, with the assistance of non-Federal public land owners and managers, nonprofit organizations, land conservancies, and private landowners.	Continuous	USFWS* CDFG	TBD	TBD	TBD	TBD	TBD	TBD	
		Need 1 Subtotal Cost:			**1376**	**243**	**243**	**193**	**93**	**93**	**73**

Priority Number	Task Number	Task Description	Task Duration (Yrs)	Responsible Party	Total Cost Through FY 2010	Cost Estimates, thousands of dollars, by fiscal year 1999	2000	2001	2002	2003	Annual Cost Estimates 2004 – 2010
Need 2: Monitor arroyo toad breeding populations.											
2	2.1	Develop a comprehensive arroyo toad monitoring protocol.	1	USFWS*	2	2	0	0	0	0	
				USFS	2	2	0	0	0	0	
				BRD	2	2	0	0	0	0	
2	2.2	Conduct bi-yearly monitoring of adult populations.	Continuous	CDFG*	120	10	10	10	10	10	10
				USFS	600	50	50	50	50	50	50
2	2.3	Assess the results of population monitoring and modify management direction as necessary.	Continuous	CDFG*	12	1	1	1	1	1	1
				USFS	120	10	10	10	10	10	10
		Need 2 Subtotal Cost:			**858**	**77**	**71**	**71**	**71**	**71**	**71**
Need 3: Identify and secure additional populations and suitable habitat throughout the range of the arroyo toad.											
2	3.1	Develop a comprehensive arroyo toad survey protocol.	1	USFWS*, USFS, CDFG	5	5	0	0	0	0	
2	3.2.1.1	Survey the main Salinas River upstream from King City for suitable habitat and the presence/absence of arroyo toads.	1	CDFG	2	2	0	0	0	0	
2	3.2.1.2	Survey the San Antonio River for suitable habitat and the presence/absence of arroyo toads.	1	FHLMR*	20	20	0	0	0	0	
				CDFG	2	2	0	0	0	0	
2	3.2.1.3	Survey the Nacimiento River for suitable habitat and the presence/absence of arroyo toads.	1	FHLMR*	20	20	0	0	0	0	
				CDFG	2	2	0	0	0	0	

Priority Number	Task Number	Task Description	Task Duration (Yrs)	Responsible Party	Total Cost Through FY 2010	Cost Estimates, thousands of dollars, by fiscal year 1999	2000	2001	2002	2003	Annual Cost Estimates 2004 – 2010
2	3.2.2.1	Survey the main Cuyama River above Twitchell Reservoir for suitable habitat and the presence/absence of arroyo toads.	1	CDFG*	2	2	0	0	0	0	
				USFS	20	20	0	0	0	0	
2	3.2.2.2	Survey Huasna Creek above Twitchell Reservoir for suitable habitat and the presence/absence of arroyo toads.	1	CDFG	2	2	0	0	0	0	
2	3.2.3.1	Survey Cachuma Creek for suitable habitat and the presence/absence of arroyo toads.	1	USFS*	20	20	0	0	0	0	
				CDFG	2	2	0	0	0	0	
2	3.2.3.2	Survey Santa Cruz Creek for suitable habitat and the presence/absence of arroyo toads.	1	USFS*	20	20	0	0	0	0	
				CDFG	2	2	0	0	0	0	
2	3.2.3.3	Survey Horse Canyon for suitable habitat and the presence/absence of arroyo toads.	1	USFS*	20	20	0	0	0	0	
				CDFG	2	2	0	0	0	0	
2	3.2.3.4	Survey Redrock Canyon for suitable habitat and the presence/absence of arroyo toads.	1	USFS*	20	20	0	0	0	0	
				CDFG	2	2	0	0	0	0	
2	3.2.4.1	Survey Elizabeth Creek upstream from Castaic Lake for suitable habitat and the presence/absence of arroyo toads.	1	USFS*	20	20	0	0	0	0	
				CDFG	2	2	0	0	0	0	
2	3.2.4.2	Survey San Francisquito Canyon drainages for suitable habitat and the presence/absence of arroyo toads.	1	USFS*	20	20	0	0	0	0	
				CDFG	2	2	0	0	0	0	

Priority Number	Task Number	Task Description	Task Duration (Yrs)	Responsible Party	Total Cost Through FY 2010	Cost Estimates, thousands of dollars, by fiscal year 1999	2000	2001	2002	2003	Annual Cost Estimates 2004 – 2010
2	3.2.4.3	Survey Bouquet Canyon drainages for suitable habitat and the presence/absence of arroyo toads.	1	USFS*	20	20	0	0	0	0	
				CDFG	2	2	0	0	0	0	
2	3.2.4.4	Survey Mint Canyon drainages for suitable habitat and the presence/absence of arroyo toads.	1	USFS*	20	20	0	0	0	0	
				CDFG	2	2	0	0	0	0	
2	3.2.5.1	Survey San Jacinto River upstream from Hemet for suitable habitat and the presence/absence of arroyo toads.	1	USFS*	20	20	0	0	0	0	
				CDFG	2	2	0	0	0	0	
2	3.2.5.2	Survey Bautista Creek for suitable habitat and the presence/absence of arroyo toads.	1	USFS*	20	20	0	0	0	0	
				CDFG	2	2	0	0	0	0	
2	3.2.6.1	Survey Arroyo Trabuco for suitable habitat and the presence/absence of arroyo toads.	1	USFS*	20	20	0	0	0	0	
				CDFG	2	2	0	0	0	0	
2	3.2.6.2	Survey Cañada Chiquita for suitable habitat and the presence/absence of arroyo toads.	1	CDFG	2	2	0	0	0	0	
2	3.2.6.3	Survey Cañada Gobernadora for suitable habitat and the presence/absence of arroyo toads.	1	CDFG	2	2	0	0	0	0	
2	3.2.7.1	Survey Fremont Canyon for suitable habitat and the presence/absence of arroyo toads.	1	CDFG	2	2	0	0	0	0	
2	3.2.7.2	Survey Black Star Canyon for suitable habitat and the presence/absence of arroyo toads.	1	USFS*	20	20	0	0	0	0	
				CDFG	2	2	0	0	0	0	

Priority Number	Task Number	Task Description	Task Duration (Yrs)	Responsible Party	Total Cost Through FY 2010	Cost Estimates, thousands of dollars, by fiscal year 1999	2000	2001	2002	2003	Annual Cost Estimates 2004 – 2010
2	3.2.7.3	Survey Baker Canyon for suitable habitat and the presence/absence of arroyo toads.	1	USFS*	20	20	0	0	0	0	
				CDFG	2	2	0	0	0	0	
2	3.2.7.4	Survey Silverado Canyon for suitable habitat and the presence/absence of arroyo toads.	1	USFS*	20	20	0	0	0	0	
				CDFG	2	2	0	0	0	0	
2	3.2.8	Survey Temecula Creek above Vail Lake, Upper Santa Margarita River basin for suitable habitat and the presence/absence of arroyo toads.	1	USFS*	20	20	0	0	0	0	
				CDFG	2	2	0	0	0	0	
2	3.2.9	Survey the San Luis Rey River basin for suitable habitat and the presence/absence of arroyo toads.	1	CDFG	2	2	0	0	0	0	
2	3.2.10	Survey the San Dieguito River basin for suitable habitat and the presence/absence of arroyo toads.	1	USFS*	20	20	0	0	0	0	
				CDFG	2	2	0	0	0	0	
2	3.2.11	Survey the San Diego River basin for suitable habitat and the presence/absence of arroyo toads.	1	CDFG	2	2	0	0	0	0	
2	3.2.12	Survey the Sweetwater River basin for suitable habitat and the presence/absence of arroyo toads.	ongoing	USFS*, SA,	20	20	0	0	0	0	
				CDFG	2	2	0	0	0	0	
2	3.2.13	Survey the Otay River basin for suitable habitat and the presence/absence of arroyo toads.	1	CDFG	2	2	0	0	0	0	
2	3.2.14	Survey the Cottonwood Creek drainage basin for suitable habitat and the presence/absence of arroyo toads.	1	USFS*	20	20	0	0	0	0	
				CDFG	2	2	0	0	0	0	

Priority Number	Task Number	Task Description	Task Duration (Yrs)	Responsible Party	Total Cost Through FY 2010	Cost Estimates, thousands of dollars, by fiscal year 1999	2000	2001	2002	2003	Annual Cost Estimates 2004 – 2010
2	3.2.15	Survey the San Felipe Creek basin for suitable habitat and the presence/absence of arroyo toads.	1	CDFG	2	2	0	0	0	0	
2	3.2.16	Survey Borrego Springs and Coyote Creek area for suitable habitat and the presence/absence of arroyo toads.	1	CDPR*	2	2	0	0	0	0	
				CDFG	2	2	0	0	0	0	
2	3.2.17	Survey the Vallecito Creek basin for suitable habitat and the presence/absence of arroyo toads.	1	CDFG	2	2	0	0	0	0	
2	3.2.18	Survey the Pinto Wash basin for suitable habitat and the presence/absence of arroyo toads	1	BLM*	2	2	0	0	0	0	
				CDFG	2	2	0	0	0	0	
3	3.3	Identify and implement management actions necessary for securing additional populations of arroyo toads.	2	USFWS*	4	2	2	0	0	0	
				CDFG	4	2	2	0	0	0	
		Need 3 Subtotal Cost:			**503**	**499**	**4**	**0**	**0**	**0**	**0**
Need 4: Conduct research to determine ecology and threats.											
2	4.1	Determine and quantify differences in the life history and ecology of the arroyo toad relative to latitude and elevation.	3	CDFG* BRD	25	10	10	5	0	0	
					25	10	10	5	0	0	

Priority Number	Task Number	Task Description	Task Duration (Yrs)	Responsible Party	Total Cost Through FY 2010	Cost Estimates, thousands of dollars, by fiscal year 1999	2000	2001	2002	2003	Annual Cost Estimates 2004 – 2010
2	4.2	Quantify the ecological parameters, both abiotic and biotic, for arroyo toad presence within drainages.	1	CDFG*	5	0	5	0	0	0	
				BRD	5	0	5	0	0	0	
2	4.4.2	Experiment to find effective methods of removing exotic species from arroyo toad habitats.	3	USFS, CDFG	90	30	30	30	0	0	
3	4.3	Evaluate the potential of habitats within the historic range for reestablishment	5	BRD	TBD	TBD	TBD	TBD	TBD	TBD	
3	4.4.1	Investigate the interactions of arroyo toads with exotic species.	3	BRD, CDFG	30	0	10	10	10	0	
3	4.5	Reduce roadkill of arroyo toads by determining the best types stream crossings and road barriers.	1	USFS, CDFG	30	30	0	0	0	0	
3	4.6	Determine if arroyo toads are moving between drainages.	3	CDFG	25	10	10	5	0	0	
				BRD	25	10	10	5	0	0	
3	4.7	Assess impacts of different grazing regimes on arroyo toads.	5	USFS	50	10	10	10	10	10	
3	4.8	Assess impacts of recreational activities on toads.	3	USFS, CDFG	30	10	10	10	0	0	
3	4.9	Assess the effects of fire on arroyo toad habitat and populations.	5	USFS, BRD	50	10	10	10	10	10	

Priority Number	Task Number	Task Description	Task Duration (Yrs)	Responsible Party	Total Cost Through FY 2010	Cost Estimates, thousands of dollars, by fiscal year 1999	2000	2001	2002	2003	Annual Cost Estimates 2004 – 2010
3	4.10	Determine genetic differences and similarities within and among populations by collecting and evaluating tissue samples.	3	BRD*	27	15	10	2	0	0	
				CDFG	27	15	10	2	0	0	
		Need 4 Subtotal Cost:			**444**	**160**	**140**	**94**	**30**	**20**	**0**
Need 5: Develop information and education programs.											
3	5.1	Develop educational brochures and make them available to agencies.	ongoing	USFWS, CDFG, USFS	16	5	1	1	1	1	1
3	5.2	Provide educational programs for visitors to arroyo toad habitats.	ongoing	USFS, CDPR	120	10	10	10	10	10	10
		Need 5 Subtotal Cost:			136	15	11	11	11	11	11
		TOTAL COST			**3317**	**994**	**469**	**369**	**205**	**195**	**155**

APPENDIX: Summary of the agency and public comments on the Draft Recovery Plan for the Arroyo Southwestern Toad

In August 1997, the Service released a preliminary draft recovery plan for the arroyo southwestern toad to selected parties for review and comment. These reviewers were invited to attend a workshop on September 15, 1997. On October 10, 1997, the Service requested additional comments from Federal agencies. On May 6, 1998, the Service released the Draft Recovery Plan for the Arroyo Toad for a 90-day comment period that ended on August 4, 1998, for Federal agencies, State and local governments, and members of the public (63 Federal Register 25062).

In response to the releases of the preliminary and draft plans, 14 letters were received, each containing varying numbers of comments. Verbal comments were noted during the workshop. Federal, State, and local jurisdictions that responded or attended the workshop included U.S. Fish and Wildlife Service, U.S. Forest Service, U.S. Department of Defense, California Department of Fish and Game, Montecito Water District, Helix Water District, and Sweetwater Authority (a water district). Copies of the draft recovery plan were sent to more than 130 interested parties. Of these, three individuals (Peter H. Bloom, Samuel S. Sweet, and Erik W. A. Gergus), were asked to peer review the document; all three peer reviewers responded. Peer reviewers were selected for their familiarity with the taxonomic group, a geographic area, and/or jurisdictional issues.

The number of parties responding, by affiliation:

Federal agencies	3
State agencies	1
Local governments or agencies	4
Environmental/conservation organizations	1
Academia/professionals	5

Summary of Significant Comments and Service Responses

The Service reviewed all of the comments received during the comment periods and the workshop. Comments that were editorial or technical in nature, or were updating the information

in the draft recovery plan, have been incorporated into the appropriate sections of the recovery plan. Some letters simply expressed a desire to work with the Service in efforts to conserve populations of arroyo toads on lands under the agencies' jurisdictions. Some comments dealt with matters of opinion, which are not relevant to the recovery of the arroyo toad, and did not result in changes to the plan. Several comments suggested shifts of emphasis or concurred with parts of the plan. While these review comments were helpful, they generally did not result in changes to the recovery plan. The Service did not receive any comments that it considered controversial or significant in the sense of making a difference in the fundamental way that recovery of the arroyo toad is being approached.

Comment: One commenter asked what would be the effect of a change in the arroyo toad's taxonomic status from a subspecies to a full species.

Response: If accepted by the herpetological community, a proposed change in the arroyo toad's status and a consequent name change (from *Bufo microscaphus californicus* to *Bufo californicus*) would result in a change in the Recovery Priority number from 9 to 8. This might result in a change in how monies are allocated through the section 6 process, which allocates funds through State agencies to accomplish recovery tasks.

Comment: During the public comment period, the U.S. Fish and Wildlife Service conducted further internal review and discussion of the recovery plan. Many comments from those sessions have been incorporated into the final recovery plan. In particular, the possibility of establishing recovery units was broached.

Response: After further discussion in the Service's Ventura and Carlsbad Fish and Wildlife Offices, we incorporated recovery units as part of the recovery strategy for the arroyo toad. We feel that an approach incorporating recovery units will allow us to better evaluate and reduce the threats to the arroyo toad, and to develop recommendations that can be applied on a regional basis.

Comment: One commenter stated that data submitted since 1994 has not been used.

Response: The Service respectfully disagrees. The authors incorporated the data that were

made available to them, including recent data from a number of agencies and individuals. Further information was submitted through the public comment period. Where appropriate, the information was incorporated into the final plan. It is not necessary for the plan to incorporate detailed information from every sighting of arroyo toads.

Comment: Several commenters expressed concerns that specific potential actions, such as airport expansion, urban development, highway projects, or flood control activities, were not addressed in the recovery plan. One commenter stated that such projects should be prohibited.

Response: The Endangered Species Act addresses these concerns through its section 7 consultation process. If a proposed project is to be authorized, funded, or carried out by a Federal agency and may affect a listed species, the Federal agency must consult with the Service. The section 7 process is intended to ensure that Federal actions do not jeopardize the continued existence of listed species or adversely modify their critical habitat. During that process, measures to avoid, minimize, or mitigate for effects to arroyo toads and their habitat should be identified and incorporated into the resulting biological opinion. The project must be carried out under the specific terms and conditions detailed in the biological opinion.

If a proposed project does not involve a Federal agency but may result in the take of a listed animal species, the project proponent should apply for an incidental take permit, pursuant to section 10(a)(1)(B) of the Act. When an application is made for an incidental take permit under section 10(a)(1)(B), measures to avoid, minimize, or mitigate for effects to arroyo toads and their habitat will be identified and incorporated into a habitat conservation plan. If the plan and the application for the permit meet the issuance criteria, a permit can be issued. Before an incidental take permit under section 10(a)(1)(B) of the Act can be issued, the Service must ensure that issuance of the permit is not likely to jeopardize the continued existence of listed species or adversely modify critical habitat and determine that the effects of any incidental take are minimized and mitigated to the maximum extent practicable.

Recovery plans provide recommendations that guide the Service and others in recovering listed species. Recovery plans are not land use plans and cannot restrict activities proposed by other agencies or the public. The Service cannot identify every potential action that may occur within a species' range, nor can the Service identify every site where those actions might be proposed. Proposed actions will be evaluated under the procedures established by sections 7 and 10(a)(1)(B) of the Act. The review, consultation, and permitting processes are the avenues by which those actions may be identified and evaluated, and any negative effects avoided or minimized.

Comment: One commenter stated that some activities that are intended to improve conditions for a population have the potential for or may cause a short term negative effect (e.g., take of one or a few individuals). The commenter suggested that projects intended to benefit the population as a whole, where there was a "likely to adversely affect" determination, could be handled under a programmatic consultation.

Response: The Service agrees that short-term negative effects to individuals may be offset by long-term positive effects. The section 7 process and resulting biological opinions are designed to take this possibility into account in rendering the determination regarding jeopardy and the accompanying incidental take statement, if one is included in the biological opinion. The Service agrees that some actions designed to benefit a species can be dealt with through programmatic opinions, and this should be done in appropriate cases.

Biological assessments, which are prepared by or under the direction of the action agency, are intended to assist the agency in determining if a project is likely to adversely affect any individuals or populations of listed species. If the agency finds that the project is likely to adversely affect listed species, even in the short term, then formal consultation must be initiated. Our resulting biological opinion will determine whether the proposed action is likely to jeopardize the continued existence of a species. In cases involving listed animal species, we will often provide an incidental take statement, which provides the action agency (and an

applicant, if appropriate) an exemption from the prohibitions against take for the action analyzed in the biological opinion.

Comment: Several commenters questioned the biological basis for the recovery criteria. Most of those comments have been dealt with by expansion of the criteria in the plan. One commenter, in particular, questioned the number of populations required to be protected for downlisting.

Response: The recovery criteria are based on our review of the available data and discussions with species experts and other professionals. We believe that it is reasonable to tentatively prescribe recovery criteria that would at least demonstrate population stability and good habitat management over a period of years, substantially improving the current situation. We anticipate developing better information on the status and needs of arroyo toads, based on the surveys, research, and monitoring prescribed in the plan. As this recovery plan incorporates an adaptive management approach to recovery of the arroyo toad, the information will be used to modify the recovery tasks and criteria, as appropriate.

The number of populations was determined based on an examination of the distribution of the arroyo toad and suitable habitat throughout the species' range. We believe that protecting the number of arroyo toad populations and their habitat as identified in the recovery criteria will allow the preservation of the genetic and phenotypic characteristics of the species throughout the range, and the maintenance of connectivity between subpopulations where applicable. The latter will ensure that metapopulation dynamics can function properly; that is, that there will be adequate gene flow between small subpopulations to prevent deleterious founder effects from becoming established, that dispersing arroyo toads from expanding populations will be able to move into nearby suitable habitats, and that the natural recolonization of habitats from which arroyo toads have been extirpated by naturally occurring random events will take place within a reasonable time frame. The actual distribution of those protected populations or metapopulations and habitats will be determined based on hydrologic units and watershed management areas, connectivity between and among habitat patches,

and existing reserves, as appropriate.

Comment: Several commenters expressed concerns over the budget as set forth in the Implementation Schedule.

Response: Recovery plans do not commit funds, but are used to identify, where possible, the cost for recovery of the species and in setting regional and national funding priorities. Recovery plans can be used to justify recovery appropriations to Congress. The funds necessary to attain the objectives will be made available subject to budgetary and other constraints affecting the parties involved, as well as the need to address other priorities. Budget estimates are based on information provided to us, and are modified accordingly.

Comment: Several commenters felt that the emphasis and burden of recovery is on Federal agencies and ignores the role of non-Federal and private landowners. One stated the belief that full recovery of the species is not possible unless non-Federal lands are given priority.

Response: The Service agrees that the emphasis for downlisting the arroyo toad to threatened status is on Federal lands, but disagrees that the role of non-Federal and private landowners is ignored. Section 7 of the Act states that all Federal agencies shall further the purposes of the Act by carrying out programs for the conservation of endangered and threatened species. Due to the occurrence of suitable habitat and arroyo toad populations on Federal lands throughout nearly the entire known (current and historic) range of the species, we feel that securing those habitats and documenting stable or increasing populations on those lands will justify the reclassification to threatened under the Act. We concur with the belief that full recovery of the toad is not possible if only those populations on Federal lands are protected, which is why additional populations on State, county, local, land conservancy, and private lands are to be secured and shown to be stable or increasing before the arroyo toad will be considered for delisting.

Comment: Several commenters stated that site-specific plans needed to be presented in the recovery plan or questioned the lack of site-specific recovery tasks on non-Federal lands.

Response: The Endangered Species Act (section 4(f)(1)(B)(i)) requires the Service to incorporate in each plan "a description of such site-specific management actions as may be necessary to achieve the plan's goals." The Service is also expected to develop recovery plans expeditiously and to revise them as new information becomes available. The arroyo toad has a sufficiently broad distribution that, while it is practical for the plan to describe what sorts of measures need to be taken locally and to set geographically specific recovery criteria, the plan cannot anticipate activities that will be planned on specific sites during its lifetime. Site-specific tasks for non-Federal lands will be developed, based on the guidance presented in the recovery plan, during the planning and permitting processes appropriate for those sites and projects.

Comment: One commenter expressed concern over measures found in previously issued habitat conservation plans designed to offset unavoidable impacts to arroyo toads. The commenter was especially concerned about the potential loss of habitat for arroyo toads, and with the option that the relocation of arroyo toad populations from proposed project sites could be used to offset impacts.

Response: The basic purpose of a recovery plan is to identify what measures need to be taken to recover a listed species. In addition to what habitat conservation plans may contribute towards recovery, they also may identify further measures that contribute to the conservation of the species which Federal or State agencies and other entities can implement. When a recovery plan is in place prior to the development of habitat conservation plans and the issuance of incidental take permits under section 10 of the Act, the architects of such plans and permits can benefit from referencing recovery plans and develop avoidance, minimization, and mitigation measures that would further the conservation of the listed species. Unfortunately, a recovery plan often is not available during the preparation of habitat conservation plans, the amount of information is limited, and we later find that the relative value of some measures changes as the information regarding the

species becomes more complete.

The development of a recovery plan does not include the technical review of incidental take permits and their associated habitat conservation plans. Although such plans may be identified and referenced, the recovery plan is not the appropriate platform for critical analysis of those habitat conservation plans. The Service will use the guidelines and recommendations in this recovery plan while participating in the development of future habitat conservation plans. Issuance of incidental take permits is subject to the issuance criteria at 50 CFR 17.22(b). The Service cannot direct applicants to apply for incidental take permits; however, properly functioning habitat conservation plans developed in support of incidental take permit applications could play a major positive role in the recovery of the arroyo toad.

We do not dispute that there may be a loss of arroyo toad habitat as a result of habitat conservation planning efforts. However, areas of habitat conserved within plan boundaries should offset habitat losses by allowing for active management and monitoring of arroyo toad populations. Such management is intended to guard against the continued degradation of arroyo toad habitat and loss of conserved populations.

Comment: One commenter noted that the Orange County Central/Coastal Natural Community Conservation Plan allows for the loss of smaller arroyo toad populations, reintroduced populations, or populations which have expanded due to Natural Community Conservation Plan management, but does not allow for loss of major arroyo toad populations. The commenter states that no arroyo toad population should be impacted until it can be determined what is a "small" or "major" population. The commenter further states that expanding populations should be protected no matter what the reason is for their expansion, as this is a sign of recovery. Finally, the commenter argues that the recovery plan should acknowledge that all small, reintroduced, or expanding populations within the Natural Community Conservation Plan will be extirpated and should not be

included in the recovery scheme.

Response: These comments are predominantly criticisms of the Natural Community Conservation Plan rather than the recovery plan. Determination of what constitutes a "small" or "major" arroyo toad population will be made based on the best available information at the time that take of a population is proposed within Natural Community Conservation Plan boundaries. In instances on participating landowner's property where take of a "covered" arroyo toad population is proposed, mitigation by means of relocation shall be required to areas within the Reserve System in a manner and location specified by the Service. Thus, while the Natural Community Conservation Plan allows for the disturbance of small, reintroduced or arroyo toad populations expanding as a result of reserve management, application of appropriate relocation methodologies is intended to prevent the extirpation of such populations.

Comment: One commenter stated that consistency in rulings from the Service on Federal and non-Federal projects will be necessary for the recovery of the arroyo toad.

Response: We agree that determinations on Federal and non-Federal projects should be consistent with the objective of recovery. The recovery plan provides information on particular threats that occur in known and potential arroyo toad habitat. The plan outlines tasks and goals that, when accomplished, we believe will result in the recovery of the species. By reviewing the threats and the tasks, Service biologists should be able to develop appropriate strategies for specific watersheds, which then can be applied to all projects within those watersheds.

Comment: One commenter expressed the concern that the recovery plan might "invalidate" agreements previously made through formal consultation, but recognized their responsibility to reassess the impacts of activities discussed in the recovery plan and update their management plans based on new information.

Response: The recovery plan does not invalidate agreements previously made through formal consultation under section 7 of the Act. Reinitiation of formal consultation is covered under 50 CFR 402.16 and in the "No Surprises" assurances published in 63 FR 8859. Reinitiation is triggered a) if the incidental take in the original

biological opinion is exceeded, b) if new information leads to the conclusion that the action will have effects previously not considered, c) if the identified action is modified in a manner that causes effects not originally considered, d) or if a new species is listed or if critical habitat is designated that may be affected by the identified action. Recovery plans in and of themselves do not require reinitiation unless the information contained within them fulfills criteria b, above. We concur regarding the agency's responsibilities, and appreciate their recognition of them.

Comment: One commenter stated that some tasks in the Implementation Schedule, such as the development of management plans and agreements, have already been completed.

Response: Although management plans and agreements may have been developed, their implementation is an ongoing process. Once a plan has been developed and initiated, ongoing monitoring of the effects is necessary, and may necessitate modification of the plan. As a result, some tasks truly cannot be considered completed as long as the activity is still occurring within the drainage or in the area of interest (such as on a National Forest). Tasks that have begun generally are identified as "ongoing" in the "Task Duration" column of the Implementation Schedule.

Comment: One commenter stated that the first task of the recovery plan should be to designate critical habitat.

Response: We respectfully disagree. The evaluation of the need for and designation of critical habitat is accomplished through the listing process under subsections 4(a)(3) and 4(b)(2) of the Act. The development and implementation of a recovery plan is accomplished under section 4(f) of the Act, and is a separate process. In addition, recovery plans are different from critical habitat in that they are not legally binding documents. That is, the designation of critical habitat imposes specific legal requirements on Federal agencies under section 7 of the Act. In comparison, a recovery plan provides guidance, that if followed, can achieve the objectives of the plan (e.g., downlisting of an endangered species). Furthermore, we believe that recovery plans allow the Service to protect identified

habitat more sufficiently than formally designated critical habitat. Through recovery planning, appropriate habitat areas can be addressed and protected without creating undue concern among landowners who routinely do not understand the meaning of critical habitat.

Comment: One commenter stated that grazing is used as a management tool for black toads and implied that it may be appropriate for arroyo toads.

Response: Although a specific grazing regime may be appropriate for black toads, it does not follow that the same or similar regime is automatically appropriate for all toad species. The recovery plan discusses the known adverse effects of grazing on arroyo toads and their habitat, points out a situation where the removal of grazing within arroyo toad habitat appears to be associated with the dramatic recovery of a population, and includes research on the effects of grazing on the species as a recovery task. The recovery plan does not require the complete removal of grazing within known arroyo toad habitat, but it does seek minimization (i.e., reduction to an insignificant level or elimination) of impacts from grazing. The methods by which that goal will be accomplished will depend on the specific sites to be managed.

Comment: One commenter expressed a concern that alterations in the management of their resources would require full evaluation and consideration under the National Environmental Policy Act and stated that recovery plans are required to balance the benefits of the conservation measures with the economic cost.

Response: Recovery plans are broad planning documents that outline the tasks that will contribute to the recovery of a species or group of species. Therefore, they are categorically excluded from analysis requirements under the National Environmental Policy Act. Further, the "Guidelines for Planning and Coordinating Recovery of Endangered and Threatened Species" (Service 1990) do not state that benefit-cost analyses are to be conducted in order to finalize recovery plans. Recovery actions to be carried out by Federal agencies may be subject to National Environmental Policy Act analysis at the time they are "proposed" within the guidelines of the National Environmental Policy Act.

Similarly, habitat conservation plans are subject to National Environmental Policy Act review.

Comment: The water districts expressed concerns about their ability to comply with recovery tasks that guide them to manage flows downstream from dams in drainages that have arroyo toad populations in a manner conducive to arroyo toad reproduction and survival and to the maintenance of arroyo toad habitat, and to maintain appropriate stream flow patterns.

Response: Water management districts and other public agencies have responsibilities under section 9(a)(1) of the Endangered Species Act, which make it unlawful for any person subject to the jurisdiction of the United States to engage in specific activities with respect to endangered species, including, but not limited to, the take of any such species. Federal and non-Federal actions that may affect or take arroyo toads and their habitat will be reviewed by the Service under the section 7 and section 10 processes, as discussed previously. The section 10 (habitat conservation plan) process in particular recognizes economic factors and provides permit applicants with long-term assurances that their activities will be in compliance with Endangered Species Act requirements.

Appropriate stream flows will be determined through section 7 and/or section 10 processes, based on reviews of historic rainfall records and hydrologic data. Such efforts will require cooperation among appropriate Federal, State, and local agencies such that the guidelines and plans developed will allow for the conservation of arroyo toads, other listed species, candidate species, and species of concern, while still meeting safety guidelines and regulations, and the needs of the customers.

Recovery plans are guidance documents, and set forth what the Service believes to be the actions and management directions necessary to downlist and delist species. Many recovery tasks are intended to provide guidance in the development of appropriate management plans that will conserve and recover species, including habitat conservation plans.

Comment: One commenter noted that no research efforts were directed toward arroyo toad populations in Mexico.

Response: We agree that the recovery plan does not identify specific research efforts directed toward arroyo toad populations in Mexico. The plan addresses recovery actions, including research that will allow us to secure arroyo toad populations and habitat, and reduce threats to the species in the United States.

Comment: One commenter urged that we adopt a landscape perspective for describing the threats and the conservation needs of the arroyo toad, and that we should apply recovery actions to all streams within the species' geographic range, not just those known to support arroyo toads.

Response: The draft recovery plan did discuss the threats and recovery strategy in a landscape perspective. For example, the impacts of dams were discussed in terms of the direct loss of habitat from inundation, the degradation of habitat below the dams due to the retention of sediments and alteration of water flow patterns, the introduction and facilitation of the spread of exotic species, and as barriers to the movement of toads. Other threats were discussed in a similar manner.

The recovery strategy clearly stated that the focus is to provide sufficient properly functioning aquatic, riparian, and upland habitats for arroyo toad populations. It also stated that ecosystem-based conservation plans need to be developed to properly manage arroyo toad recovery.

We do not believe that the application of recovery tasks to all streams within the range of the arroyo toad is necessary to achieve recovery of the species to a point at which it no longer needs protection under the Act. The California Department of Forestry has prepared maps of small-area watersheds and hydrologic planning units which can, in many cases, be used as a basis for determining appropriate areas for specific recovery tasks. The arroyo toad is found in six of California's nine hydrologic regions. In Region 9, South Coast, alone, which includes parts of Orange, Riverside, and San Diego Counties, there are over 150 hydrologic

subareas, some of which cover more than one stream. Many of the streams never supported arroyo toad habitat, or are currently or potentially incapable of doing so due to human-related changes. One of the main tasks suggested in the plan is to survey potential habitat within the range of the species, and to identify and implement appropriate recovery actions for newly identified populations.

Comment: One commenter suggested that we focus on "restoring ecological integrity" as a means to eliminate exotic species.

Response: We believe that wherever possible, restoration of local ecosystems should be the goal of recovery actions. We believe that removal of exotic species is one part of returning watersheds to health, and that it should be done in concert with other actions, as appropriate. Due to the extensive changes affecting most drainages in which arroyo toads are found, including dams and reservoirs, roads, and urbanization, it is impossible to restore full "ecological integrity" to many of the watersheds in much of the current range of the species.

Although ecosystems can be made more hospitable for the return of native species by undoing modifications and through biological control measures, it is generally unrealistic to expect exotic species to be spontaneously replaced by natives without removal measures.

Comment: One commenter expressed concerns that the long turnaround times for processing 10(a)(1)(A) permit applications can interfere with conducting necessary survey, site verification, and monitoring efforts.

Response: We recognize that delays in processing permit applications can interfere with expedient completion of tasks. Permit applications are processed as quickly as possible given established priorities and workloads. The Service is seeking ways to streamline and expedite the permit process.

Comment: Two commenters expressed concern that the California Department of Fish and Game issues permits for suction dredge mining without consulting with the U.S. Forest Service and the Fish and Wildlife Service regarding endangered,

threatened, and sensitive species issues.

Response: The Service, the Forest Service, and California Department of Fish and Game are currently involved in discussions to resolve this issue.

Comment: One commenter suggested that efforts to acquire additional lands in Sloan Canyon as preserve area should be identified as a recovery task.

Response: The recovery plan includes the possibility of land acquisition as an appropriate recovery task. As arroyo toad populations and habitats are identified and their status and threats evaluated, the role of individual populations or subpopulations and sites in meeting the recovery goals will be analyzed. Decisions regarding conservation mechanisms, including acquisition, will be made on a case-by-case basis, within the overall recovery framework, as priorities and resources allow.

Comment: One commenter stated that "a more diverse group of researchers" should have been consulted, that there should be an institutionalized format for information exchange, that the timing of the draft recovery plan release was inopportune, and that the draft was not widely distributed.

Response: We recognize that there will always be an array of opinions regarding how recovery plan development and implementation should occur. The Service does have national guidelines for the preparation of recovery plans, and we have developed this plan in accordance with those guidelines. During the development of the draft recovery plan, we contacted a wide range of Federal, State, and private sector biologists for input regarding the biology, ecology, and management of the arroyo toad. The timing of the release of recovery plans is dependent on several factors, including workloads and priorities at both Field Office and Regional Office levels. The public comment period for the draft recovery plan was longer than the minimum review period (90 versus 60 days). During that period, we sent more than 150 copies of the plan to Federal, State, and local agencies and to private individuals. We specifically requested peer review from additional experts. We cannot require any individual or agency to comment on the draft recovery plans, nor do we discourage anyone from providing comments.

We are grateful to individuals who provided new biological information for the final version of the plan.

Any interested parties with outstanding concerns are invited to contact us at the following address:

U.S. Fish and Wildlife Service
Ventura Fish and Wildlife Office
2493 Portola Road, Suite B
Ventura, California 93003
telephone 805/644-1766