PETITION TO THE STATE OF CALIFORNIA FISH AND GAME COMMISSION SUPPORTING INFORMATION FOR

The California Tiger Salamander ***(Ambystoma californiense)***

TABLE OF CONTENTS

EXECUTIVE SUMMARY

Petitioners Center for Biological Diversity, Environmental Defense Center, Defenders of Wildlife, VernalPools.Org, Butte Environmental Center, Sierra Club Sonoma Group, Citizens for a Sustainable Cotati, Ohlone Audubon Society, and the Citizen's Committee to Complete the Refuge submit this petition to list the California tiger salamander (*Ambystoma californiense*, "CTS") as an endangered species under the California Endangered Species Act ("CESA") pursuant to the California Fish and Game Code §§ 2070 et seq. This petition demonstrates that the CTS clearly warrants listing under CESA based on the factors specified in the statute.

The CTS is an amphibian native to the vernal pools, sag ponds, grasslands, and oak woodlands of California. The CTS spends the majority of its life cycle underground, usually in small mammal burrows. These salamanders emerge from their burrows during the winter rainy season to breed and lay their eggs in vernal pools, or seasonal wetlands. The CTS larvae maturation period of approximately 9 to 13 weeks corresponds to the natural ponding duration of California's vernal pools and sag ponds. While CTS are relatively long-lived (20+ years in captivity), scientists believe that most breed only once or twice in their lifetime (7–10 years), and usually not before reaching 4–6 years of age.

The CTS once occurred in many areas throughout the grasslands and oak woodlands of the Santa Rosa Plain in Sonoma County, Santa Barbara County, eastern Bay Area, Central Valley, southern San Joaquin Valley, and the foothills of the Coast Ranges. The species is generally thought to occur below 1,500 feet in elevation, although CTS have been found at elevations up to 3,600 feet in the San Francisco Bay Area. The U.S. Fish and Wildlife Service has divided the CTS into three "distinct population segments" based on geographical, genetic, and morphological separation: Sonoma County, Santa Barbara County, and Central California. Based on information indicating additional geographical and genetic separation within the Central California population segment, we discuss its status and threats with reference to four subpopulations: the Bay Area, Central Valley, Southern San Joaquin, and Central Coast Range subpopulations.

Some or all of the population segments and subpopulations may ultimately be described as separate species or subspecies. Because formal subdivision into species or subspecies has not yet taken place, Petitioners request listing as endangered for the full species, *Ambystoma californiense*, including all populations statewide.

The historic range and habitat of the CTS comprised some of the most desirable land in California for agriculture and urban development. The species had been eliminated from significant portions of its former range well before the passage of the federal or California Endangered Species Acts. As early as 1966, Dr. Robert Stebbins recommended that the CTS be included on the first federal endangered species list. Protection has been slow in coming. The California Department of Fish and Game first proposed some degree of bag limit protections for CTS in 1972 as part of its nongame program. These limited California Department of Fish and Game protections became more restrictive throughout the 1980s with protections given to native amphibians and reptiles in sport fishing regulations. Later, CTS were formerly categorized as a State Species of Special Concern in 1994 and additional steps were taken during the 1990s to curb the introduction of live, non-native tiger salamander (*Ambystoma tigrinum* spp.) larvae as fish bait within the native range of CTS. Such limited regulations proved inadequate for the protection of this species, and the Santa Barbara and Sonoma County population segments received emergency protection from the U.S. Fish and Wildlife Service under the federal Endangered Species Act in 2000 and 2002, respectively, and are currently listed as endangered. The U.S. Fish and Wildlife Service has proposed to list the Central California population as threatened, and is scheduled to make a final listing determination by May 15, 2004.

Because of its biology and life history, the CTS is extremely vulnerable to habitat destruction, modification, and fragmentation by human activities. All CTS subpopulations statewide face a high to extreme degree of threat from the physical elimination of habitat primarily due to urban and agricultural development. The species is also threatened by a number of other factors including habitat fragmentation, hybridization with non-native tiger salamanders, introduced diseases, and predation by other non-native introduced species.

The species' plight in Sonoma County is particularly extreme, where it has been extirpated from a significant amount of its historic range. The remaining breeding sites all occur in an area 5 miles long by 4 miles wide in southwestern portion of the City of Santa Rosa, as well as parts of Rohnert Park and Cotati, which are experiencing explosive growth. None of the small existing preserves within the known range of this subpopulation contain sufficient breeding or upland habitat to support a viable population. More than 95 percent of the remaining sites are threatened either directly or indirectly by urban development and growth. Despite the federal protection, CTS habitat continues to be lost.

The Santa Barbara population is also on the verge of extinction, though it has enjoyed protection under the Endangered Species Act since September 21, 2000 when it was listed as endangered as a distinct population segment. Only six populations remain, and each faces threats from habitat fragmentation, vineyard expansion, introduced species, and agricultural contaminants.

In Central California, each of the four subpopulations face varying degrees of threat from a combination of urbanization, conversion of habitat to intensive agriculture, hybridization, other introduced species, habitat fragmentation, and introduced diseases. The Bay Area subpopulation faces extreme urbanization in pressure, and also the spread of hybrid salamander populations. The Central Valley subpopulation faces high urbanization pressure, especially in Contra Costa County. Hybrid salamanders have recently been discovered in eastern Merced County, where some of the largest remaining of expanses of habitat are located. In addition, urbanization is increasing in this area. The Southern San Joaquin Valley subpopulation faces less urbanization pressure than in other areas, and hybrid salamanders have not yet been discovered. However, an enormous percentage of historic habitat has already been lost to intensive agriculture, and remaining populations face threats from non-native predators, water development projects, and roadway construction. In the Central Coast Range, hybridization poses the largest threat, as hybrid populations are the most widespread in this area. Conversion of historic habitat to vineyards and the introduction of non-native aquatic predators are also important factors within this region. The factors that threaten the CTS with extinction statewide are documented in detail below.

PROCEDURAL HISTORY

Decades have elapsed since scientists first alerted management agencies to the plight of the CTS. In 1966, Dr. Robert Stebbins suggested that the species be included on the first federal endangered species list (Barry and Shaffer 1994). Decades have elapsed since scientists first alerted management agencies to the plight of the CTS. In 1966, Dr. Robert Stebbins suggested that the species be included on the first federal endangered species list (Barry and Shaffer 1994). The California Department of Fish and Game first proposed limited bag limit protections for CTS in 1972 as a part of its nongame program (Bury 1972). These limited California Department of Fish and Game protections became more restrictive throughout the 1980s with protections given to native amphibians and reptiles on sport fishing regulations (Mallette and Nicola 1980). Later, CTS were formerly categorized as a State Species of Special Concern in 1994 (Jennings and Hayes 1994) and additional steps were taken during the 1990s to curb the introduction of live, non-native, tiger salamander (*Ambystoma tigrinum* spp.) larvae as fish bait within the native range of CTS. However, such limited California Department of Fish and Game regulations were felt to be inadequate for the projection of this species. Thus, at the federal level, the species has gradually received greater protection as illustrated in the timeline below.

Federal Protection Timeline

- September 18, 1985-- USFWS designates the CTS as a category 2 candidate species[1] (USFWS 2000a, b).
- February 21, 1992 -- Dr. H. Bradley Shaffer petitions the USFWS to list the CTS an endangered species throughout its range (USFWS 2000a, b).
- November 19, 1992 -- the USFWS publishes a positive 90-Day finding on the petition concluding that the petition presented substantial information indicating that listing may be warranted.
- August 13, 1993 -- Dr. H. Bradley Shaffer petitions the USFWS for emergency listing of the Sonoma County and Santa Barbara County populations of the CTS.
- April 18, 1994 -- the USFWS publishes a 12-month finding concluding that listing of the California tiger salamander is warranted but precluded by higher priority listing actions (USFWS 1994). The USFWS states, "Most of the remaining range of the California tiger salamander is imminently threatened by urban development, conversion of natural habitat to agriculture, introduction of exotic predatory animals, and/or other anthropogenic factors (e.g., rodent control programs, vehicular- related mortality)," and designates the CTS as a Candidate 1 species (USFWS 1994).
- January 19, 2000 -- the USFWS lists the Santa Barbara County CTS as an endangered species on an emergency basis.
- September 21, 2000 -- the USFWS lists the Santa Barbara County CTS as endangered on a permanent basis (USFWS 2000b).
- June 11, 2001 – the Center and Citizens for a Sustainable Cotati petition the USFWS for emergency listing of the Sonoma County CTS.
- October 31, 2001 – the USFWS finds that listing of the CTS throughout its remaining range is still "warranted but precluded."
- January 31, 2002 – the Center files suit in U.S. District Court against the USFWS for failing to respond to the emergency petition and for unlawfully concluding that listing of the CTS throughout its remaining range was still "warranted but precluded." (Center for Biological Diversity v. U.S. Fish & Wildlife Service, C-02-0558 WHA).
- June 11, 2002 – Settlement agreement and consent decree filed in the above litigation which requires the USFWS to make a determination on the emergency listing of the Sonoma County

[1] The category 2 designation was for taxa for which the USFWS had information indicating that listing might be appropriate but for which additional data were needed to support a listing proposal. The category 2 designation has since been eliminated.

CTS by July 15, 2002, to propose the CTS for listing throughout its remaining range by May 15, 2003, and to make a final determination on such proposal by May 15, 2004.

- July 22, 2002 – the USFWS lists the Sonoma County CTS on an emergency basis (USFWS 2002a).
- March 19, 2003 – the USFWS lists the Sonoma County CTS as an endangered species on a permanent basis (USFWS 2003a).
- May 23, 2003 – the USFWS issues proposed rule to list the CTS as threatened throughout its range. The proposed rule includes a proposal to downlist the Sonoma County and Santa Barbara distinct population segments to threatened and promulgate a special 4(d) rule to exempt "routine ranching activities."
- May 15, 2004 – Court ordered deadline for the USFWS to issue a final listing determination for the CTS throughout its remaining range in California.

The California Fish & Game Commission ("Commission") has not yet protected the CTS under the California Endangered Species Act. On July 6, 2001, the Center for Biological Diversity ("Center") petitioned the Commission for state listing of the CTS throughout its range on an emergency basis (CBD 2001). On August 3, 2001, the Commission considered the request for emergency listing and declined to take emergency action to protect the CTS. On October 3, 2001, the California Department of Fish and Game ("Department"), in a 24-page report, concurred with the petition in every major regard and recommended that the Commission accept the petition and designate the CTS as a candidate species under CESA. At least thirteen independent scientists supported listing of the CTS under CESA and further recommended that the Commission utilize its emergency listing authority to protect the species.

On December 7, 2001, the Commission considered the petition to list the CTS. The Department testified that the petition should be accepted and the CTS designated a candidate. Four independent scientific experts also testified that listing of the CTS was warranted. The Commission voted 2-1 to reject the petition to list the CTS. On February 8, 2002, the Commission adopted written findings rejecting the petition. The findings stated that the Commission rejected the petition because the Commission found that the petition had presented insufficient information in three areas: (1) Population trend, (2) Population abundance, and (3) The degree and immediacy of threat. The findings stated that the Commission encouraged the Center to resubmit the petition with additional information in these three areas.

While the Center believes the Commission's December 7, 2001 decision and February 8, 2002 findings were without scientific merit, the Center submits this renewed petition for listing of the CTS in the hopes of obtaining protection for the CTS without the need for legal action. An analysis of the Commission's first decision is attached as Appendix A. The information contained in this renewed petition, in combination with the information in the original petition, Department report and testimony, and the written and oral testimony of many scientific experts familiar with the species clearly provides more than sufficient information indicating that listing of the CTS "may be warranted." Petitioners urge the Commission to accept the petition, designate the CTS as a candidate species, and direct the Department to initiate a status review for the species.

THE CESA LISTING PROCESS AND THE STANDARD FOR ACCEPTANCE OF A PETITION

Recognizing that certain species of plants and animals have become extinct "as a consequence of man's activities, untempered by adequate concern for conservation," (Fish & G. Code § 2051 (a)) that other species are in danger of extinction, and that "[t]hese species of fish, wildlife, and plants are of ecological, educational, historical, recreational, esthetic, economic, and scientific value to the people of this state, and the conservation, protection, and enhancement of these species and their habitat is of statewide concern." (Fish & G. Code § 2051 (c)) the California Legislature enacted the California Endangered Species Act ("CESA").

The purpose of CESA is to "conserve, protect, restore, and enhance any endangered species or any threatened species and its habitat...." Fish & G. Code § 2052. To this end, CESA provides for the listing of species as "threatened[1]" and "endangered[2]." The Commission is the administrative body that makes all final decisions as to which species shall be listed under CESA, while the Department is the expert agency that makes recommendations as to which species warrant listing. The listing process may be set in motion in two ways: "any person" may petition the Commission to list a species, or the Department may on its own initiative put forward a species for consideration. In the case of a citizen proposal, CESA sets forth a process for listing that contains several discrete steps.

Upon receipt of a petition to list a species, a 90-day review period ensues during which the Commission refers the petition to the Department, as the relevant expert agency, to prepare a detailed report. The Department's report must determine whether the petition, along with other relevant information possessed or received by the Department, contains sufficient information indicating that listing may be warranted. Fish & G. Code § 2073.5.

During this period interested persons are notified of the petition and public comments are accepted by the Commission. Fish & G. Code § 2073.3. After receipt of the Department's report, the Commission considers the petition at a public hearing. Fish & G. Code § 2074. At this time the Commission is charged with its first substantive decision: determining whether the Petition, together with the Department's written report, and comments and testimony received, present sufficient information to indicate that listing of the species "may be warranted." Fish & G. Code § 2074.2. This standard has been interpreted by as the amount of information sufficient to "lead a reasonable person to conclude there is a substantial possibility the requested listing could occur." *Natural Resources Defense Council v. California Fish and Game Comm*. 28 Cal.App.4th at 1125, 1129. If the petition, together with the Department's report and comments received, indicates that listing "may be warranted," then the

---

[1]"Threatened species" means a native species or subspecies of a bird, mammal, fish, amphibian, reptile, or plant that, although not presently threatened with extinction, is likely to become an endangered species in the foreseeable future in the absence of the special protection and management efforts required by this chapter. Fish & G. Code § 2067.

[2]"Endangered species" means a native species or subspecies of a bird, mammal, fish, amphibian, reptile, or plant which is in serious danger of becoming extinct throughout all, or a significant portion, of its range due to one or more causes, including loss of habitat, change in habitat, overexploitation, predation, competition, or disease." Fish & G. Code § 2062.

Commission must accept the petition and designate the species as a "candidate species[3]." Fish & G. Code § 2074.2.

Once the petition is accepted by the Commission, then a more exacting level of review commences. The Department has twelve months from the date of the petition's acceptance to complete a full status review of the species and recommend whether such listing "is warranted." Following receipt of the Departments status review, the Commission holds an additional public hearing and determines whether listing of the species "is warranted." If the Commission finds that the species is faced with extinction throughout all or a significant portion of its range, it must list the species as endangered. Fish & G. Code § 2062. If the Commission finds that the species is likely to become an endangered species in the foreseeable future, it must list the species as threatened. Fish & G. Code § 2067.

Notwithstanding these listing procedures, the Commission may adopt a regulation that adds a species to the list of threatened or endangered species at any time if the Commission finds that there is any emergency posing a significant threat to the continued existence of the species. Fish & G. Code § 2076.5.

DESCRIPTION, BIOLOGY, AND ECOLOGY OF THE CALIFORNIA TIGER SALAMANDER

I. Description

The California tiger salamander is a large, stocky, terrestrial salamander with a broad, rounded snout (Stebbins 2003). Adults may reach a total length of 207 millimeters (mm) (8.2 inches (in)), with males generally averaging about 200 mm (8 in) in total length and females averaging about 170 mm (6.8 in) in total length (Stebbins 2003). For both sexes, the average snout to vent length is approximately 90 mm (3.6 in). The small eyes have black irises and protrude from the head (Jennings and Hays 1994). Coloration consists of white or pale yellow spots or bars on a black background on the back and sides (Jennings and Hays 1994). The belly varies from almost uniform white or pale yellow to a variegated pattern of white or pale yellow and black. Males can be distinguished from females, especially during the breeding season, by their swollen cloacae (a common chamber into which the intestinal, urinary, and reproductive canals discharge), more developed tail fins, and larger overall size (Stebbins 1951; Loredo and Van Vuren 1996).

[3] "Candidate species" means a native species or subspecies of a bird, mammal, fish, amphibian, reptile, or plant that the commission has formally noticed as being under review by the department for addition to either the list of endangered species or the list of threatened species, or a species for which the commission has published a notice of proposed regulation to add the species to either list." Fish & G. Code § 2068.

II. Taxonomy

The CTS was first described as a distinct species, *Ambystoma californiense*, by Gray in 1853 from specimens collected in Monterey (Grinnell and Camp 1917). Storer (1925) and Bishop (1943) likewise considered the California tiger salamander as a distinct species. However, Dunn (1940), Gehlbach (1967), and Frost (1985) considered the CTS a subspecies (*Ambystoma tigrinum californiense*) that belonged within the *A. tigrinum* complex. Based on recent morphological and genetic work, geographic isolation, and ecological differences among the members of the *A. tigrinum* complex, the California tiger salamander is considered to be a distinct species (Shaffer and Stanley 1991; Shaffer and McKnight 1996; Irschick and Shaffer 1997).

Mitochondrial DNA (mtDNA) sequence results (Shaffer and Trenham 2002) support the recognition of at least six distinct genetic units of CTS as follows: Sonoma County, Santa Barbara County, Bay Area, Central Valley, Southern San Joaquin, and Central Coast Range. The USFWS (2003b), in its proposed rule for listing the California tiger salamander throughout its entire range, groups the CTS into three Distinct Population Segments[2] ("DPSs"): Sonoma County, Santa Barbara County, and the Central California (which includes the Bay Area, Central Valley, Southern San Joaquin, and Central Coast Range DPSs identified in Shaffer and Trenham (2002)). Based on extensive allozyme and mtDNA sequence analysis of populations of California tiger salamanders from across their existing range, Shaffer et al. (1993) found that the two most genetically divergent populations of California tiger salamanders are those in Sonoma County and Santa Barbara County. These populations are clearly distinct genetically from other populations of California tiger salamanders. There may be justification for recognizing these populations as separate species, and they may be recognized as such when they are formally described. However, because they have not yet been formally described as such, this Petition requests listing as endangered under the California Endangered Species Act for the full species, *Ambystoma californiense,* including all populations statewide.

III. Reproduction and Growth

Based on research from Monterey County, CTS are often 6 years old before breeding for the first time (Trenham et al. 2000). Fewer than fifty percent of California tiger salamanders breed more than once in their lifetime (Trenham et al. 2000). Migration to breeding ponds is concentrated during a few rainy nights early in the winter, with males migrating before females (Twitty 1941; Shaffer et al. 1993; Loredo and Van Vuren 1996; Trenham 1998; Trenham et al. 2000). Males usually remain in the ponds for an average of 6 to 8 weeks, while females stay for approximately 1 to 2 weeks. In dry years, both sexes may stay for shorter periods (Loredo and Van Vuren 1996; Trenham 1998). In years where rainfall begins late in the season, females may forego breeding altogether (Loredo and Van Vuren 1996; Trenham et al. 2000). In years where rainfall is insufficient for creating suitable breeding habitat, both males and females will forego breeding for that year and each year thereafter fro which breeding ponds do not fill with water (Jennings 2000).

Female CTS mate and lay their eggs singly or in small groups (Twitty 1941; Shaffer et al. 1993). The number of eggs laid by a single female ranges from typically less than 350 eggs (M. Jennings, pers. comm.) to approximately 400–1,300 per breeding season (Trenham 1998; Trenham et al. 2000). The

[2] A DPS of any vertebrate animal may be listed separately under the federal ESA if it is both discrete and significant. See, e.g. USFWS 2003a. CESA does not specifically provide for the listing of a DPS.

eggs typically are attached to vegetation near the edge of the breeding pond (Storer 1925; Twitty 1941), but in ponds with no or limited vegetation, they may be attached to objects (rocks, boards, etc.) on the bottom (Jennings and Hayes 1994). After breeding, adults leave the pond and typically return to small mammal burrows (Loredo et al. 1996), although they may continue to come out nightly for approximately the next 2 weeks to feed (Shaffer et al. 1993).

Eggs hatch in 10 to 14 days with newly hatched larvae ranging from 11.5 to 14.2 mm (0.45 to 0.56 in) in total length (Storer 1925). Larvae feed on algae, small crustaceans, and mosquito larvae for about 6 weeks after hatching, when they switch to larger prey (P.R. Anderson 1968). Larger larvae will consume smaller tadpoles of Pacific treefrogs (*Hyla regilla*), California red-legged frogs (*Rana aurora draytonii*), western toads (*Bufo boreas*), and western spadefoots (*Scaphiopus hammondii*), as well as many aquatic insects and other aquatic invertebrates (J.D. Anderson 1968; P.R. Anderson 1968). The larvae also will eat each other under certain conditions (H.B. Shaffer and S. Sweet cited in Collins, *in litt*. 2000a). Captive salamanders appear to locate food by vision and smell (J.D. Anderson 1968).

Amphibian larvae must grow to a critical minimum body size before they can metamorphose (change into a different physical form) to the terrestrial stage (Wilbur and Collins 1973). Feaver (1971) found that CTS larvae metamorphosed and left the breeding ponds 60 to 94 days after the eggs had been laid, with larvae developing faster in smaller, more rapidly drying ponds. In general, the longer the ponding duration, the larger the larvae and metamorphosed juveniles are able to grow. The larger juvenile amphibians grow, the more likely they are to survive and reproduce (Semlitsch et al. 1988; Morey 1998).

In the late spring or early summer, before the ponds dry completely, metamorphosed juveniles leave the ponds and enter small mammal burrows after spending up to a few days in mud cracks or tunnels in moist soil near the water (Zeiner et al. 1988; Shaffer et al. 1993; Loredo et al. 1996). Like the adults, juveniles may emerge from these retreats to feed during nights of high relative humidity (Storer 1925; Shaffer et al. 1993) before settling in their selected estivation sites for the dry summer months. Newly metamorphosed juveniles range in size from 41 to 78 mm (1.6 to 3.1 in) snout-vent length (Trenham et al. 2000).

Adult female CTS cannot discriminate between suitable and detrimental aquatic habitats in which to lay their eggs (M. Jennings, pers. comm.). Thus, many of the pools in which CTS lay eggs do not hold water long enough for successful metamorphosis. Generally, a minimum of 10 weeks is required to allow sufficient time to metamorphose. The larvae will desiccate (dry out and perish) if a site dries before larvae complete metamorphosis (P.R. Anderson 1968; Feaver 1971). Pechmann et al. (1988) found a strong positive correlation with ponding duration and total number of metamorphosing juveniles in five salamander species. In one study (Feaver 1971), successful metamorphosis of California tiger salamanders occurred only in larger pools with longer ponding durations, which is typical range-wide (Jennings and Hayes 1994). Even though there is little difference in the number of pools used by salamanders between wet and dry years, pool duration is the most important factor to consider in relation to persistence and survival (Feaver 1971; Shaffer et al. 1993; Seymour and Westphal 1994, 1995).

After systematically surveying more than 275 freshwater ponds and documenting CTS breeding in 61 distinct ponds, the East Bay Regional Park District ("EBRPD") concluded that CTS are most reproductively successful in ponds with relatively low aquatic biodiversity (Bobzien 2003). Overall, these ponds tended to have no or very little emerged or submerged vegetation, and they supported few invertebrates and vertebrate species (Bobzien 2003).

Lifetime reproductive success for other tiger salamanders is typically low, with fewer than 30 metamorphic juveniles per breeding female. Trenham et al. (2000) found even lower numbers for CTS in Monterey County, with roughly 12 lifetime metamorphic offspring per breeding female. In part, this is due to the extended length of time it takes for California tiger salamanders to reach sexual maturity, as most do not breed until 4 to 6 years of age (Trenham et al. 2000). While individuals may survive for more than 10 years, fewer than 50 percent breed more than once (Trenham et al. 2000).

Combined with low survivorship of metamorphs (in some populations, less than 5 percent of marked juveniles survive to become breeding adults; Trenham 1998), reproductive output in most years is not sufficient to maintain populations. This suggests that the species requires occasional "boom" breeding events to prevent extirpation (temporary or permanent loss of the species from a particular habitat) or extinction (Trenham et al. 2000). With such low recruitment, isolated subpopulations can decline due to unusual, randomly occurring natural events as well as from human-caused factors that reduce breeding success and individual survival. Factors that repeatedly lower breeding success in isolated ponds, which are ponds that are too far from other ponds for immigrating individuals to replenish the population, can quickly drive a local population to extinction.

IV. Movement

The salamanders breeding in and living around a pool or seasonal pond, or a local complex of pools or seasonal ponds, constitute a local subpopulation. The rate of natural movement of salamanders among subpopulations depends on the distance between the ponds or complexes and on the intervening habitat (e.g., salamanders may move more quickly through sparsely covered and more open grassland versus more densely vegetated scrublands).

Subadult and adult CTS spend almost all of their lives in small mammal burrows found in the upland component of their habitat, particularly those of California ground squirrels (*Spermophilus beecheyi*) and Botta's pocket gophers (*Thomomys bottae*) (Jennings and Hays 1994; Loredo and Van Vuren 1996) at depths ranging from 20 centimeters (cm) (7.9 in) to 1.36 m (4.5 ft) beneath the ground surface (M. Jennings, pers. comm.). California tiger salamanders use both occupied and unoccupied small mammal burrows but, since burrows collapse within 18 months if not maintained, an active population of burrowing mammals is necessary to sustain sufficient underground refugia for the species (Loredo et al. 1996). California tiger salamanders may remain active underground into summer, moving small distances within burrow systems, and occasionally moving over land to other burrows during the spring (M. Jennings, pers. comm.).

During estivation (a state of dormancy or inactivity in response to hot, dry weather), CTS remain underground and likely feed on various arthropods (LSA 2001; Sweet 2003). Once fall and winter rains begin, they emerge from these retreats on nights of high relative humidity and during rains to feed aboveground and to migrate to the breeding ponds (Stebbins 1989, 2003; Shaffer et al. 1993). Studies in Santa Barbara County found few or no sub-adults emerging in winter, and feces of adult and subadult CTS encountered on the surface during rainy weather contained exoskeletal remains of various arthropods, indicating that CTS -- at least in Santa Barbara -- do the majority of their foraging underground during estivation (Sweet 2003). Sub-adults do not appear to make regular seasonal migrations, as evidenced by that fact that they are rarely captured at or near breeding ponds (Shaffer and Trenham 2003). However, juvenile and subadults have been captured near breeding ponds in the Bay Area, probably due to the sufficient estivation habitat being close to the breeding ponds and that juveniles and subadults move about on the surface during wet periods in the winter and spring (M. Jennings, pers. comm.) Movement in relation to weather conditions varies by geographical location. Adults may migrate long distances between summering and breeding sites. The distance from breeding sites may depend on local topography and vegetation, the distribution of ground squirrel or other rodent burrows, and climatic conditions (Hunt *in litt.* 1998; Stebbins 2003).

Dispersing juvenile CTS have been trapped more than 360 m (1,200 ft) from their natal (birth) pond (Ted Mullen, Science Applications International Corporation (SAIC), pers. comm., 1998, as cited in USFWS 2000b), and adults have been found along roads more than 2 km (1.2 mi) from any known breeding ponds (Sweet 1998). Although most marked salamanders have been recaptured at the pond where they were initially captured, in one study approximately 20 percent of California tiger salamanders hatched in one pond traveled to ponds a minimum of 580 m (1,900 ft) away to breed (Trenham 1998). Non-dispersing CTS, however, tend to stay closer to breeding ponds; 95 percent of CTS at a study site in Monterey County stayed within 173 m (568 ft) of the pond in which they bred (USFWS 2000b).

Once established in underground burrows, CTS may move short distances within burrows or overland to other burrows, generally during wet weather. Dispersal distance is closely tied to precipitation; California tiger salamanders are able to travel further in years with more precipitation. During drought years, adults, especially females, migrate in low numbers (Shaffer and Trenham 2003). As with migration distances, the number of ponds used by an individual over its lifetime will be dependent on landscape features.

V. Feeding

Adults apparently forage on various arthropods while underground, which provides energy needed for continued growth, locomotion, and egg production (LSA 2001; Sweet 2003). Adults feed heavily on terrestrial invertebrates after emergence. After returning to burrows following breeding, adults may continue to come out nightly for approximately 2 weeks to feed (Shaffer et al. 1993). Larvae feed on algae, small crustaceans, and mosquito larvae for about 6 weeks after hatching, when they switch to larger prey (P.R. Anderson 1968). Larger larvae will consume smaller tadpoles of Pacific treefrogs, California red-legged frogs, western toad, and western spadefoots, as well as many aquatic insects and other aquatic invertebrates (J.D. Anderson 1968; P.R. Anderson 1968). The larvae also will eat each other under certain conditions (H.B. Shaffer and S. Sweet cited in Collins, *in litt*. 2000a). Captive salamanders appear to locate food by vision and smell (J.D. Anderson 1968).

VI. Population Genetics

Using what is perhaps one of the largest genetic data sets for a non-human vertebrate (USFWS 2000b), Dr. H. Bradley Shaffer has analyzed the population genetics of the CTS (Shaffer et al. 1993; Irschick and Shaffer 1997; McKnight and Shaffer 1997; Shaffer and Trenham 2002). These studies used both allozyme and mitochondrial (mt) DNA sequence analyses. These data are used for two distinct purposes. First, these two types of genetic data allow an examination of areas of genetic differentiation and endemism, and the amount of genetic variation across the CTS (Shaffer et al. 1993). In this way, the level of divergence among populations, and the extent to which the most variable populations are in danger of extirpation, can be evaluated. Second, the genetic data allow an estimation of the amount of migration, or gene flow, among populations (Shaffer et al. 1993). Conclusions from the extensive study of CTS genetics are summarized below.

First, the most recent mtDNA sequence results (Shaffer and Trenham 2002; USFWS 2003b) support the recognition of at least six distinct genetic units of CTS. These are: Sonoma County; Santa Barbara County; the Bay Area (inner coast range, from extreme southwestern San Joaquin and most of Alameda counties, west into San Mateo County, and all of Santa Clara and most of San Benito counties); Central Valley (Dunnigan to northern Madera County on the east and western Merced County on the west sides of the Central Valley, southern border is Fresno River), Southern San Joaquin Coast Range (Fresno River south to the end of the range along the eastern edge of the Central Valley), and Central Coast Range (Monterey County, west of and including the San Andreas rift zone that forms the border with San Benito County, south to the inner coast range in San Luis Obispo County) (Shaffer and Trenham 2002). The USFWS (2003b) has recognized three distinct population segments, including Sonoma and Santa Barbara counties and the Central California segment, which includes the Bay Area, Central Valley, Southern San Joaquin, and Central Coast distinct population segments. Where appropriate throughout this petition, for example when discussing habitat loss, the statewide population will be discussed by addressing each of these genetic entities in turn.

Second, populations, or sets of populations, of the CTS are genetically isolated from each other (Shaffer and Trenham 2002). This implies that when populations are lost, there is little chance of recolonization from other areas (Shaffer and Trenham 2002). It also means that further isolation may have serious repercussions in reducing populations below minimum viable sizes (Shaffer and Trenham 2002).

Third, populations from the San Francisco Bay Area and Sacramento region are most variable, and are thus particularly important in terms of retaining genetic diversity within a single area (Shaffer and Trenham 2002). This also suggests that this area has maintained the largest populations historically, and can correctly be viewed as the “core” of the CTS distribution, as proposed by Stebbins in 1989 (Shaffer and Trenham 2002).

Fourth, there is a separation of populations from the east and west sides of the Central Valley (Shaffer and Trenham 2002). Each of these is clearly a separate genetic entity requiring consideration and protection (Shaffer and Trenham 2002).

Fifth, the populations from Sonoma and Santa Barbara counties live in isolated patches of habitat, and are clearly separate genetic entities from the remaining CTS (Shaffer et al. 1993). Populations of California tiger salamanders from near Santa Rosa, Sonoma County, are differentiated at a 2% or greater level from virtually all other statewide samples, and clearly constitute a highly differentiated group that has been long isolated from all other CTS (Shaffer et al. 1993). In comparison, the Santa Barbara County DPS of California tiger salamanders, which was emergency listed as an endangered species on September 21, 2000 (Federal Register, Vol. 65, No. 184), is divergent on an order of 1.8%. These are levels that justify separate species recognition in other members of this species complex, and may warrant separate taxonomic recognition and subdivision within the CTS as well (Shaffer et al. 1993).

Sixth, there is sufficient genetic information to consider the following as separate genetic entities, in addition to the Sonoma and Santa Barbara populations, discussed above: the Bay Area, Central Valley, Southern San Joaquin, and Central Coast Range (Shaffer and Trenham 2002).

In general, such high levels of genetic differentiation may lead to two possible interpretations. First, it may be that populations are extremely small, and genetic drift has led to high levels of diversification even with reasonable levels of migration. Alternatively, it may be that levels of migration are very, very low, leading to highly differentiated local populations (Shaffer et al. 1993). It appears that in this case the high levels of genetic differentiation are due primarily to extremely low migration rates (Shaffer et al. 1993). This conclusion is supported by the fact that even small ponds, under the right circumstances, can harbor large numbers of individuals. Further support is found in the high level of philopatricity in the species (i.e. most adults return to breed in the pond in which they hatched) (Shaffer et al. 1993).

HABITAT REQUIREMENTS

The CTS is endemic to the San Joaquin-Sacramento river valleys, bordering foothills, and coastal valleys of central California (Barry and Shaffer 1994; Jennings and Hays 1994; Shaffer et al. 1993; Storer 1925; Stebbins 2003). The species' range historically followed the low-elevation grassland-oak woodland plant and coastal sage scrub communities of the valleys and foothills from at least Butte County south to Santa Barbara and Tulare counties (Shaffer et al. 1993; Jennings and Hays 1994; USFWS 2000b). Within this large area, CTS occur only where their habitat requirements are met. Optimal habitat for the CTS can be succinctly described as low elevation vernal pools surrounded by upland habitat containing rodent burrows or other suitable dry-season refugia.

The CTS is generally restricted to low elevations, typically below 427 m (1,400 ft) (Shaffer et al. 1993). The precise reason for this low elevation habitat is unknown, however, the species is generally found below about 1,500 ft in elevation (Shaffer et al. 1993). However, the EBRPD has documented the species at up to 3,600 feet in the Sunol-Ohlone wilderness areas (Bobzien 2003).

For breeding, the CTS requires long lasting rain-filled pools. Although CTS are adapted to natural vernal pools and sag ponds, manmade or modified ephemeral and permanent pools are now frequently used (Fisher and Shaffer 1996). The species is currently presumed to be capable of successful breeding in temporary pools (Jennings and Hayes 1994). Permanent lowland aquatic sites can be used for breeding (Zeiner et al. 1988; P. Moyle pers. comm., as cited in Jennings and Hayes 1994; Stebbins 2003) but persistence at such sites is unlikely if they contain fish predators (Shaffer and Stanley 1992; Shaffer et al. 1993). Shaffer et al. (1993) found a statistically significant negative correlation between non-native, introduced fish and CTS in ponds surveyed throughout the state. They concluded, "<u>it is very clear from our results that fish, bullfrogs, and mosquito fish are all biological indicators of ponds that have been sufficiently disturbed so as to exclude CTS as well as most other native vernal pool species</u>." (Shaffer et al. 1993 at 14 (emphasis in original)). This conclusion was confirmed in subsequent studies by Seymour and Westphal (1994) and Fisher and Shaffer (1996).

Adults spend most of their lives underground, typically in burrows of ground squirrels, badgers, gophers, and other animals (CH2M Hill 1995). Dry-season refuge sites within 1 mile (1.6 km) of breeding sites (Austin and Shaffer 1992) are presumed to be a necessary habitat requirement, since the species is absent from sites with potentially suitable breeding habitat where surrounding hardpan soils lack small mammal burrows (Jennings and Hays 1994). The burrow density required to support viable populations of CTS in an area is not known. Occasionally, CTS have been found in locations with very few ground squirrel or gopher burrows (LSA 2001), but rodent control programs have been blamed for the lack or low density of CTS in some areas, such as Altamont Pass (Shaffer et al. 1993). The burrowing ability of CTS is presumed to be poor (Jennings and Hayes 1994), similar to that of eastern species of the same genus (Semlitsch 1983). Burrows of the California ground squirrel may be favored in some areas (Shaffer et al. 1993; J. Medeiros and S. Morey, pers. comm., as cited in Jennings and Hayes 1994). Burrows of the Botta's pocket gopher are known to be used (Shaffer et al. 1993; Barry and Shaffer 1994), as are certain man-made structures, such as wet basements, underground pipes, and septic tank drains (Zeiner et al. 1988; Myers undated; S. Sweet, UCSB, pers. comm., Jennings and Hayes, pers. observ., as cited in Jennings and Hayes 1994). CTS seem to prefer open grasslands to areas of continuous or dense woody vegetation.

Because CTS may migrate long distances from underground burrows to breeding pools, sufficient migration corridors are also required (USFWS 1992).

DISTRIBUTION

I. Historical Distribution

Historically, the CTS was found throughout large portions of the Central Valley of California from the southern San Joaquin Valley into the southern Sacramento Valley north of the Sacramento River Delta (Shaffer et al. 1993; Jennings and Hays 1994). The species was also found in the lower foothills along the eastern side of the Central Valley and in the foothills of the Coast Range (Shaffer et al. 1993). Although the historical distribution is not known in detail, current distribution and genetic data suggest that they were continuously distributed in the vernal pool/grassland habitat that dominated much of the Central Valley from Tulare and San Luis Obispo counties in the south, to Sacramento and Solano Counties in the north (Shaffer and Trenham 2003). The species' historic range followed the low-elevation grassland-oak woodland plant communities of the valleys and foothills. Shaffer et al. (1993) identified historic localities in twenty four counties: Alameda, Butte, Calaveras, Contra Costa, Fresno, Kern, Kings, Madera, Merced, Maripos, Monterey, Sacramento, San Benito, San Joaquin, San Luis Obisbo, San Mateo, Santa Barbara, Santa Clara, Santa Cruz, Solano, Sonoma, Stanislaus, Tulare, and Yolo. There is currently no evidence to support the occurrence of CTS in any other counties except Glenn County and some additional Bay Area locations (Jennings and Hays 1994; Jennings 1996, 2000).

Within this very large area, it is presumed that CTS generally occurred wherever suitable habitat was present, with some limited exceptions. For example, the CTS was probably never abundant in the San Joaquin saltbush community of the southern San Joaquin valley, (and they are absent from this area now), and the species was probably distributed only intermittently in the Tule Marsh floodplain surrounding the major rivers, since these marshes probably supported fish, at least in wet years (Shaffer et al 1993). The species was probably historically uncommon in the southernmost San Joaquin valley and foothills (Shaffer et al 1993). The California Natural Diversity Database contains an historical record from the north-facing slopes of the Tehachapi range, but this is likely to be an erroneous record

(M. Jennings, pers. comm.). In addition, the central and southern inner coast range has likely always been marginal habitat for salamanders (Shaffer 1992).

Subject to these exceptions, however, the CTS was probably present in much of the 13.72 million hectares of prairie calculated by Heady (1977). Shaffer et al. (1993 at 3) concluded, "there is every reason to expect that they [California tiger salamanders] were continuously distributed in the California Prairie, Valley Oak savanna, and the lower reaches of the Blue Oak-Digger Pine communities up to about 1500 ft elevation..." Therefore, the historical range of the California tiger salamander can be described as all suitable habitat within the Central Valley, bordering foothills, and coastal valleys from at least Sonoma and Butte counties south through Santa Barbara and Tulare counties.

II. Current Distribution

A. Range-wide Distribution

A distribution map of the California tiger salamander is shown in Figure 1. Historic and recent (i.e., 1990 to 2003) CTS occurrences from the California Natural Diversity Database ("CNDDB") are presented in Figure 2.

The CTS has been extirpated from much of its historic range, and is very limited in its remaining habitat. Shaffer et al. (1993) reached this conclusion over a decade ago, and since that time much more habitat has been lost. In general, the species has been eliminated from lowland habitats on the floor of the Central Valley. In some areas, such as the San Joaquin Valley, suitable habitat has been virtually eliminated. Shaffer et al. (1993) stated, "our field work indicates that it is virtually impossible to find habitat in the flat grassland of the original San Joaquin Prairie, because the prairie has been converted to either intensive agricultural uses or urban development." In other areas, suitable habitat exists but CTS are absent (Shaffer et al. 1993). A statistical analysis comparing the results of the extensive surveys conducted by Shaffer et al. between 1990-1992 and museum records have confirmed this observation. The average elevation of localities containing CTS in 1990-1992 was 922 feet, while the average elevation of localities surveyed without CTS was 639 feet, and the average elevation with historical localities that contained CTS was 510 feet (Shaffer et al. 1993). The authors noted that although they were sampling the ponds at lower elevations, they were only finding salamanders on average at higher elevations. These results confirm the observation that CTS have generally been eliminated from low elevation habitat.

The current distribution of the species can also be inferred from a county-by-county analysis conducted by Shaffer et al. (1993). This analysis grouped specific sites into general localities in order to be able to compare historic localities, which often have only vague locality information, with the much more specific information collected in this study. The results, shown in Table 1, demonstrate that in most cases the recent study documented a 50 percent to 100 percent loss of historic habitat.

Table 1: Historic and Present Localities (1990-1992) for CTS by County (from Shaffer et al. 1993)

Number	County	Number of Historic localities[3]	Historic localities verified during 1990-1992[4]	Percent loss of Historic localities
1	Butte	1	0	100%
2	Kings	1	0	100%
3	Mariposa	1	0	100%
4	Merced	4	0 (0p, 2a)	100%
5	San Mateo	1	0	100%
6	San Joaquin	9	1 (1p, 1a)	89%
7	Fresno	7	1 (1p, 2a)	86%
8	Santa Clara	9	3 (3p, 6a)	66%
9	Monterey	5	2 (6p, 2a)	60%
10	Madera	7	3 (3p, 13a)	57%
11	Sacramento	2	1 (2p, 3a)	50%
12	San Luis Obispo	2	1 (1p, 2a)	50%
13	Solano	2	1 (5p, 2a)	50%
14	Sonoma	2	1 (2p, 10a)	50%
15	Tulare	2	1 (1p, 1a)	50%
16	Alameda	7	4 (5p, 3a)	43%
17	Stanislaus	5	3 (3p, 6a)	40%
18	Contra Costa	8	5 (11p, 6a)	37%
19	San Benito	3	2 (2p, 3a)	33%
20	Calaveras	2	2 (2p, 0a)	0%
21	Kern	1	0 (1a (dry))	0%
22	Santa Barbara	3	3 (4p, 5a)	0%
23	Santa Cruz	1	1-sent to us 92	0%
24	Yolo	1	1 (1p)	0%
25	Colusa	0	0	NA[5]
26	Glenn[6]	0	0	NA
27	Napa	0	0	NA
28	Placer	0	0	NA
29	Sutter	0	0	NA
30	Tehama	0	0	NA
31	Tuolumne	0	0	NA
32	Yuba	0	0	NA

Another useful data set for estimating the current range of the species is the presence and absence of CTS in non-historic localities as reported by Shaffer et al. (1993). This table presents information on new potential breeding sites that were not reported in previous literature or in museum localities (Shaffer et al. 1993). Although the survey was not based on random sampling of potential sites but rather on site accessibility, the vast majority of these sites lacked CTS despite the fact that they

[3] A locality as used here refers to a general region, such as "Jepson Prairie" or "Livermore Valley," not a specific pond or site.

[4] For each entry Shaffer et al. (1993) presented the number of historic localities where they found CTS, followed by (in parentheses) the total number of ponds from those viable localities where CTS were present (p) or absent (a). Thus, for Alameda County, there are 7 historical localities, 4 of which still harbor CTS. Of the 8 sites the authors visited in those 4 locations, 5 contained CTS and 3 did not.

[5] NA indicates that these counties have no historic CTS localities, and Shaffer et al. were unable to locate any.

[6] There is 1 historic location in Glenn County that is not reported in Shaffer et al. (Mark Jennings, pers. comm.).

all appeared to be excellent potential habitat. The results are shown in Table 2. These dramatic figures provide further evidence that the CTS has been eliminated from much of its former range.

Table 2: Presence and absence of California Tiger Salamanders in Non-historic Localities (1990-1992) from Shaffer et al. (1993).

Number	County	Non-historic localities with CTS present	Non-historic localities with CTS absent	Percent of non-historic localities lacking CTS
1	Butte	0	6	100%
2	Colusa	0	9	100%
3	Contra Costa	0	3	100%
4	Glenn	0	5	100%
5	Kern	0	8	100%
6	Napa	0	2	100%
7	Placer	0	4	100%
8	San Joaquin	0	4	100%
9	Santa Barbara	0	2	100%
10	Santa Clara	0	3	100%
12	Solano	0	20	100%
13	Sonoma	0	3	100%
14	Stanislaus	0	1	100%
15	Sutter	0	4	100%
16	Tehama	0	11	100%
17	Tulare	0	5	100%
18	Tuolumne	0	1	100%
19	Yolo	0	8	100%
20	Yuba	0	8	100%
21	Sacramento	1	6	86%
22	San Luis Obispo	2	12	86%
23	Monterey	4	17	81%
24	Merced	1	4	80%
25	San Benito	3	9	75%
26	Alameda	4	6	60%

The remaining habitat for the CTS can best be described as rapidly shrinking islands. The CTS is being squeezed into an increasingly narrow fringe of habitat surrounding low-lying valleys, as reported by both Shaffer et al. (1993) and Holland (1998b). Holland (1998b) stated: "both maps [1972 and 1997 maps of Central Valley vernal pool distribution produced by Holland] portray a similar picture: a bath tub ring of habitat around the Great Valley's perimeter, together with a swath in the basin lands along the valley trough." Shaffer et al. (1993) stated: "this trend implies that the salamanders are being squeezed into an increasingly narrow fringe of habitat surrounding the low-lying valleys. If this continues, they will eventually be squeezed out; it must stop if the species is to be kept from extinction." Because the CTS is generally found below approximately 1,500 feet in elevation, although it has been documented at elevations up to 3,600 feet in the Bay Area (Bobzien 2003), its historic range, while large, is clearly limited by this factor. Because lowland and foothill areas have disproportionately been converted to intensive agriculture and development, the CTS has been eliminated from most of its former range.

The East Bay, Livermore Valley population has been recognized as the "core" population by both Stebbins (1989) and Shaffer et al. (1993). Shaffer et al. (1993) wrote the following:

Regions that clearly support the greatest concentrations of CTS are the East Bay counties of Alameda and Contra Costa (especially the Livermore Valley region), the general region around Sacramento, and parts of the inner Coast range from Santa Clara to San Luis Obispo Counties. Stebbins, in his 1989 report on the decline of the CTS, recognized a central "core area" in the East Bay/Livermore Valley region as well. In general, we find that as one proceeds away from this core region, the abundance of CTS decreases until they finally reach their distributional limits.

It is important to note that the current configuration of CTS habitat is a narrow strip fringing the Central Valley, making the isolation of populations from each other much more likely than was previously the case. This is especially true as urban centers like Fresno, Madera, and Sacramento expand off of the valley floor and into the Sierra foothills, cutting off sections of grassland habitat to the north and south. As this continues to occur, once continuous sections of habitat will be even further isolated and subdivided, and increasingly subject to environmental catastrophes and local extirpation. And under these conditions of isolation, recolonization from other areas becomes increasingly difficult or impossible.

B. Sonoma County Distribution

The Sonoma County population of the CTS historically occurred in suitable habitat throughout the Santa Rosa Plain, a relatively flat valley with low gradient watersheds extending approximately from the Santa Rosa Flood Control Channel in the north, south to Rohnert Park and Cotati, and including the western portions of Santa Rosa, west to near Sebastopol (Cook and Northen 2001; CH2M Hill 1995; Zeiner et al. 1988; Stebbins 2003; M. Jennings, pers. comm.). The historic range of the species may also have included the lowlands of the Petaluma River watershed, possibly as far south as the current city of Petaluma (Cook and Northen 2001). There is one historic report of a California tiger salamander in the vicinity of Petaluma from the spring of 1856 (Borland 1857). Some authors also include southern Marin and Napa counties within the historical range of the species (Zeiner et al. 1988; Stebbins 2003), but no evidence to support this conclusion has been found, despite active searching by a number of herpetologists over the past 20 years. The historic range of the Sonoma County population of the CTS within Sonoma County is shown in Figure 3.

Cook and Northen (2001) summarized the current distribution of the Sonoma County Population of the CTS as follows:

> Presumed extant locations of CTS are distributed west of the cities of Santa Rosa, Rohnert Park, and Cotati, as well as south of Cotati. These cities are located in central Santa Rosa Plain. CTS reports appear to be clustered in four areas: west Santa Rosa area, south Santa Rosa area, west Cotati area, and south Cotati area. The latter area is the only cluster located in the Petaluma watershed, the other areas are located on the Santa Rosa Plain. It is reasonable to conclude that urbanized portions of all of these areas were once occupied by CTS and that this species is currently restricted to four small areas located on the western fringe of the Santa Rosa Plain and a small portion of the upper Petaluma River watershed (Cook and Northen 2001).

The current distribution of the Sonoma County population of the CTS is shown in Figure 3. For earlier reports of Sonoma County distribution, see Shaffer et al. (1993) (searched two historic localities in Sonoma County and found CTS present at one locality, a 50% loss of historic localities), Jennings and Hayes (1994) (found CTS to be extirpated from 2 of 4 known historical localities in Sonoma County), and Seymour and Westphal (1995) (sampled 13 sites in Sonoma County in 1995 and found 5 salamander localities, concentrated within a few miles of each other around the old Santa Rosa Air Center). Currently, there are 64 known locality records and 36 known breeding sites for the County, based on the California Natural Diversity Data Base records as of August 2003 and confirmed in a letter to the CTS Fund II by Mark Jennings and Gretchen Padgett-Flohr in October 2003. CTS habitat continues to shrink in the County because of recent urban developments and proposed infrastructure associated with these developments.

C. Santa Barbara Distribution

The Santa Barbara population of the CTS is separated by the Coast Ranges, particularly the La Panza and Sierra Madre Ranges, and the Carrizo Plain from the closest other population (Shaffer et al. 1993; USFWS 2000b). Historically, the species ranged throughout suitable habitat in Santa Barbara County, and probably into southern San Luis Obispo County as well (USFWS 2000b). No CTS have been found during more recent survey efforts in appropriate habitat in southern San Luis Obispo County, however (USFWS 2000b). Any CTS found in southern San Luis Obispo County would probably be part of the Santa Barbara population, although genetic testing would need to be conducted to verify this (USFWS 2000b).

Only six CTS metapopulations remain in Santa Barbara County. These occur in 6 discrete regions: southwestern and southeastern Santa Maria Valley, west Solomon Hills/north Los Alamos Valley, east Los Alamos Valley, Purisima Hills and Santa Rita Valley (USFWS 2000b). These metapopulations are defined less by natural barriers than by recent (i.e., past 150 years) agricultural conversion and urbanization (S. Sweet, UCSB, pers. comm.). Quite a few of the remaining breeding sites are stockponds. There may be some connectivity between the Los Alamos Hills and Santa Rita Valley provided by ponds and upland habitats on the crest of the Purisima Hills (USFWS 2000b). Extensive searches in other areas within Santa Barbara County with apparently suitable habitat have not identified additional occupied areas or subpopulations (USFWS 2000b). Forty-eight breeding ponds are currently known in Santa Barbara County (S. Sweet, UCSB, pers. comm.).

D. Central California Distribution

1. Bay Area Distribution

The Bay Area population occurs within the Central Western California Jepson ecological zone (Hickman and Jepson 1993). It is bounded in the north by the ecological transition into the Great Central Valley Jepson Ecological Zone, and meets the boundaries of the Central Valley population segment's range in Alameda County (Shaffer and Trenham 2002). All sites in the Bay Area population in Alameda County are in the Jepson Central Western California ecological zone rather than the Great Central Valley ecological zone. The Bay Area population occurs in the southern half of Alameda County, most of Santa Clara and San Benito Counties, the southwestern tip of San Joaquin county, western edges of Stanislaus and Merced counties, and eastern edge of San Mateo county.

The boundary between the range of the Bay Area population and that of the Central Valley population is complex. While there are some shared haplotypes near the border between Alameda and Contra Costa counties, the region of shared haplotypes does not extend far beyond the assigned boundary (Shaffer and Trenham 2002). Thirty-two percent (194 of 608 known sites up to 2002) of Central California records are in this population, most of them in eastern Alameda and Santa Clara counties, and 49 of the records in the Bay Area population are considered extirpated (USFWS 2003b).

2. Central Valley Distribution

The Central Valley population includes many of the known and historically documented CTS sites. The range of this population extends through the Central Valley from east to west, and extends from Dunnigan in Yolo County in the north, to northern Madera County (Shaffer and Trenham 2002). There were isolated outposts in Butte and Glenn counties (Jennings and Hays 1994). The range of the Central Valley population includes the northeastern part of Yolo County most of Sacramento, Solano, San Joaquin, and Merced counties, as well as approximately the eastern half of Contra Costa County, northeastern corner of Alameda County, and the northern half of Madera County. The USFWS (2003b) analyzed the 608 CTS localities in the CNDDB from Central California and found that forty-seven percent (286 of 608 known sites up to 2002) occurred in the Central Valley population (USFWS 2003b). The USFWS considers populations at 37 of these locations to be extirpated (USFWS 2003b).

As discussed above, CTS habitat has been eliminated from most of the Central Valley lowlands, and remaining CTS localities are largely clustered in a ring around the Central Valley foothills. A dense cluster of CTS localities occurs in the eastern half of Contra Costa County and northeastern corner of Alameda County. These localities, along with those from the southern half of Alameda County which are part of the Bay Area population comprise the East Bay “core” CTS population.

The largest block of intact vernal pool and grassland habitat remaining in the state is located in Eastern Merced County (Vollmar 2001b). Recent surveys in this area have found CTS distributed throughout a large portion of the eastern third of Merced County, with the highest density of CTS found south of Highway 140 (Vollmar 2001b).

3. Southern San Joaquin Distribution

The Southern San Joaquin population occurs on the eastern edge of the Jepson Great Central Valley ecological zone (Hickman and Jepson 1993; Shaffer and Trenham 2002). CTS localities are distributed from the Fresno river south to the southern end of the range of the CTS along the eastern edge of the Great Central Valley ecological zone adjacent to the lower elevation portions of the Sierra Nevada ecological zone (Shaffer and Trenham 2002). The Southern San Joaquin population’s range includes approximately the central portions of Madera and Fresno counties, northeastern tip of Kings County, and the northern part of Tulare County. Nine percent (56 of the 608 known sites as of 2002) of Central California CTS localities occur in this population (USFWS 2003b). Populations at 18 of recorded locations in the Southern San Joaquin Valley are considered extirpated (USFWS 2003b).

4. Central Coast Range Distribution

Like the Bay Area population, the Central Coast Range population is within the Central Western California Jepson Ecological Zone (Shaffer and Trenham 2002). It is distributed throughout Monterey County, west of and including the San Andreas rift zone that forms the border with San Benito County, and south to the inner coast range in San Luis Obispo County. In this area, CTS are known from Fort Ord, the Hastings Reserve site, and possibly on Fort Hunter Liggett (Shaffer et al. 1993). CTS genotypes from Fort Hunter Liggett in southern Monterey County are presumed to be part of the Central Coast Range population but this has not yet been confirmed. Twelve percent (72 of the 608 known localities as of 2002) of CTS records occur in the Central Coast Range population: nineteen of these sites are considered extirpated (USFWS 2003b).

ABUNDANCE AND POPULATION DECLINE

The dramatic decline of the CTS has been documented by multiple researchers. Landmark studies by Shaffer et al. 1993, Jennings and Hayes 1994, and Davidson et al. 2002 are discussed below.

Shaffer et al. (1993) surveyed over 300 total sites representing 86 historic localities and found that the CTS had been extirpated from over half (56%) of historic localities. Opponents to the listing of the CTS have questioned the accuracy of this work, but these objections are scientifically unfounded. The sampling methods used by Shaffer et al. (1993) followed widely accepted protocols, and were designed to assess the current distribution of the CTS and its proportional loss from historic habitat. Despite efforts to cast doubt on the results of Shaffer et al. (1993), in no case did the opponents return to locations surveyed by Shaffer et al. (1993) and find CTS where the original study failed to do so. Opponents also raised the issue of false absences, or the possibility of not detecting CTS during surveys when, in fact, the species might occupy the site. While it is true that multi-year resurveys for amphibians have been shown to yield smaller estimates of decline than single-year resurveys (Skelly et al. 2003), Shaffer et al. (1993) minimized false absences by surveying the largest pools in each area, and by using minnow seines rather than dipnets and other methods. Shaffer et al. (1993) failed to find CTS at 57% of 86 historic sites; even a false absence rate of approximately 10% would instead indicate a loss of approximately 51% of historically occupied sites. In addition, because Shaffer et al. (1993) only surveyed historical localities where ponds still occurred (i.e., they did not include extinct urbanized CTS sites identified in the CNDDB), their results actually <u>underestimated</u> the loss of historic sites. Finally, opponents have suggested that the drought during the 1990 and 1992 survey seasons increased the probability of false absences. However, these were not extreme drought years (Fisher and Shaffer 1996), and even in drier years some CTS breed and larvae are detectable, particularly in the larger, deeper pools. Also, the rate of false absences in 1990 and 1991 was similar to 1992, indicating that the below-average rainfall had no demonstrable impact on CTS detection in the Shaffer et al. (1993) study. Thus, even accounting for false absences, the evidence is overwhelming that CTS have declined significantly throughout their range, since over half of historic localities no longer contain CTS.

Jennings and Hayes (1994) also documented the decline of the CTS, using 383 locations from 769 museum records and 158 records from other sources. Based on their review of the status of the species, Jennings and Hayes (1994) concluded that the CTS should be classified as threatened. As discussed herein, since 1994 large areas of habitat have been lost and the species now should be classified as endangered.

Davidson et al. (2002) conducted a comprehensive study documenting the connection between urbanization and the decline of the CTS. Analyzing the CTS as one of 8 amphibian species known to be declining, Davidson et al. (2002) used the maps produced by Jennings and Hayes (1994), and measured the percentage of urban and agricultural land use in a 5-km radius surrounding each site based on USGS digital land use/land cover maps. The authors performed several analyses to assess the accuracy of the maps and the sensitivity of their results to possible errors in both site spatial location and population status. Davidson et al. (2002) found that the percentage of all formerly occupied sites where the CTS is now absent was high: 33%. Davidson et al. (2002) also confirmed the finding of Shaffer et al. (1993) that CTS declines have been concentrated at lower elevations. The authors concluded that urbanization was a significant negative variable for occurrence of the CTS. That is, sites where CTS occurred historically but were no longer present had three times more urbanization than sites where the CTS persists.

The decline of the CTS should also be inferred from the documented contraction in its range and the documented loss of its habitat. Population counts for amphibian species such as the CTS are notoriously difficult to obtain for a variety of reasons including the cryptic nature of adults and the large natural fluctuations in population size. There is no existing historical abundance estimate.

The decision to accept a petition to list a species under CESA, and the ultimate decision to list must be based on an assessment of the degree of threat to the species. While documented population declines or low population counts can certainly help demonstrate a high degree of threat, a lack of such information does not demonstrate a lack of threat. As the USFWS acknowledged in the final rule listing the Santa Barbara population as endangered under the Federal Endangered Species Act, knowledge of the number of extant individuals is simply not necessary in order to conclude that protection is warranted (USFWS 2000b). Even a small pool may contain a large number of individuals in some years; however, the number of individuals is not an accurate indicator of the likelihood that the population will persist at a site, nor is it an accurate indicator of the degree of threat faced by the species. In this particular case, due to the interplay between the natural history of the CTS and the various threats, such as habitat destruction and the introduction of non-native predators, population counts are not particularly useful data in determining the risk of extinction faced by the species.

This Petition and the literature clearly document the decline of the CTS. The Petition has also presented the best available information on population abundance for the species. Most importantly, however, this Petition below documents the extreme and immediate factors that threaten the continued survival of the CTS. These are the factors demonstrating that the Commission has an obligation to accept the Petition and protect the CTS as a candidate species.

NATURE AND DEGREE OF THREAT

The CTS merits immediate listing as endangered throughout its range in California under the California Endangered Species Act. The nature and degree of the threats faced by the species are documented in detail below.

I. Present or Threatened Modification or Destruction of Habitat[7]

One of the most serious threats to the continued survival of the CTS is habitat destruction and modification, primarily due to conversion of land to urban and agricultural uses. The broad categories of urbanization and agriculture conversion of course encompass a broad range of intensity and type of use. The impact of land conversion on the CTS will vary with the intensity and type of use, but even relatively subtle land use changes can have a devastating impact on the species.

Urbanization eliminates CTS and their habitat. Earthmoving operations and cultivation in upland habitat directly and indirectly kill and injure CTS in burrows or on the surface by crushing or trapping them (USFWS 2003b). Construction activities also render surviving salamanders vulnerable to unfavorable environmental conditions such as increased predation, high temperatures, and low humidity (USFWS 2003b). These activities alter surface hydrology of vernal pools and destroy California ground squirrel and other small mammal burrows, thus impacting the suitability of breeding sites and upland habitat (USFWS 2003b). Even in the rare instance where some habitat is preserved in an urban setting, the resultant habitat fragmentation and isolation have extremely deleterious effects on the species. As discussed above, the CTS has low reproductive output and requires occasional years of unusually high recruitment, and/or recolonization from other areas in order to avoid extirpation. Because of this biological characteristic, isolation and fragmentation of habitat is highly likely to lead to local extirpations of the species, even if small patches of otherwise suitable habitat are preserved. Even relatively minor habitat modifications, such as construction of roads, pipelines, fences, and berms that traverse the area between breeding and refuge sites, can increase habitat fragmentation, impede or prevent breeding migrations, and result in direct and indirect mortality for CTS (Mader 1984; Sweet 1998; Findlay and Houlahan 1996; Launer and Fee 1996; Gibbs 1998). Roads also greatly increase adult mortality through road kill. The more traffic on the road, the higher the resulting mortality.

The effect on the CTS of the conversion of native habitats to agricultural uses varies depending on the type of land use. Intensive agriculture results in the alteration of natural vernal pools and seasonal ponds, as well as the loss of upland habitat used for estivation and migration. Of particular concern is the process of deep-ripping (or "deep slip plowing"), a process that uses a four to seven foot plow to break up the hardpan (the layer of dense soil that prevents water percolation and leads to the formation of vernal pools; Jennings and Hays 1994). Deep ripping, along with repeated discing and repeated plowing techniques, will permanently alter the hydrology of the area and eliminate suitable habitat for CTS. Of course, these practices also kill adult CTS in their burrows. Vineyards generally require deep-ripping of the soil prior to planting. Because wine grapes are a high value crop, the development of new vineyards and vineyard expansion will continue in California. Irrigation practices also eliminate suitable CTS habitat when seasonal ponds are drained, lands leveled, and hydrological patterns altered.

Low intensity agricultural uses, such as some livestock grazing and/or low-intensity farming, while still degrading the quality of the natural habitat for CTS, are more compatible with the continued survival of the species. In the Santa Rosa Plain, for example, virtually all natural habitat has been altered by human activity and the best remaining habitat tends to be in areas of very low intensity

[7] This section focuses on the factors that result in or contribute to the physical elimination of suitable CTS habitat. Other impacts that render existing habitat unsuitable for CTS, such as the introduction of non-native species, are discussed under OTHER NATURAL EVENTS OR HUMAN-RELATED ACTIVITIES, *supra.*

agriculture. By contrast, overgrazing is not compatible with the persistence of CTS as the practice leads to extensive terracing of hillsides, and damages vernal pools and other waterbodies.

A. Measures of Habitat Destruction Throughout the Range of the California Tiger Salamander

1. Range-wide Decline

The CTS has experienced a dramatic population decline and range contraction. See discussion of Shaffer et al. 1993, Jennings and Hayes 1994, and Davidson et al. 2002, *supra*, ABUNDANCE AND POPULATION DECLINE.

2. Continued Decline of Vernal Pools in California

Holland (1998a) Holland 1998a analyzed vernal pool loss in the Central Valley from 1989-1997. Using modern cartographic techniques, including extensive GIS analysis, Holland was able to obtain a snapshot of current vernal pool distribution in the Central Valley. Holland concluded that approximately 960,382 acres of vernal pool habitat remain, down from an estimated 4 million acres in pre-agricultural times, for a loss of nearly 80 percent. Holland further concluded that at the current rate of loss, the remaining total in 1997 would have shrunk by one-half, or to a mere twelve percent of the historical total, by the year 2044.

Holland also summarized vernal pool loss on a county-by-county basis. Because different baseline years were used for different counties, the most helpful summary is the percent loss per year by county. Table 3 presents results from Holland (1998a) (data is only included for counties within the range of the CTS). One important note is that the minimum mapping unit, with a few exceptions, used by Holland (1998b) to map the baseline years was forty acres. The 1997 "snapshot" study by Holland (1998a) used much more modern cartographic technology and was done at a much finer scale. Therefore, it is possible that the extent of loss of vernal pools was underestimated in this study, since the smaller pieces of vernal pool habitat would not have shown up on the earlier maps. One of Holland's (1998a) conclusions following the most recent report was that losses were preferentially focused on smaller pieces, that is, the smallest pieces tended to disappear entirely. Another important note is that the Coast Range counties that experienced zero or very low losses of vernal pools account for less than 2.5 percent of the habitat extant in 1997 (Holland 1998a).

Table 3: Vernal Pool Loss by County, 1989-1997 (from Holland 1998a)

County	Baseline Year	Total Acres Lost	Acres lost per year	Percent loss over interval	Percent loss per year
Glenn	1993	2,688	672.0	24.9	6.2
Colusa	1993	1,348	337	23.5	5.9
Yolo	1989	971	121.3	26.6	3.3
Napa	1987	226	22.6	17.3	1.7
Sacramento[8]	1972	30,512	1,450	36	1.7

[8] Holland (1998a) notes that for most of the 4-year period from 1993-1997 Sacramento County had a moratorium on new housing projects. A more accurate summary of habitat loss in Sacramento County can be obtained by examining the time period 1972-1993, presented in Holland (1998b).

Sonoma	1986	770	70.0	17.2	1.6
Tulare	1993	2,006	501.5	5.4	1.4
Yuba	1995	358	179.0	2.9	1.4
Solano	1994	1,534	511.3	3.9	1.3
Alameda	1986	348	31.6	12.6%	1.1
Kern	1990	551	78.7	7.4	1.1
Merced	1987	30,317	3031.7	10.7	1.1
Placer	1994	1,525	508.3	3.1	1.0
Sutter	1999	70	10.0	5.1	0.7
Tehama	1994	3,167	1055.6	2.3	0.7
Fresno	1994	496	165.3	1.8	0.6
Kings	1991	377	62.8	3.2	0.5
San Joaquin	1988	1,595	177.2	4.3	0.5
Madera	1987	4,130	413	4.5	0.4
Butte	1994	555	185	0.9	0.3
Stanislaus	1988	1,418	157.5	1.5	0.2
Sacramento	1993	215	53.7	0.4	0.1
Calaveras	1983	0.0	0.0	0.0	0.0
Contra Costa	1985	0.0	0.0	0.0	0.0
Mariposa	1976	0.0	0.0	0.0	0.0
Tuolumne	1976	0.0	0.0	0.0	0.0
Monterey	NA	NA	NA	NA	NA
San Benito	NA	NA	NA	NA	NA
San Luis Obispo	NA	NA	NA	NA	NA
San Mateo	NA	NA	NA	NA	NA
Santa Barbara	NA	NA	NA	NA	NA
Santa Clara	NA	NA	NA	NA	NA
Santa Cruz	NA	NA	NA	NA	NA

Keeler-Wolf et al. (1998) Keeler-Wolf et al. (1998) conducted a quantitative and qualitative assessment of vernal pool status throughout California. The authors determined that CTS occurred in 10 of the 17 distinct vernal pool regions in California, with regions defined by unique biotic (e.g., endemic species) and abiotic (e.g., soil and geomorphology) features. Keeler-Wolff et al. (1998) listed 11 of the 17 distinct vernal pool regions as highest priorities for conservation due to rapid loss of habitat, lack of protected areas, or other reasons. Seven of the 10 regions containing CTS were listed in this emergency "highest priority" category: Northeastern Sacramento Valley, Southeastern Sacramento Valley, Santa Rosa, Livermore, San Joaquin Valley, Southern Sierra Foothills, and Santa Barbara. Only three of the vernal pool regions containing CTS (Central Coast, Carrizo, and Solano-Colusa) were listed as areas requiring little immediate conservation activity due to relatively low impacts and stable management, although there are no known protected pools in the Solano-Colusa region, and CTS in the Central Coast region are suffering from biopollution due to the introduction of non-native tiger salamanders over the past 75 years.

Of particular concern is the Livermore Valley "core" area for CTS, which -- as of 1998 -- contained no reserves for vernal pools and very little acreage remaining undisturbed (Keeler-Wolff et al. 1998), although some mitigation banks are currently under development (see "Remaining Habitat on Existing Protected and Public Land is Inadequate to Ensure the Long Term Survival of the Species," *supra*). The Livermore region is one of the most threatened vernal pool regions in the state. The Sacramento Valley and Southern Sierra Foothill regions are also experiencing alarming urbanization rates with little regard for protecting vernal pools; the Santa Rosa region contains highly fragmented small reserves which do not protect the full range of variability; and the Santa Barbara region contains only small isolated pool occurrences, many of which are threatened (Keeler-Wolff et al. 1998).

Keeler-Wolf noted that the surrounding watershed areas and upland terrain, as well as the pools themselves and their spatial arrangement must be considered in conservation efforts. The integrity of the upland will influence not only the hydrology of the vernal pool but also the likelihood of maintaining some characteristic pool fauna, including the CTS (Keeler-Wolff et al. 1998). The authors concluded that vernal pools, largely endemic to California and harboring a large proportion of sensitive species, are extremely vulnerable to destruction because they most often occur on flat, easily developed, easily accessible land (Keeler-Wolff et al. 1998).

Table 4: Information Summary Table for Vernal Pool Regions in California (from Keeler-Wolf et al. 1998)

<table>
<tr><th>Vernal Pool Type</th><th>Vernal Pool Region</th><th>Viability (H,M,L)</th><th>Restoration Opportunity (H,M,L)</th><th>Protected Areas (Total Acres or H,M,L)</th><th>Sensitive Plants (No. of spp.)</th><th>Sensitive Animals (No. of spp.)</th></tr>
<tr><td>Northern Vernal Pool</td><td>Carrizo</td><td>M</td><td>M</td><td>M</td><td>6</td><td>4</td></tr>
<tr><td>Northern Vernal Pool</td><td>Central Coast</td><td>M</td><td>M</td><td>M</td><td>5</td><td>3</td></tr>
<tr><td>Northern Claypan</td><td>Livermore</td><td>L</td><td>L</td><td>L</td><td rowspan="2">12</td><td rowspan="2">3</td></tr>
<tr><td>Northern Vernal Pool</td><td>Livermore</td><td>M</td><td>M</td><td>None known</td></tr>
<tr><td>Northern Hardpan</td><td>NE Sacramento Valley</td><td>M</td><td>M</td><td>L</td><td rowspan="3">15</td><td rowspan="3">5</td></tr>
<tr><td>Northern Basalt Flow</td><td>NE Sacramento Valley</td><td>M</td><td>H</td><td>L</td></tr>
<tr><td>Northern Volcanic Mudflow</td><td>NE Sacramento Valley</td><td>M</td><td>H</td><td>L</td></tr>
<tr><td>Northern Claypan</td><td>San Joaquin Valley</td><td>M</td><td>M</td><td>M</td><td rowspan="3">19</td><td rowspan="3">9</td></tr>
<tr><td>Northern Hardpan</td><td>San Joaquin Valley</td><td>M</td><td>M</td><td>M</td></tr>
<tr><td>Northern Basalt Flow</td><td>San Joaquin Valley</td><td>H</td><td>H</td><td>L</td></tr>
<tr><td>Southern Vernal Pool</td><td>Santa Barbara</td><td>M</td><td>M</td><td>L</td><td>7</td><td>4</td></tr>
<tr><td>Northern Vernal Pool</td><td>Santa Rosa</td><td>M</td><td>M</td><td>M</td><td rowspan="2">13</td><td rowspan="2">2</td></tr>
<tr><td>Northern Hardpan</td><td>Santa Rosa</td><td>L</td><td>M</td><td>M</td></tr>
<tr><td>Northern Claypan</td><td>Solano-Colusa</td><td>M</td><td>M</td><td>M</td><td>16</td><td>7</td></tr>
</table>

Northern Hardpan	Solano-Colusa	L	M	None known		
Northern Hardpan	SE Sacramento Valley	M	M	L	9	6
Northern Volcanic Mudflow	SE Sacramento Valley	M	M	L		
Northern Claypan	Southern Sierra Foothills	M	M	M	15	9
Northern Hardpan	Southern Sierra Foothills	M	M	M		
Northern Basalt Flow	Southern Sierra Foothills	H	H	L		

USFWS (2002b) Finally, the USFWS biological opinion for the proposed UC Merced campus (USFWS 2002b) provided an estimate of the losses of vernal pool grasslands in 5 counties in the San Joaquin Valley, described in the following Table 5. In particular, Merced County lost 12% and Madera County lost 10% of vernal pool grassland acreage since 1987. These two counties support the greatest number of known CTS locations in the Central Valley population segment, according to the CNDDB (Figure 2).

Table 5: Losses and Estimate of Extant Vernal Pool Grasslands in Five Counties in the San Joaquin Valley, California (from USFWS 2002b)

County	Vernal Pool Grasslands (acres) (year)	Vernal Pool Grasslands - 1997[1] (acres)	Known Habitat Lost Since 1997 (acres/# of sites)	Current Estimate of Vernal Pool Grasslands (acres)	Percent Loss Since [Year]
Fresno	27,955 (1994)	27,495	200[2]/1	27,459	2% since 1994
Kern	7,399 (1990)	6,848	1,325[2]/5	6,648	10% since 1990
Madera	91,178 (1987)	87,047	5,040/5	82,007	10% since 1987
Merced	282,741 (1987)	252,424	3,180[3]/3	249,244	12% since 1987
Tulare	36,907 (1993)	34,900	75[2]/2	34,830	6% since 1993
TOTALS	**>446,180 ac in 1987**	**408,678**	**9,820[2]**	**398,858**	**2.5% since 1997; at least 10.6 % since 1987**

[1] Holland (1998a) No Net Loss? Changes in Great Valley Vernal Pool Distribution from 1989 to 1997. California Department of Fish and Game. Sacramento, California

[2] All sites comprised unplowed rangeland supporting endangered species habitat; however, some of the sites were not mapped by Holland (1998a) as "vernal pool grasslands."

[3] One site (160 acres) involved discing and ditching, but not deep-ripping, of vernal pool habitat; these acres may eventually be recovered to previous condition.

It is undisputed in the scientific literature that most of the original vernal pool habitat in California has been lost or degraded, and the destruction of vernal pools continues unabated (Robins and Vollmar 2001). Due to the occurrence of vernal pools on flat to low-gradient terrain, most vernal pool loss has been a result of agricultural conversion and urban development. As a consequence, more than 25 vernal pool species are listed or proposed for listing as endangered or threatened.

3. Other Studies of Habitat Conversion

Farmland Conversion Reports (1990-2000) The California Department of Conservation's biennial farmland conversion report tracks net gain and loss of categories of land including "grazing land," "cropped and irrigated farmlands," "urban and built up," and "other lands." While the farmland conversion reports are relatively crude tools for assessing actual impacts to CTS, the reports do reveal land use trends that have an impact the species overall.

In the farmland conversion reports, the "grazing land" category is defined as land on which the existing vegetation is suited to the grazing of livestock. The "urban and built-up" category is defined as land occupied by structures with a building density of at least one unit to one and one-half acres, or approximately six structures to a ten-acre parcel. The "cropped and irrigated farmland" category contains cropped and irrigated farmland, and the "other land" category is defined as land that does not meet the criteria of any other category.

The following Table 6 describes the total acreage of grazing land, other lands, and urbanized areas lost or gained from 1990 to 2000. We only included counties within the range of the CTS for which 100 percent of the county was mapped in both years.

Table 6: Important Farmland Acreage Summary (from Farmland Conversion Reports 1990 to 2000, California Department of Conservation)

County	Total County Area (acres)	Total acres grazing land lost or gained (1990-2000)	Total acres of other land lost or gained (1990-2000)	Total acres urban and built up lost or gained (1990-2000)
Alameda	525,339	- 6,969	+ 867	+ 8,641
Contra Costa	514,020	- 7,663	+ 2,284	+12,982
Monterey	2,121,128	- 19,379	- 427	+ 7,298
Sacramento	636,083	- 12,093	+ 3,870	+ 19,783
San Benito	889,387	+ 8,703	+ 2,374	+ 1,578
San Joaquin	912,600	- 7,521	+ 2,885	+ 10,390
Santa Clara	835,225	- 16,349	+ 12,037	+ 11,289
Solano	582,370	- 6,693	+ 2,438	+ 7,758
Sonoma	1,026,060	- 12,054	- 519	+ 10,548
TOTAL	8,042,212	**- 80,018**	**+ 25,809**	**+ 90,267**

In reviewing this data, the following general assumptions are appropriate:

(1) Grazing land is relatively likely to contain suitable habitat for the CTS;
(2) Urban and built-up land is relatively unlikely to contain suitable habitat for the CTS, although some habitat could remain;
(3) It is unknown how likely "other land" is to contain suitable CTS habitat.

Based on these reasonable assumptions, a number of observations about the impacts of land conversion patterns can be made. First, there was a large net loss of grazing land (80,018 acres) and a large net gain of urbanized land (90,267 acres) over the ten-year period, which can only be considered a very detrimental trend for the CTS. Second, it is impossible to say whether the increase (25,809) in "other land," which could include suitable habitat for the CTS, had any impact on the species one way or another. However, even if one assumed that the entire 25,809 acres of "other land" gained during this time period included suitable habitat for the species, the increase in this category is still may times less than the decrease in grazing land and increase in urban and built-up land. It is, in fact, extraordinarily unlikely that there could be a net gain in suitable CTS habitat, because the process of restoring CTS habitat (especially vernal pools) is laborious, of uncertain success, and has only been undertaken to date on a very small scale. Fourth, the trends revealed in the reports must be considered an underestimate of the loss of suitable or potentially suitable CTS habitat for several reasons. Because the reports track only net gain and loss of habitat, and because some natural habitat, grazing land, and other land containing suitable habitat for the CTS was likely converted to cropped and irrigated farmland during the study period but was no longer actively cropped or irrigated by the end of the study period, the trends almost certainly an underestimate of the loss of CTS habitat. In addition, the myriad negative indirect impacts associated with urbanization and increased human populations lead to a greater overall loss of suitable habitat than just the acres that are directly converted.

Overall, the farmland conversion reports demonstrate a large net loss of suitable or potentially suitable CTS habitat from 1990-2000.

4. Destruction of Native Prairie Habitat

Another measure of the impact of habitat loss on the CTS is the amount of native grassland and prairie that has been lost.[9] Historically, approximately 9.06 million ac of valley and coastal grasslands existed in the Central California portion of the range of the species (i.e., all counties within its range excluding Sonoma and Santa Barbara), with an additional 6.53 million ac supporting an overstory of blue oak/foothill pine, valley oak, or mixed hardwoods (USFWS 2003b). The USFWS has calculated that overall about 11.1 million ac of this habitat remains, for a loss of about 30 percent of potentially suitable grassland and oak woodland habitat. However, the statistics overall mask a disproportionate loss of native habitats and a broad scale replacement of native prairie with grasslands dominated by non-native species.

One report has estimated that at most 1/10 of one percent of native grassland remains in California (Jones and Stokes 1987; Shaffer et al. 1993). This report concludes, "The golden summer grasslands of California, often used to symbolize the state and its riches, in fact represent one of the greatest losses of indigenous natural diversity in western America," (Jones and Stokes 1987 at 37). The Central Valley is one of the most heavily impacted of all of California's ecosystems. A report prepared by the San Joaquin Valley Drainage Program ("SJVDP;" 1990) states that replacement of native grasslands and degradation of the Central Valley was well underway by the 1830's (Jones and Stokes 1987; Shaffer et al. 1993). Jones and Stokes (1987) state that between 1945 and 1980, 26% of the remaining annual and perennial grasslands have been lost in the state. The grasslands remaining in 1945 were likely only a very small fraction of the original grasslands found in the Central Valley.

Habitat loss in the San Joaquin Valley has been particularly extreme. The SJVDP (1990) report states that less than 1 percent of the valley oak savanna remains in the San Joaquin Valley proper, and

[9] This is not to suggest that the extent of CTS habitat loss is equal to the extent of native prairie loss, as CTS clearly do persist in non-native dominated habitats. However, the disappearance of high quality, native habitats is certainly a relevant factor to consider in an assessment of the overall status of the species.

that the tiny patches of remaining habitat are in jeopardy. Prairie habitat is essentially gone from the San Joaquin Valley itself (SJVDP 1990). As early as 1937, one author wrote that: "The major portion of the grassland belt northward from a point west of Los Banos, then eastward across the valley, and finally south along the east side of the valley, has been destroyed by cultivation and is farmed at the present time," (SJVDP 1990). Shaffer et al. (1993), despite extensive searching, found almost no habitat to survey for CTS in the San Joaquin Valley, and what little they did find lacked any CTS. The impression of Shaffer et al. (1993) that virtually all CTS habitat in the San Joaquin Valley has been lost to agriculture and urbanization is confirmed by the fact that 4.7 million acres are currently under cultivation in the San Joaquin Valley (Shaffer et al. 1993). An estimated 4.44 million acres of prairie habitat originally occurred in the San Joaquin Valley (Shaffer et al. 1993).

5. Human Population Growth

Current and projected human population growth within the range of the CTS is also relevant to the degree of future threat to the species from habitat destruction. According to the California Department of Finance, the Bay Area's population is projected to increase by 37 percent by 2040 (Association of Bay Area Governments ("ABAG") 1999). Yet this increase is dwarfed by the population growth forecast for the 10 counties adjoining the Bay Area: Lake, Mendocino, Merced, Monterey, Sacramento, San Benito, San Joaquin, Santa Cruz, Stanislaus and Yolo. In total, these counties are expected to grow 97 percent during the same period (ABAG 1999). In general, over the next 40 years, the population of counties west of the San Francisco Bay, Marin, San Francisco and San Mateo counties, which contain very little remaining CTS habitat, will grow the least. The counties of Alameda and Contra Costa, which contain the "core" of the statewide CTS populations, are forecast to grow 41 and 36 percent respectively. Santa Clara County, in the South Bay, will grow by 47 percent (ABAG 1999). But the most significant growth will occur in the North Bay. Sonoma County, home to the most genetically differentiated and most imperiled CTS population, will grow by 64 percent (ABAG 1999). Solano County will grow by 75 percent, while Napa County will increase by 51 percent (ABAG 1999).

But the Bay Area growth statistics are in turn dwarfed by the triple-digit growth forecast for Lake, San Joaquin, Stanislaus, Merced, San Benito and Monterey counties (ABAG 1999). That growth is being fueled in part by lower housing prices. In Merced County, especially where some large blocks of habitat still remain, this enormous development pressure spells disaster for the species.

Over the 20-year planning horizon, the population in the nine county Bay Area is projected to increase by 16 percent overall (ABAG 1999). Table 7 shows population growth by county between the year 2000 and the year 2020.

Table 7: Population Growth By County, Year 2000 to Year 2020 (from ABAG 1999)

County	2000 Population	2020 Population
Alameda	1,462,700	1,671,700
Contra Costa	941,900	1,169,000
Marin	250,400	275,400
Napa	127,600	156,900
San Francisco	799,000	808,800
San Mateo	737,100	809,800

Santa Clara	1,755,300	2016,700
Solano	401,300	547,400
Sonoma	455,300	571,200

6. CNDDB and Environmental Review Documents

The USFWS reports in the Proposed Rules that 486 of 608 CTS sites (about 80%) identified in the CNDDB are "known to be extant," (USFWS 2003b). This statistic was derived from a Geographic Information System ("GIS") study using CNDDB locations and land-use coverages from 2000 (USFWS 2003d). GIS point data of the CTS from the CNDDB as of November 2002 were used to analyze locations that could potentially be extant (USFWS 2003d). This analysis initially excluded locations in Sonoma and Santa Barbara counties, and locations identified as extirpated by California Fish and Game in the database (46 records). A 1.5-mile buffer was created around each of the remaining locations, and all CTS records wherein a hybrid and/or non-native occurred within the buffer were determined to be extirpated. CTS records that directly overlayed onto an urban or orchard/vineyard polygon (obtained from 2000 coverages) were also determined to be extirpated. Results from the analysis indicated that 58 CNDDB locations had been extirpated by urbanization or agricultural conversion, and 23 had been extirpated by hybridization, as described in Table 8.

Table 8: GIS Analysis Range-wide Extirpated Records (from USFWS 2003d)

	Bay Area	**Central Coast**	**Central Valley**	**Southern San Joaquin**	**Unknown Sub Population**	**Total**
Extirpated NDDB	13	2	16	11	4	46
Extirpated Urban	26	1	12	2		41
Extirpated Orchards/Vineyards	3		9	5		17
Extirpated Hybrids or Non-native site	7	16				23
TOTAL	**49**	**19**	**37**	**18**	**4**	**127**

Table 9 shows the number of locations by population segment presumed extant as a result of the GIS analysis (USFWS 2003d).

Table 9: GIS Analysis Range-wide Presumed Extant Records (USFWS 2003d)

	Bay Area	**Central Coast**	**Central Valley**	**Southern San Joaquin**	**Total**
Presumed Extant	144	41	250	38	473
Presumed Extant - affected by hybrids or non-natives	1	12			13
TOTAL	**145**	**53**	**250**	**38**	**486**

Because this analysis includes all CNDDB CTS locations, which span a century, it remains unknown which of the 486 sites described as "known to be extant" in the Proposed Rules, are actually extant in the year 2003. A better description of these locations would be "presumed extant," as stated in USFWS (2003d). Petitioners present in further detail the threats posed to the 486 CNDDB CTS locations that are presumed extant by the USFWS (2003d). In addition, Petitioners compiled information on threats to CTS from urbanization by researching and compiling information from environmental review documents for development projects within the current range of the species. Results from these analyses are provided below.

Individuals submitting records to the CNDDB may, but are not required to, list threats to the species or habitat known at the time the record is submitted. The CNDDB contains records describing numerous direct and indirect threats to the CTS at many locations presumed extant by USFWS (2003d). Our review of the CNDDB to May 2003 found that many of the surveys were conducted by consulting biologists as part of project-level surveys for developments. A table of CNDDB CTS locality entries, compiled from the CNDDB to 2003, is attached as Appendix B. This table includes the 486 CTS locations presumed extant by USFWS (2003d), as well as an additional 20 locations from the 2003 breeding season that were unavailable to USFWS at the time of their analysis. Petitioners subtracted 17 locations from Fort Hunter Liggett because these are all hybrid sites (B. Shaffer, UC Davis, pers. comm.). Thus, the following analysis included a total of 489 locations. Petitioners' analysis documented that 239 of the 489 locations (49%) had threats listed from factors such as development including building and golf course construction and road widening, or by habitat degradation from encroaching urbanization, presence of feral pigs, use of ponds as flood control, overgrazing, erosion of breeding pools due to ranching activities, off-road vehicle use, military operations, trash dumping, and other impacts. Some of the projects are likely already built out, and some of the other impacts may have already eliminated the salamanders. Petitioners re-iterate that the CNDDB is not a comprehensive database. In addition, the opportunity to list threats is subjective and descriptive based on the observations of the biologist submitting the information, rather than an objective and quantitative exercise. However, the high percentage of presumed-extant CTS locations that are facing a degree of threat as described in the CNDDB illustrates just some of the imminent threats facing the remaining populations of the CTS, and demonstrates that much remaining habitat for the species is far from secure.

Threats to the species as outlined in the CNDDB also can be investigated by population unit. Because the most recent CNDDB and USFWS analysis only includes six extant records for Sonoma and only one that might be in the Santa Barbara population (the record was in southern San Luis Obispo County near Santa Barbara County), threats are described just to the four sub-populations in the range of the Central CTS. Overall, <u>60 of 139 locations (46%) in the Bay Area population are facing some type of threat</u>: 26 of 139 (19%) are threatened by development; 22 (16%) are threatened by non-native predators; and 13 (9%) are threatened by overgrazing. Fifty-four of the 139 locations (39%) occur on private lands, and 32 (23%) are under unknown ownership. <u>In the Central Valley population, 145 of the 268 locations (54%) are experiencing a threat</u>: 36 of 268 (13%) are threatened by development; 52 (19%) are threatened by non-native predators; and 55 (21%) are threatened by overgrazing. Private lands support 111 of the 268 locations (41%), and ownership at 134 of the locations (50%) is unknown. <u>In the Southern San Joaquin population, 23 of 38 locations (61%) are facing a threat</u>: 8 of 38 (21%) are threatened by development and 6 of 38 (16%) are threatened by overgrazing. Twelve of the 38 locations (32%) are on private lands, and 20 (53%) are unknown ownership. Finally, <u>of the 37 locations in the Central Coast Range (excluding Fort Hunter Liggett), 11 (30%) are experiencing threats</u>: 10 (27%) are threatened with development and one is threatened by overgrazing. Five of 37 (14%) are on private lands and ownership at 19 (51%) locations is unknown.

We also conducted an extensive search for environmental review documents prepared for projects within the current range of the CTS with the potential to impact the species. We searched the

CEQANET database (http://www.ceqanet.ca.gov) for all environmental impact reports ("EIRs")[10] prepared since 1998[11] for projects that appeared to be within the current range of the species. We then phoned the agency contact for the relevant documents, and requested a copy of the EIR and/or the relevant pages dealing with CTS. Many agency contacts listed in the database were unresponsive; we called some contacts up to five times. We contacted responsible agencies for 437 projects from our original list, and received responses on 169, for a response rate of approximately 39%. We visited the OPR clearinghouse in Sacramento to obtain copies of EIRs we were unable to obtain from unresponsive lead agencies. The OPR had disposed the vast majority of EIRS. While new legislation will require the OPR clearinghouse to retain all CEQA documents in the future, as a practical matter there are some EIRS that cannot be obtained, even with diligent efforts by full time, professional staff. We also searched all public notices issued in 2002 and 2003 for individual Clean Water Act 404 Permits for the San Francisco and Sacramento Districts and added those projects that appeared to have the potential to impact the CTS. From the total database of 458 projects, we identified 118 that would definitely impact occupied, or suitable, CTS habitat. The time between project approval and the commencement of project construction varies tremendously from a few weeks to a decade or more. Some of the projects have already been constructed, while some have been approved by the lead agency but not yet built. The database containing all of the projects we identified within the range of the species is attached as Appendix C. A table describing the projects with known impacts to the CTS is attached as Appendix D. Because of the constraints described above, Appendix D represents only a small portion of the projects actually approved during this time frame with the potential to impact the CTS.

A number of observations can be made on the results of our search. First, 47 of 169 (approximately 28%) of the documents we reviewed described what appeared to be potentially suitable CTS habitat (e.g. grasslands, oak woodlands, and various wetlands within the apparent current range of the species) as unsuitable or failed to even identify the presence of the CTS as a possibility. Second, in many instances project consultants identified habitat as “potentially suitable” or concluded that CTS had some potential to occur but failed to conduct surveys. Often the lack of surveys was justified with the conclusion that CTS occurrence was unlikely because the habitat was “degraded.” Third, when surveys were conducted, the surveys usually failed to locate any CTS (62%, or 28 of 45 projects where surveys were conducted). Many of the surveys were single-year surveys, which are less reliable indicators of presence/absence than multi-year surveys (Skelly et al. 2003). Overall, there was a positive identification of CTS occurrence at only 19 of 169 projects (11%) for which we reviewed CEQA documents. Some type of mitigation for impacts to CTS was included for only approximately 42% of Appendix D projects (projects with documented CTS impacts) (20 of 48 projects). Perhaps most notably, of all the proposed projects identified with the potential to impact the CTS, there is no indication that a single one failed to receive approval based on impacts to the CTS or any other species.

The high percentage of cases where suitable and potentially suitable CTS habitat was found to be unsuitable or unoccupied can be interpreted in one of two ways. First, if these conclusions are mostly accurate, then there is much less suitable and occupied habitat within the remaining range of the species than previously thought. Second, if these conclusions are mostly inaccurate, then suitable and occupied CTS habitat is being destroyed at a very rapid rate without any record of its loss or mitigation for the

[10] Because of the large number of projects, we began the project as a search only for EIRs. We are currently expanding the project to include Negative Declarations (“Neg. Decs.”) and Notices of Preparation (“NOPs”). Currently, Neg. Decs. And NOPs are included only for Sonoma County.

[11] Some EIRs included in the both the appendices and the threats portions of this petition are from before 1998. These projects were brought to our attention during investigations of the post-98 projects.

impacts to the species. Either of these interpretations leads to the conclusion that the CTS is in serious trouble and needs immediate protection as an endangered species.

In cases where CTS were identified on a project site, our review indicates that biologically meaningful mitigation was seldom required, with many projects approved with "mitigation" limited to the requirement of pre-construction surveys, with no additional measures specified if the CTS or any other species was discovered (See Appendix D). Moreover, while CEQA requires (and places particular emphasis upon) a cumulative impacts analysis, our review failed to discovery a single meaningful cumulative impacts analysis that has been conducted for the CTS. This is not surprising given the difficulty we encountered in obtaining information on past and current impacts to the species. Despite CEQA's mandate to protect the environment, including species such as the CTS, the destruction of CTS habitat is currently being permitted based on incomplete information at best. Our review reveals the existence of large-scale cumulative impacts that are not being considered as each new project is approved.

Our review of the many projects approved in CTS habitat also indicates that breeding pools and complexes are facing rapidly increasing isolation from each other. Trenham (1998) found that in some populations, less than 5 percent of marked juveniles survive to become breeding adults. This low survivorship of metamorphs guarantees that reproductive output in most years is not sufficient to maintain populations. This suggests that the species requires occasional "boom" breeding events to prevent extirpation (temporary or permanent loss of the species from a particular habitat) or extinction (Trenham et al. 2000). With such low recruitment, isolated subpopulations can decline greatly from unusual, randomly occurring natural events as well as from human-caused factors that reduce breeding success and individual survival. Factors that repeatedly lower breeding success in isolated ponds, which are ponds that are too far from other ponds for immigrating individuals to replenish the population, can quickly drive a local population to extinction.

When project consultants conclude that habitat is unoccupied by CTS, that habitat is almost never preserved, and mitigation is almost never required for its destruction. Because of the CTS' metapopulation dynamic, habitat that is in fact essential to the species may not be consistently occupied. Moreover, projects that isolate breeding locations can severely impact the species without destroying a large amount, or even any amount, of habitat that is suitable for CTS breeding or estivation. Projects are being approved in suitable and potentially suitable habitat based on unsophisticated analyses by project biologists that appear to lack a basic understanding of CTS biology. This is likely explained by the extreme pressure placed upon consulting biologists and consulting firms by project proponents not to identify environmental "constraints" to development. Some consulting biologists consider themselves advocates of the project proponent's position on biological and legal issues, rather than impartial researchers.

II. Specific Threats by Population Segment

A. Sonoma County

1. Status

The Sonoma County population segment has been extirpated from the majority of its former range in Sonoma County. The particularly dire plight of the Sonoma County population segment was most recently summarized in the March 19, 2003 final federal listing determination (USFWS 2003a). The species is on the verge of extinction because so little breeding and uplands habitat remains. The remaining habitat is severely impacted by factors including habitat fragmentation, isolation, and high traffic roads. Despite the federal emergency and final listings, CTS habitat continues to disappear from Sonoma County. While new breeding and estivation sites have been discovered, none are out of the known range of the Sonoma County population, and these new sites are all threatened by urbanization, isolation, small size, and agricultural conversions.

When the USFWS finalized the federal endangered listing, only a handful of breeding locations were known in the County. Since the federal listing, two small properties have been preserved, the South Ludwig Avenue and Gobbi Ranch sites. The known remaining breeding sites are listed in Table 10, compiled using data from C.A. Patterson, D. Cook, and M. Jennings. Sources are USFWS Federal Emergency Listing Package (2002) and supplemental materials; Cook and Northen (2001); a letter to CTS Fund II from M. Jennings and G. Padgett-Flohnr from October 2003; and LSA Associates' regional map of compiled CTS sighting locations, historic range mapping, and existing seasonal and persistent ponds in and around the Santa Rosa Plain.

Table 10. Known Locations and Potential CTS Habitats on the Santa Rosa Plain, Sonoma County California (Sources: Patterson 2002; USFWS 2002a; Cook 2003; Jennings and Padgett-Flohr 2003).

Name	Preserve Area (ac)	Comments
Wright Bank	174	Wetland bank operated by CDFG. Supports two rare plants and numerous breeding pools for CTS (Patterson 2002). Development is approved or has occurred on lands surrounding preserve, particularly on the east side, and non-native predators are present (USFWS 2002a; Cook 2003).
FEMA/ Broadmoor North	79 and 13, respectively	FEMA: Wetland bank operated by CDFG. Supports one rare plant and two large breeding pools for CTS; Broadmoor N: Wetland mitigation site for local high school. Supports CTS in secondary pools (Patterson 2002). Together, the sites contain 3 breeding pools, 2 of which are productive CTS breeding sites; urbanization of uplands to the east and west, including road/housing on the western edge, will isolate the site (USFWS 2002a; Cook 2003).
Yuba Drive Mitigation Bank	12	Wetland Bank with preserved and created wetlands. Supports breeding CTS in created pools (Patterson 2002).
Southwest Santa Rosa Community Park	Approx. 20+ acres; only 3 ac preserve	Contains artificial pool with breeding CTS (Patterson 2002). Includes 19 ac of paved surfaces and manicured lawn, 1 ac preserve, and 2 ac upland proposed for development (Cook 2003). 90% of surrounding uplands have been developed (D. Cook, pers. comm.).
abandoned Army Auxilliary post	Approx. 10	One small CTS breeding pool (Patterson 2002). Owned by City of Santa Rosa; habitat proposed for conservation easement (D. Cook, pers. comm.).
'Walmart Mitigation Site' (South Ludwig)	18	Wetland preservation & creation for private development in Windsor. CTS known onsite (Patterson 2002). Noted as private by USFWS (2002a); increasing residential development and traffic on Ludwig Ave threaten migration routes.
Wright Avenue (may be army auxiliary site described above)	-	Supports one breeding site on private land; approved development will isolate the site (USFWS 2002a)
SW Santa Rosa VP	40	Private wetland bank; preservation & creation CTS onsite (Patterson

('Engle') Bank		2002).
'Gobbi Ranch' Mitigation site	45	Wetland mitigation project with CTS now onsite through translocation as per CDFG (Patterson 2002) New preserve; CTS larvae found in spring 2003 (Cook 2003).
'Hartunian' or 'Haroutunian' Open Space parcel and annex	23 + 8	Open space parcel preserved for wetland resources. CTS breeding onsite (Patterson 2002). Annex is new preserve site adjacent to existing preserve with salamander; degraded by agricultural practices, but may provide upland habitat (Cook 2003).
Alton Lane Mitigation site	Approx. 45	Private wetland & rare plant mitigation site; one CTS sighting (Patterson 2002). One CTS breeding site (D. Cook, pers. comm.).
Northwest Air Center	55	Composed of 1 likely breeding pond on private land; much of the upland has been developed recently, eliminating migration to the east and south (USFWS 2002a).
North Air Center	37	Contains 1 breeding pool on private land; recent developments border the site on 3 sides, and new residential and road projects are approved (USFWS 2002a).
Whistler, Millbrae, Scenic, Primrose Avenues and Stony Point Road near Meachum and Hellman Lanes.	-	Various roadside channel and drainage ditch breeding sites (CNDDB 2003) Threatened by runoff and maintenance activities and vehicle mortality (D. Cook, pers. comm.).
Northpoint Village	9	Private mitigation set-aside for Northpoint Village subdivision; no significant CTS breeding, but suitable for aestivation (Patterson 2002). New preserve adjacent to existing FEMA preserve; likely provides salamander upland habitat (Cook 2003).
'Hale' Bank	75	Private wetland bank; preservation & creation CTS nearby, potential for breeding onsite
CDFG's Todd Road Preserve	75	Wetland & rare plant preserve established by CDFG; may have potential for CTS (Patterson 2002). CTS not known from site (D. Cook, pers. comm.).
Carinalli Bank on Todd Road	67	Proposed private wetland bank; preservation & creation. Potential habitat onsite (Patterson 2002).
'Crinella' set-aside (Hall Rd at Piezzi)	6	Private wetland & rare plant set-aside for local subdivision. CTS sighting nearby. Potential breeding pool onsite (Patterson 2002).
'Laguna Preserve' (CDFG)		Combined wetland mitigation bank and easement. Potential for CTS (Patterson 2002).
Abramson Road Preserve	14	Wetland & rare plant mitigation site for several subdivisions in NW Santa Rosa. Has potential CTS habitat (Patterson 2002).
S. F. Archdiocese site on Whistler	35	Private wetland reserve. Potential CTS habitat (Patterson 2002).
Walker Ave. ('Bennett') mitigation site	28	Private wetland & rare plant mitigation site for So. Sonoma Bus. Park. Has potential CTS habitat (Patterson 2002).
Five Creek Mitigation Bank	19	Created wetlands and riparian preservation. Significant potential for CTS breeding (Patterson 2002).
'City Wastewater' mitigation site	Approx. 10+	Wetland mitigation site for Co. road project (Stony Point Rd) + seasonal disposal of treated water (Patterson 2002).
'Desmond' Mitigation Bank	45+	Proposed private wetland mitigation bank; preservation & creation, with potential CTS habitat (Patterson 2002).
Horn Avenue Mitigation Bank	30	Proposed private wetland mitigation bank; 3 parcels; wetland creation, with potential to create CTS habitat (Patterson 2002).
Sonoma Co. Airport Wildflower Reserve	-	Wildflower (LABU) preserve established by airport (Patterson 2002).
Wikiup Mitigation Bank	12	Private wetland mitigation bank; has potential CTS habitat (Patterson 2002).

Alba Lane Mitigation site	63	Wetland mitigation site for regional high school; may have potential CTS habitat (Patterson 2002).
American Tank Mitigation site	1	Private wetland mitigation site, with wetland creation and riparian preservation (Patterson 2002).
'Wilson Lane' mitigation site	5?	Older wetland mitigation (creation) site for nearby subdivision (Patterson 2002).
'Simi' rare plant reserve	1+	Small rare plant set-aside on Piner Road at edge of vineyard (Patterson 2002).
'Jinks' wetland/rare plant easement	3-5?	Small easement/set-aside for BLBA (Patterson 2002).
'Rivendale' mitigation site	13	Private wetland mitigation site, with wetland creation and rare plant preservation (Patterson 2002).
Stone Ranch		Wastewater disposal? May have significant potential for wetland restoration, potential CTS habitats (Patterson 2002).
'Balleto'	165+	"Forever Wild" easement. Potential for CTS habitats (Patterson 2002).
Kelly Farm		Wastewater disposal. May have significant potential for wetland restoration, potential CTS habitats (Patterson 2002).
Brown Farm		Wastewater disposal. May have significant potential for wetland restoration, potential CTS habitats (Patterson 2002).
Alpha Farm		Wastewater disposal. May have significant potential for wetland restoration, potential CTS habitats (Patterson 2002).
'Morrison'		Agricultural easement (Patterson 2002).
'Tesauro' Mitigation Bank	38	Proposed wetland mitigation bank. Potential CTS habitats (Patterson 2002).
'Poncia' mitigation site	118?	Private mitigation site for impacts to local dairy (Patterson 2002).
Southwest Air Center	-	Contains 1 pool on private land, but the City of Santa Rosa has issued permits for development of this site; CTS may use FEMA/Broadmore North preserves to the east (USFWS 2002a).

Known CTS breeding sites are denoted in bold

Table 10 provides the most exhaustive compilation available on known and potential breeding sites in Sonoma County. According to data compiled by C. A. Patterson, D. Cook, and M. Jennings and G. Padgett-Flohr, as well as data available in the CNDDB as of August 2003, there are currently 36 known breeding sites in Sonoma County. CTS habitat continues to shrink in the County because of recent urban developments and proposed infrastructure associated with these developments. Survey efforts are ongoing to determine use of irrigated fields by CTS. There have been no confirmed breeding sites in irrigated fields, but these areas may provide marginal upland habitat, particularly where they are located adjacent to native breeding habitats (D. Cook, pers. comm.).

Cook and Northen (2001) provided a detailed report of the status of the Sonoma County population segment. In 2001, there were four areas that still supported the species: the West Santa Rosa area, South Santa Rosa area, West Cotati area, and South Cotati area. Subsequent to Cook and Northen's 2001 report, a great deal of additional habitat, including at least 5 known breeding sites, has been lost. New breeding sites and estivation habitat also have been discovered, but the majority of these locations are still under threat from urbanization, flood control projects, and agricultural development, and no additional sites outside the known range have been discovered. Most of the known breeding sites in the west Cotati area have been destroyed, including all the vernal pools on the South Sonoma Business Park site and a known breeding pool on the nearby Larsen property, although some roadside ditches on Hellman Lane are extant. Most known breeding sites are now clustered in the City of Santa Rosa and immediately associated unincorporated areas, an area approximately 5 miles long and 4 miles wide (USFWS 2003a). Since the July 22, 2002 emergency listing, at least 98.5 acres of CTS habitat has been lost (Cook 2003). Suitable CTS habitat has been lost at the following known sites: 10 acres of grassland at Stonebriar subdivision; 5 acres of grassland for a Lutheran Church; 20 acres of grassland for the Redwood Church; grading of a 20-acre field of grassland and a roadside ditch 200 ft from the Old Santa Rosa Air Center breeding pool; 0.25 acres of grassland for landscaping at Southwest Park; 0.25 acres of vernal pool breeding habitat for South Sonoma Business Park; 35 acres of grassland for the Golf Learning Center; 20 acres of open field on Todd Road disced and graded within 500 ft of a breeding pool; 5 acres at Dutton Meadow graded and trenched, within 1,000 ft of Southwest Park breeding pool; and 1 acre of grassland and possible wetlands graded and filled, within 100 ft of breeding sites along Hellman Lane (Cook 2003). CTS breed in roadside ditches, which provides marginal habitat and is subject to several ongoing disturbances, including maintenance, runoff pollution, and vehicle mortality.

These continuing impacts have not been off set by corresponding conservation gains. The 18-acre South Ludwig Avenue and 45-acre Gobbi Ranch sites are the only breeding sites that have contributed to the protection of the Sonoma County population since the emergency listing (Cook 2003). Both of these sites are in Southwest Santa Rosa, and therefore their discovery does not expand the previously known range of the species. Both of these sites are extremely small, and both are threatened by the encroaching development pursuant to Santa Rosa's Southwest Redevelopment Plan, described below.

None of the Sonoma County reserves contain a sufficient quantity and quality of breeding and uplands habitat to support a viable CTS population over the long term (Cook and Northen 2001; USFWS 2003a). The largest preserved site is 174 acres, and the others range in size from 3 to 92 acres, each threatened by encroaching development, traffic, and other impacts. Eight of the nine known breeding locations are located in Southwest Santa Rosa, and threatened by increasing development and resulting habitat fragmentation. Recent surveys have documented the elimination of terrestrial habitat by the construction of artificial wetlands at the Alton Preserve and proposed construction at the Wright and Sonoma County Open Space Preserve (Hartunian). In addition, the Wright Preserve is threatened by adjacent residential development and exotic species, and habitat at FEMA/Broadmore North and Yuba Preserves are compromised by encroaching residential development, overgrazing (at Broadmore North), pets, and overgrowth of thatch in some areas (CNDDB 2003).

Opponents of the listing have argued that the CTS may be more widespread than currently believed, and have prepared a map based on aerial photography showing 515 water bodies in Sonoma County that they claim could be occupied by the CTS (USFWS 2003a). The USFWS considered this submittal in its final listing determination. It found that of the 515 water bodies, 360 could be eliminated as potentially suitable habitat due to a variety of factors including unsuitable soils, unsuitable vegetation, high elevation, presence of aquatic predators, agricultural development, urbanization, and unsuitable hydrology (USFWS 2003a). Of the 155 sites remaining, 65 were eliminated because they hold water for too long and harbor aquatic predators or do not hold water long enough to support CTS metamorphosis. Of the remaining pools, four are previously known breeding sites that have been destroyed, and eight are currently known breeding sites. It was not possible to investigate every remaining water body shown on the map because many of the potentially suitable sites are located on private land where surveyors have not been granted access. The existence of additional breeding sites cannot be ruled out, but despite focused surveys, no new sites have been discovered outside the known range.

The existence, construction, and expansion of roadways also severely constrain the viability of remaining habitat. All of the known breeding sites are located within 450 m (1,476 ft) of roads (USFWS 2003a). Roads within 2,000 m (1.2 mi) adversely impact amphibian species (USFWS 2003a, citing Findlay and Houlihan 1996). Large numbers of CTS and other amphibians are killed on roadways;

estimates range from 25 to 72 percent of a population in different areas (USFWS 2003a, citing Twitty 1941; S. Sweet, in *litt.*, 1993). Between November 21, 2001, and December 5, 2001, 26 CTS were found killed by cars on Stony Point Road between Santa Rosa and Cotati (USFWS 2003a, citing Twitty 1941; S. Sweet, in *litt.*, 1993). Fourteen were found near Meachum Road in Southwest Santa Rosa. As the Santa Rosa area continues to grow, traffic continues to increase along Stony Point Road and other major roadways. As discussed below, several road construction and widening projects pose particularly grave threats to the species.

In the final listing rule, the USFWS summarized the effect of habitat destruction and modification on the Sonoma CTS as follows:

> Except for the Hall Road Preserve, all of the known breeding sites of the Sonoma County California tiger salamander are found on small locations in areas being rapidly converted from low-intensity farming, cattle grazing, and low-density housing, to high-density housing and office buildings. Only three breeding sites (the Hall Road Preserve, FEMA/Broadmore North Preserve, and Engel Preserve) have hydrologic regimes adequate to provide recruitment for Sonoma County California tiger salamanders in normal to dry years. Five of the breeding sites are on private property. Two of the breeding sites on private lands are on agricultural lands where access for salamander surveys has not been allowed in recent years. Thus, it is unknown if these two breeding sites still have Sonoma County California tiger salamanders, or if they retain hydrological features required for successful salamander breeding. Four of the breeding locations associated with the old airfield in southwest Santa Rosa are slated for development, which will disrupt the hydrology of the surrounding uplands by altering natural runoff. If plans for the development of the area in the vicinity of these four breeding sites are completed, there will be no migratory corridors remaining between any of the currently extant breeding locales.
>
> Maintenance of tracts of habitat between breeding sites will likely play a pivotal role in maintenance of the Sonoma County California tiger salamander metapopulation dynamics. If breeding sites are eliminated and the metapopulation becomes so fragmented that individuals are unable to disperse between suitable patches of habitat, the probability of natural recolonization will not offset the probability of extinction. Some of the salamander breeding sites, such as the FEMA/ Preserve/Broadmore North Preserve and the pools associated with the Air Center, are linked to each other by suitable habitat. If movements through these linkages are disrupted or precluded (*e.g.*, by urban development), then the stability of the metapopulations (*i.e*, the exchange of individuals between breeding sites) will be affected. Isolation, whether by geographic distance or ecological factors, will prevent the influx of new genetic material, and likely to result in inbreeding and eventual extinction….

(USFWS 2003a).

Below we detail additional threats to the species from urban development and road construction.

2. Current Threats

Many of the projects discussed as threats in the first petition have since been constructed. They have been discussed in the emergency and final federal listing rules for the Sonoma CTS, or included in the discussion of additional habitat lost, *supra*. Projects likely or certain to impact the CTS that are currently approved or proposed but not yet completed are discussed below. A list of all projects searched for potential to impact the CTS, see Appendix C.

Southwest Redevelopment Plan: The Southwest Redevelopment Plan, finalized in May 2000, and the earlier Southwest Area Plan, lay out a plan for the near complete urbanization of Southwest Santa Rosa. Figure 4 and the Key to Figure 4 show and describe the 35 projects planned for the area. These projects are, for the most part, approved, and many are already built or under construction. Very little protection or mitigation has been provided for the CTS pursuant to this plan in the past. The few areas that are being "preserved" typically consist only of breeding pools, while terrestrial habitat is almost always eliminated or severely reduced. The only mitigation specifically for CTS was added in the Final EIR and states "under-road culverts for tiger salamanders shall be incorporated into the design of new or improved roadways adjacent to all known wetlands where salamander migration routes have been identified." Building culverts under roads is a necessary, but not sufficient, mitigation measure for the impact of the Southwest Redevelopment Plan on the CTS. Overall, the proposed mitigation does far too little to protect the species and its habitat. The importance of terrestrial habitat is almost completely disregarded. In addition, the means by which CTS breeding ponds within the boundaries of the Plan were identified were deficient. When it was pointed out that a well-known breeding pond at the Southwest Community Park was not included in the EIR, the consultants responding to the comment excused the omission on the basis that the record did not occur in the California Natural Diversity Database, despite that fact that a disclaimer in CNDDB that states "Information supplied is based on the material available at the time of the request and should not be regarded as complete data on the elements or areas being considered...Absence of data does not constitute the basis for a negative declaration," (Northen 2002; see: http://www.dfg.ca.gov/whdab/html/rarefind.html for CNDDB disclaimer). Ultimately, while the Southwest Redevelopment Plan defers review of specific projects to site-specific analyses, much of the best habitat for CTS in Sonoma County has already been developed or approved for development and there is an insufficient amount of habitat remaining for mitigation to allow for the buildout of the Southwest Area Redevelopment Plan (Northen 2002). As discussed under "The Inadequacy of Current Regulatory Mechanisms," *supra*, there are no regulatory mechanisms aside from CESA and federal ESA listing that are sufficient to ensure the survival of the Sonoma County population segment. Given the destruction of all known breeding sites in the West Cotati area, and the fact that the majority of remaining breeding sites occur in Southwest Santa Rosa, the build out of the Southwest Area Redevelopment Plan would almost certainly result in the extinction of the Sonoma County population segment.

Toscana Project: The 54.59-acre Toscana Project is located in the southwest corner of the City of Santa Rosa, about halfway between Pyle and Ludwig Avenues. The tentative tract map for the proposed project includes 355 houses, which would eliminate grasslands and pasturelands with two vernal pools. CTS were located on this site in January, 2002 (CNDDB 2003). The development abuts the western edge of the FEMA Preserve southwest of the Santa Rosa Air Center. The developer intends to set aside one area with a CTS breeding pool adjacent to the FEMA preserve for contiguity, and to purchase some parcels south of Ludwig Avenue to create a runoff area as storm drainage mitigation (including restoring vernal pools on that site) (J. Leland, pers. comm). The Toscana project is the first development in the southwest area within the City boundaries, and would eliminate effective habitat connectivity between the Air Center, the FEMA preserves, and potentially occupied lands southwest of the City.

Trumark/Dutton Meadows Residential-Commercial Development Project: This 37.3 acre project is part of a larger 47.3 acre Planned Community District bounded by Dutton Meadows Drive, Hearn Avenue, and the Colgan Creek Flood Control Channel (U.S. Army Corps of Engineers 2002). The project site contains seasonal wetlands and also appears to be suitable estivation habitat for the CTS population at the Southwest Community Park breeding site. The proposed project would eliminate 3.69 acres of wetlands on site (U.S. Army Corps of Engineers 2002). The Public Notice claims that 1.77 acres of the wetlands on site are isolated and therefore not subject to Army Corps jurisdiction (U.S. Army Corps of Engineers 2002). The Public Notice claims that the wetlands on site are too shallow to allow CTS metamorphosis, but this may not be correct as no surveys have been conducted (U.S. Army Corps of Engineers 2002). Vandalism (ditches graded to drain the wetlands) was reported either on or adjacent to this site in 2002, but no enforcement action was taken by any agency.

Casino Proposal: The Federated Indians of Graton Rancheria have proposed an approximately 360-acre casino and resort development near the City of Rohnert park. The parcel proposed for development is bounded by Wilfred Ave., the Rohnert Park Expressway, Stony Point Road, and the Rohnert Park city boundary. There are several CTS road observations north of this site, which does contain some swales and suitable CTS estivation habitat. There is also a known report in the CNDDB from immediately west of the site across Stony Point Road at the dairy (CNDDB 2003). The site may support aestivating CTS and could support CTS breeding if suitable breeding habitat is present. Development of the site could directly impact the CTS and would indirectly impact it via continuing habitat fragmentation and growth and traffic inducement.

Park Village Subdivision: This proposed high-density residential development for a 7.4-acre site is located at the southwest corner of Hearn Avenue and Dutton Meadow Drive, adjacent to the Southwest Community Park breeding site. The project site appears to be suitable estivation habitat for the Southwest Community Park CTS population.

South Sonoma Business Park: This project will completely develop an area of approximately 35 acres into a commercial complex including 650,000 square feet of office space and parking for approximately 2,300 vehicles. The project would result in the fill of all 3.5 acres of wetlands that occur on site. No on-site preservation of wetlands is proposed. The CEQA process for this project demonstrates why the species is now on the brink of extinction. The site represents what is probably some of the best remaining habitat in Sonoma County for the species. Despite this fact, and despite the fact that a documented breeding pond is located on site (Seymour and Westphal 1995) (which was brought to the attention of the City of Cotati and the project biologist), both the Draft and Final EIRs failed to acknowledge that the site constituted California tiger salamander habitat. On April 25, 2000, 37 California tiger salamander larvae were found in a second breeding pool on the site and immediately moved off the site, in violation of CEQA. Then, both the FEIR and the project itself were approved by the City of Cotati. The project site was graded in September, 2001, however, the site remained suitable estivation habitat and the pools on site could have been restored.

Cotati Commons: A new project has been proposed on the former South Sonoma Business Park Site which would have a similar development footprint but would consist of different uses, including a "big box" home improvement store. The City has proposed approving the project with an Addendum to the EIR for the previous project, the lowest level of CEQA review which excludes the notice and public comment procedures of normal CEQA review.

Measure B (Repeal of Measure F): The Cotati City Council placed a measure on the November 2003 election ballot to amend the City General Plan and Zoning Ordinance relative to former Measure F. Measure F was an Initiative, submitted by the voters and approved in the November 1997 election, that limited the commercial retail use of buildings in zoning districts allowing commercial Retail uses to a maximum of 43,000 square feet of gross floor area. The City will consider an amendment that would exempt specific areas within the City's sphere of influence from the limitations imposed by Measure F. The exempted area, known as the Northwestern quadrant in the City's General Plan, is approximately 270 acres situated north of Highway 116 (Gravenstein Highway), west of Redwood Drive, south of Copeland Creek, and east of Locust Avenue. While the three known breeding pools in this area were recently destroyed, adult CTS persist in the West Cotati area. This measure would allow much more intense development in this important habitat area, and is needed in order to allow development of a "big box" home improvement store to proceed on the South Sonoma Business Park site (See Appendix C at 41A-I). Measure B passed in the November election by approximately 30 votes.

Laguna Vista Mixed Use Development: The Laguna Vista Project in the City of Sebastopol consists of 182 dwelling units at a variety of densities, office use (7,700 square feet), a restaurant (3,200 square feet) and general retail uses (5,400 square feet). The project also includes construction of on-site private streets and parking spaces. It is unknown whether the CTS occurs this far west. No surveys have been conducted for CTS to date but at least two years of USFWS protocol surveys on the site have been recommended (Zander Associates 2003) (See Appendix C at 29A-I and Appendix D, pg. 1).

Stony Point Road Reconstruction Project: The City of Santa Rosa released a notice of preparation in February, 2003, for a supplemental draft EIR on the reconstruction of Stony Point road from Highway 12 to Hearn Avenue, a distance of 1.3 miles. While the NOP does not describe any specific alternatives that will be studied in the EIR, the Santa Rosa General Plan calls for Stony Point to be widened to six lanes from Highway 12 to Sebastopol Avenue and to four lanes from Sebastopol Road to Todd Road. When Stony Point Road was last widened 24 feet from Petaluma Blvd. to Hearn Avenue, no mitigation was provided for impacts to CTS (T. Mayer, pers. comm.). The widening of Stony Point Road in this area would significantly impact the CTS. The widening of the road and vast increase in traffic will make it infinitely more difficult for CTS to cross Stony Point road at any point, and will likely increase roadkill. The widening could also impact CTS by eliminating potentially suitable habitat. Surveys have yet to be conducted for this particular project but CTS are known to occur just south of the road-widening project.

Todd Road east of Stony Point Road in Santa Rosa is also slated for widening. California tiger salamander eggs and larvae were detected in surveys in the Todd Road area in the winter of 2001-2002 in numerous roadside ditches along Meacham Road, Stony Point Road, and many of the small roads south of Todd Road (Northen 2002; CNDDB 2003). Most sites were most likely too small and shallow to allow for metamorphosis, although metamorphosis can occur from some ditches where and when the conditions are appropriate (Northen 2002). However, these roadside ditches are by no means secure breeding habitat for the species. Roadside ditches are specifically targeted whenever roads are improved, and such road improvement is often accompanied by the development of storm drains in which CTS can be trapped (Northen 2002). In spring 2002, at least three roadside ditches that were recently improved dried before larval metamorphosis could occur (Cook 2002). Another concern is that most of the uplands in the vicinity of Todd Road are unprotected except for small areas on the eastern end of Scenic Avenue (Northen 2002).

A third road project, proposed in conjunction with a high density housing development in Southwest Santa Rosa, would separate the breeding sites located in the old Santa Rosa Air Base from the breeding areas at the FEMA/Broadmore North Preserves (USFWS 2003a). If this road construction project were to proceed, only three breeding sites will remain where salamanders can access more than one breeding pool without crossing roads (USFWS 2003a). This represents an extreme level of habitat fragmentation.

Route 101 HOV Widening: This Caltrans proposal involves a plan to widen a portion of Route 101 from 4 to 6 lanes, along with bridge improvements, and construction of soundwalls. The project would impact the CTS because it would remove (at least temporarily) traffic congestion that currently acts as a constraint on further growth and would facilitate additional development that could impact the species. The CTS is identified as species that may occur in the project area or be affected by the project. No mitigation is mentioned in the DEIR (See Appendix C at 6A-I and Appendix D, pg. 1).

Costco Wholesale Warehouse Project: The project involves the construction of a 148,654-square foot wholesale warehouse facility along with a tire center and a refueling station on a 14.45-acre site in the City of Rohnert Park. Multiple CTS sightings have been recently documented near the project site (the closest being 0.86 miles southwest of site). The project site also contains suitable CTS breeding habitat (including wetlands and temporary ponds) as well as a potential dispersal corridor. No mitigation is mentioned or proposed. A notice of determination for the project was filed on June 21, 2002 (See Appendix C at 33A-I and Appendix D, pg. 2).

Shamrock Materials Industrial Development Project: This recently proposed project includes construction and maintenance of a ready-mix concrete plant, sand and gravel processing plant, and a topsoil processing plant, along with other industrial facilities on a 17.5-acre project site in the City of Santa Rosa. The project applicant has applied for a CWA § 404 permit for fill of 4.4 acres of wetlands on the project site. The Corps Public Notice identified the CTS as potentially occurring within the project area and the site as located within designated potential CTS habitat; CTS subsequently were found on the site during surveys (D. Cook, per. comm.). Mitigation calls for an impermeable fence placed along the base of earthen berm to prevent the migrating CTS from entering the project site. The Corps notice also explains that ESA section 7 consultation will be initiated for the species (See Appendix C at 13A-I and Appendix D, pg. 2).

Northwest Santa Rosa Annexation: This project involves the annexation of land by the City of Santa Rosa slated for future development. According to the SEIR, CTS breeding habitat exists on site, including many ponds and vernal pools. There are no known CTS occurrences on site, but known occurrences do exist within 250 feet of the annexation area. The SEIR concludes: "The presence of suitable aestivation habitat, potential for migration to the annexation area, and breeding habitat leads to the conclusion that this species is likely present within annexation area." Mitigation for the project calls for pond replacement and FWS consultation (See Appendix C at 28A-I and Appendix D, pg. 3).

B. Santa Barbara

Conversion of native habitats to urban and agricultural uses poses the greatest threat to the Santa Barbara population of the California tiger salamander (“SB CTS”). All of the known and potential localities of the SB CTS are largely on private lands, none are protected by implemented Habitat Conservation Plans, and access for wildlife managers is limited (USFWS 2000b).

Population projections for Santa Barbara County suggest that urban development will continue to impose increasing pressure on existing open lands, particularly North Santa Barbara County, which contains all six metapopulations of the SB CTS. Santa Barbara County projects an estimated 2% annual growth rate for the communities of Santa Maria, Lompoc and Orcutt for the next three decades, with a commensurate increase of approximately 26,000 new homes (Santa Barbara County Planning and Development 2002, at 8). This North County growth will impact the SB CTS through the conversion of habitat in proximity to these communities (e.g., the Bradley Dominion and West Orcutt metapopulations) (Santa Barbara County Planning and Development 2002 at 6-8). Agricultural lands within or adjacent to urban areas are the most likely to be developed (Santa Barbara County Planning and Development 2002 at 6). For example over 3,000 additional acres in Santa Maria and Orcutt are projected as necessary to accommodate current growth rates and densities, and "all of it will come from agriculture," (Santa Barbara County Planning and Development 2002 at 12). Although some prime agricultural land in this area has been designated as "No Urban Development Areas," the County predicts growth demands are likely to pressure the City and County to convert much of this land to urban uses (Santa Barbara County Planning and Development 2002).

Current information also indicates that, although much of the agricultural land occupied by the SB CTS is currently being utilized for grazing and other ranching activities, trends in Santa Barbara County agricultural practices over the last decade suggest that conversion from rangeland to more intense cultivation activities, such as row crops and vineyards will continue and likely affect SB CTS habitat (Santa Barbara County Planning and Development et al. 1999). For example, nearly 8000 acres of livestock rangeland were converted to higher-intensity farming acreage between 1998 and 2000 alone (California Department of Conservation, Santa Barbara County Land Use Conversion Reports 1998–2000, Table A-30). The Santa Barbara County Agriculture Commission's ("SBCAC") Annual Crop Reports document expansion of vineyard acreage from approximately 9000 acres in 1996 to over 16,000 acres in 2002 (SBCAC 1996; 2002). Meanwhile, the most recent Annual Crop Report data (2001 and 2002) show increases in value for vineyard and vegetable row crop production, and a decrease in value for livestock production (SBCAC 2001; 2002). These data indicate market forces may continue to exert pressure resulting in further conversion of grazing land to agricultural land uses that are significantly less compatible with SB CTS survival and recovery. As USFWS noted in 2000, an increase in vineyard and other row crop farming directly imperils SB CTS through discing or deep-ripping of breeding and estivation habitat, as well as pesticide application, and is a primary cause of reduced SB CTS distribution. 65 Fed. Reg. 57242, 57252.

According to the USFWS (2000b), of the six remaining SB CTS metapopulations, four face severe threats from agriculture, urbanization, overgrazing, fragmentation, and roadkill mortality. Two more face moderate threats from these factors, and only one appears to be relatively free from immediate threats (USFWS 2000b). In a recent inventory of SB CTS ponds, for example, USFWS (2003e) identified the majority of ponds as facing a medium to high threat of habitat conversion, as well as varying degrees of other threats[12]. Examples of current and potential threats for each of the six metapopulations (West Orcutt, Bradley-Dominion, North Los Alamos, East Los Alamos, Purisima Hills, and Santa Rita) are discussed below.

Breeding sites and upland habitat in southwestern Santa Maria Valley (west of Highway 101 and Santa Maria) comprise the West Orcutt metapopulation (USFWS 2000b). These sites occur on grazing

---

[12] Matrix identifying breeding ponds, including qualitative assessment of ponds, population sizes, and potential threats; provided by the USFWS on September 5, 2003 in response to an Environmental Defense Center FOIA request. This matrix demonstrates that, although there has been an increase in the number of ponds documented since the SB CTS was listed by USFWS, this does not correlate to an improvement in status or reduction in threats. Many of the ponds more recently identified as known breeding ponds were known to the USFWS as potential breeding ponds at the time the agency determined the SB CTS warranted listing as endangered (Sweet 2003 at 9; 65 Fed. Reg. 57242, 57247). Moreover, these documented ponds vary significantly in terms of their size and quality (e.g., natural versus stockpond), quality of upland habitat, and size of the CTS population they support (Sweet 2003).

and other agricultural lands. The vernal pools in the area have all been lost or adversely affected by rapid development in the Santa Maria Valley (USFWS 2000b). This vernal pool complex is affected by ongoing agriculture, which can have negative effects on the hydrology, expose salamanders to contaminants, and kill terrestrial phase salamanders outright (USFWS 2000b). Thirty years ago, a housing development directly affected one breeding site in this metapopulation (USFWS 2000b). Two sites are subject to mortality from roadkill due to their proximity to roads: One is by the heavily-traveled Black Road and the other is near a dirt road subject to yearly grading (USFWS 2000b). Two remaining breeding ponds are separated from each other by a railroad that may disrupt migration routes and reduce genetic interchange (USFWS 2000b). These sites are also threatened by overgrazing, as evidenced by terracing of the hillsides and a lack of vegetative cover (USFWS 2000b) (See discussion on livestock grazing in "OTHER FACTORS", *supra*).

The Orcutt Community Plan ("OCP"), which has been approved by Santa Barbara County, includes urban development within areas utilized by the West Orcutt metapopulation. OCP Key Site 22, for example, consists of 16 parcels within a 1,179.45-acre area west of Santa Maria adjacent to the Santa Maria Airport. The site contains "the largest known vernal pool complex in the County" and is known to support a "wide variety of wildlife including tiger salamanders," (OCP EIR, Volume II, at 22-25). Under pre-OCP zoning a total of 53 residential units could have been built in this area. The OCP allows for construction of up to 2,000 residential units of various densities, and a community center. Development could also include supporting commercial facilities. It is also likely that two 10-acre elementary school sites and one 17-acre junior high school site would be located on Key Site 22 (OCP EIR, Volume II). It also allows for development and realignment of roads to service the area. While the OCP includes protecting 40% of Key Site 22 as open space, including creeks and other habitats, development of this area pursuant to the Plan would surround the complex potentially restricting tiger salamander immigration and emigration to and from this complex, and would eliminate adjacent upland habitats suitable for SB CTS.

Additional examples of projects likely to impact this metapopulation include: (1) A large research park (80 buildings) and a golf course proposed for development near the Santa Maria Airport, an area that currently supports several known SB CTS breeding ponds; and (2) On August 31, 2003, Santa Barbara County released a Notice of Preparation of a Draft Environmental Impact Report/Environmental Assessment for the proposed Santa Maria Animal Shelter/Public Works Service Center. This project is located on the southeast portion of the Santa Maria Airport and according to the NOP may cause biological effects, including reducing the numbers and restricting the range of the SB CTS.

Breeding sites and upland habitat in southeastern Santa Maria Valley constitute the Bradley-Dominion metapopulation (USFWS 2000b). This is probably the most at-risk metapopulation due to agricultural intensification. Prior to 1996, this metapopulation was surrounded by oil production and grazing lands (USFWS 2000b). Since 1996, agricultural land conversion for vineyards, vegetable row crops, and flowers has destroyed one documented and one suspected breeding site, possibly extirpated salamanders from two other documented sites and one possible breeding site, and threatens a remaining possible breeding site (USFWS 2000b). Although SB CTS were found migrating across roads in the vicinity of the possible breeding sites throughout the 1980s, salamanders have not been observed there since the early 1990s, when the grazing lands were converted to vineyards (USFWS 2000b). One documented breeding site may not have held water long enough in 2000 to support successful breeding, and although surveys of two other breeding sites were not conducted, the uplands surrounding one pond have been converted to intensive agriculture (USFWS 2000b). It is likely that the adult breeding population at that site has been greatly reduced. A storage facility for agricultural products is within the watershed of a remaining documented breeding site (USFWS 2000b). Runoff from this storage site could poison habitat for salamanders during the breeding or development seasons. A road between this pond and a nearby pond, the watershed of which was converted to *gladiolus* fields in 1998, disrupts migration between the ponds and the uplands, has caused the deaths of many salamanders, and contributes to potentially lethal contamination of the ponds (USFWS 2000b). Although the area near the Bradley-Dominion metapopulation is currently designated as off-limits for urban expansion, it is currently being considered for annexation and development by the Bradley Land Co. of 2,000 acres to accommodate 6,000 homes in a planned community of 15,000 people and including a resort hotel and golf course. A 2003 survey by Steve Sykes found CTS on the eastern margin of this area, adjacent to East Bradley Lake (S. Sweet, UCSB, pers. comm.).

The North Los Alamos Valley metapopulation, although divided by Highway 101, was considered by Stebbins (1989) to be an important breeding site for the species, provided existing conditions could be maintained (USFWS 2000b). However, grazing land has been converted to vineyards east of Highway 101 (USFWS 2000b). The direct effects of this conversion resulted in the loss of one vernal pool and the severe degradation of upland habitats surrounding that pool and another documented breeding site (USFWS 2000b). CTS were not found during a survey of the remaining pond in March 2000, although they were present in other ponds in the metapopulation at that time (USFWS 2000b). Additional surveys and monitoring are needed to determine if adult CTS are still present in the vicinity of the pool and if the remaining upland habitat around the pond is sufficient to support a SB CTS population (USFWS 2000b). West of Highway 101, there are vernal pools and seasonal ponds that may be converted from grazing lands to intensive agriculture at any time (USFWS 2000b). One of these ponds is in danger of being completely filled in by siltation due to increased soil erosion from the vineyard on the east side of the highway (USFWS 2000b). Half of the uplands adjacent to a recently discovered CTS breeding pond were converted to intensive agriculture in the fall of 1999, probably killing many of the adult salamanders in the uplands associated with that pond. Continued farming of that area will likely result in further losses of SB CTS and their habitat (USFWS 2000b). In addition, CalTrans is currently considering a proposal to widen Highway 101, which bisects the range of the North Los Alamos metapopulation (Santa Barbara County Planning and Development 2002, at 7). This will likely increase the threat of mortality from roadkill to this population.

The Purisima Hills metapopulation, consists of small ponds and surrounding upland habitats on the crest of the Purisima Hills (USFWS 2000b). The ponds may be satellites to the larger Laguna Seca pond, a reported SB CTS breeding site (USFWS 2000b). Salamanders from this metapopulation may provide evidence of an historic genetic link between the Los Alamos and Santa Rita Valley metapopulations, although the intensive agriculture currently along State Highway 135 in the Los Alamos Valley probably constitutes a barrier to gene flow now. The land use around these ponds consists of cattle grazing. According to the USFWS, this metapopulation is the least threatened of the SB CTS metapopulations. However, Dr. Sam Sweet (pers. comm.) has noted that there are recurrent proposals to place rural homesites throughout the area occupied by CTS. While these are very low-density developments, the topography is such that nearly all of the known breeding ponds will necessarily be close to homesites, stables and corrals. Further, the all-weather access roads such development requires will also necessarily be placed very close to most of the existing breeding ponds. Upland habitat adjacent to several of the Purisima Hills ponds is quite restricted, and is likely to be severely degraded by both road-building and housing and outbuilding construction and use.

The east Los Alamos metapopulation consists of 2 large and 2 small ponds in open savannah grassland (USFWS 2000b). Currently, the property is used for cattle grazing; however, the site is proposed for vineyard installation by the Kendall Jackson Company (USFWS 2000b). The property is bordered to the north by Highway 101, which, along with extensive vineyards, probably serves as a barrier between this site and some potential breeding ponds on the north side of the highway (USFWS 2000b).

In the Santa Rita Valley metapopulation, the westernmost area occupied by the SB CTS has been severely affected by agricultural grading, conversion to row crops, and livestock facilities (USFWS 2000b). A site in the eastern part of the valley has two vernal pools that have been deepened to create a permanent water source for cattle and have had introductions of mosquitofish (*Gambusia affinis*) and sunfish (*Lepomis* spp.) (USFWS 2000b). Introduced predatory bullfrogs (*Rana catesbeiana*) also occur at the site (USFWS 2000b). The upland habitat to the north of the pools is still in very good condition, however, the pools are adjacent to Highway 246, resulting in considerable road mortality of salamanders during their breeding migrations (USFWS 2000b). Cal Trans has recently approved a proposal to widen Highway 246 between Lompoc and Buellton (Santa Barbara County Planning and Development 2002, pg. 7). Upland habitats around two possible breeding ponds northeast of the second site were deep-ripped in 1998 in preparation for conversion to vineyards (USFWS 2000b). Vineyards have been installed and one of the ponds was enlarged and deepened in 1999 (USFWS 2000b). This change may make the pond less desirable for the SB CTS and more likely to be inhabited by exotic fish, crayfish (*Procambarus clarkii*), and bullfrogs (USFWS 2000b). The remaining undisturbed habitat is probably insufficient to support SB CTS over the long term (USFWS 2000b). There are likely to be 1–3 undocumented CTS breeding ponds south of Highway 246 in this area, but landowners have not permitted survey work, although the highway is now a major barrier (S. Sweet, UCSB, pers. comm.).

There is another population in the Santa Rita unit, at Fox pond. This is an isolated stockpond on a ridge. This pond was recently omitted from the critical habitat proposal for the SB CTS.

Oil production began within the range of the salamander approximately 100 years ago, with the discovery of oil in the Solomon Hills (within the range of the Los Alamos tiger salamander metapopulation). By 1910, production had begun in the Santa Maria Valley (E. Gevirtz, pers. comm. 1999). Although oil production is less disruptive to the upland habitats than agriculture, oil sump ponds, particularly those located where natural ponds and pools once existed, may act as toxic sinks. While attracting salamanders seeking breeding sites, these ponds may contain levels of contaminants that may kill adults, eggs, and larvae outright, or cause deformities in the developing larvae thus precluding their survival (see discussion on contaminants in Factor E of this section).

1. Specific Threats to the Santa Barbara County Population of the California Tiger Salamander as Presented by Sweet (1998)

As discussed above, vineyard development has been identified as one of the most severe threats to California tiger salamander habitat, particularly in Santa Barbara County. Vineyards provide minimal setback from vernal pools, and intensive management practices result in high erosion rates into the ponds, rendering them unsuitable for breeding (Sweet 1998). Vineyard development also eliminates small mammal burrows and creates barriers to dispersing individuals, and to salamanders attempting to return to breeding ponds (Sweet 1998). In addition, installation of vineyards kills salamanders outright (Sweet 1998). In his 1998 report entitled "*Vineyard development posing an imminent threat to Ambystoma californiense in Santa Barbara County, California*," Dr. Sam Sweet of U.C. Santa Barbara explicitly described existing conditions and threats to the Santa Barbara County CTS from vineyard development in each of four regions in western Santa Barbara County where the species was known to persist as of 1998: (a) West Orcutt (Tanglewood complex, Pipeline pond, Railroad pond); (b) Bradley-Dominion (east Bradley Lake, Gill pond, southwest Gill pond, Fulger tank, two additional suspected but located ponds south of Garey and west of the junction of Bradley Canyon and Dominion Road); (c) Las Flores (Big pond, Round pond, east Round pond, south Palmer Road pond, Careaga Divide pond); and (d) Santa Rita (Campbell Road pond, Santa Rita Valley ponds). There are currently six metapopulations, but the following information is still a useful summary of conditions at four of the complexes. A detailed description of each pond, including breeding status, prior land use, and recent land use changes, is excerpted below from Sweet (1998):

> (1) Tanglewood complex -- One of several small vernal ponds between the SE corner of the Tanglewood housing district and the western margin of Santa Maria Airport property, where a single larval Ambystoma californiense was captured but not collected by L.E. Hunt in 1995 in the course of survey work associated with the Orcutt General Plan. To my knowledge the site has not been sampled further, but I am completely confident of Mr. Hunt's identification. The area is currently used for grazing. Under the Orcutt General Plan the vernal pond complex at this site would be surrounded by housing and commercial developments, but would be reserved as recreational open space. In my view, neither the size of the reserved area nor the range of uses envisioned as appropriate is consistent with persistence of a population of Ambystoma californiense.
>
> (2) Pipeline pond -- One of two sites SW of the junction of U.S. hwy 1 and Black Road discovered during survey work for the State Water Pipeline, this is a shallow artificial pond in open grassland. Numerous larvae were present in the spring of 1994, and dispersing juveniles were recovered in can traps along the pipeline right-of-way fence; most of these animals had traveled 200-600' upslope from the pond. Voucher specimens are catalogued in the Museum of Systematics and Ecology, UCSB. Currently the land is grazed, and I am not aware of imminent changes; however, the soils and aspect are favorable for vineyard development.
>
> (3) Railroad pond -- A small, relatively deep artificial pond located upslope of the SPRR grade about 0.3 mi. SW of Pipeline pond, also discovered in 1994. This pond had a very dense larval population; a significant proportion of the larvae apparently did not metamorphose during the summer, and remained in the pond until the following spring. Voucher specimens are at UCSB. Current land use continues to be grazing, but like the preceding site the area seems suited to vineyard development.
>
> (Both Pipeline and Railroad ponds probably represent colonizations from a large complex of vernal ponds present along Orcutt Creek in the 1920s, but long since converted to agriculture; the Tanglewood complex is an eastern outlier of this former wetland, which extended northwest to the vicinity of Betteravia.)
>
> (4) East Bradley Lake -- A large seasonal pond W of Telephone Road, where Bradley Canyon sinks into the Pleistocene marine terrace bordering the SE margin of the Santa Maria Valley. This is not to be confused with Bradley Lake proper, a permanent dune pond to the W with introduced bullhead. Semi-isolated pools at the ENE margin of E Bradley Lake had adult A. californiense and numerous eggs on the single occasion sampled (vouchers at UCSB). A few adult tiger salamanders have been noted DOR on Telephone Road at Bradley Canyon in subsequent years. Prior land use was a mixture of grazing, oil extraction and row crops, with

native vegetation on the sandier dunes and in adjacent swales. Most of the area around this pond has been converted to vineyard in the last 2-3 years (I have not had access to the area recently, and do not know how much of the land adjacent to the pond may have been affected).

(5) Gill pond -- A large vernal pond in the SE quadrant of the junction of Dominion X Orcutt-Garey Road, formerly maintaining one of the two largest breeding populations of A. californiense in the region. Adults were regularly found traveling to this pond from as far as 1.3 mi. S along Dominion Rd. In most years the site produced many hundreds of juvenile salamanders, though large numbers of these, and adults in winter, were killed by traffic on Dominion Road (vouchers at UCBS). Prior to 1998 the surrounding land was used for grazing, with scattered oil wells. Within the last few months the entire catchment basin of this pond has been converted to gladiolus (fide S. Collie, UCSB); Mr. Collie reports that the pond has received very heavy sedimentation, and that no A. californiense larvae were found in the pond in July 1998.

(6) SW Gill pond -- A smaller natural pond about 500' SW of Gill pond, probably part of the same breeding population. The surrounding land is also reported to have been recently cleared, apparently for vineyards. Also, a large building has been approved along Clark Avenue S of this pond and within its catchment, whose purpose is the storage of agricultural chemicals. There is no recent information as to whether A. californiense has continued to breed at this site.

(7) Fulger tank -- An abandoned irrigation pond on the NW flank of Fulger Point, which is the northern terminus of the old marine terrace on which the Gill ponds lie. A single subadult A. californiense was found DOR [dead on road] near this pond in the early 1980s (voucher, UCSB), and a few eggs (but no larvae) were observed there in 1986 and 1987. The site has not been reexamined subsequently. The Santa Maria River floodplain adjoining Fulger Point has been intensively farmed (row crops) for many years, while the terrace remained in grazing. Virtually all of this upland habitat has recently been converted to vineyards. [Note: This site was destroyed in 1999; S. Sweet, UCSB, pers. comm. 2004].

(X) Unknown pond ca. 1/2 mi S of Garvey -- Adult Ambystoma were frequently found on secondary roads in this area from 1980-1995, strongly suggesting a breeding site distinct from the Gill pond complex (which lies about 2 air mi. W, across a major canyon that cuts below the appropriate soil type). Uplands here were mixed grazing and oil production, but again have undergone recent conversion to vineyards. I have not searched for animals here since the conversions intensified.

(Y) Unknown pond(s) W of Dominion Road at Bradley Canyon -- Throughout the 1980s (to around 1993) adult tiger salamanders were regularly encountered crossing Dominion Road towards the west from about 0.5-2 mi. N of the Gill pond complex (DORs as vouchers at UCSB). Despite several attempts, no breeding pond was located among several sites surveyed here. At the time most of this land was in grazing, with some relatively small vineyards on higher parts of the terrace. Since 1991-92 nearly all of this extensive area has been converted to vineyards; I have no records of tiger salamanders from this portion of the Bradley-Dominion metapopulation site since that time.

(8) Big pond -- The largest of 5 known breeding sites on or adjacent to Rancho Las Flores along hwy 101 3-4 mi. NW of Los Alamos, Big pond is a natural depression with a surface

area of up to 4-5 acres in wet years. According to the property owner (Jeanette Sainz) and in accord with my own observations since 1980, Big pond fills in all but the lowest rainfall years, and nearly always produces thousands of metamorphosed tiger salamanders (vouchers, UCSB). Land use patterns for ponds 8-11 are summarized together.

(9) Round pond -- located ca. 0.4 mi. NE of Big pond, Round pond is a deep natural depression of ca. 1 acre maximum surface. Like Big pond, Round pond fills in most years, but usually retains its water longer; however, it is used by Ambystoma less frequently (about half of years surveyed, 1980-1997), and seldom supports high densities of larvae. Water temperatures tend to be lower, and algal blooms seem to be less frequent in Round pond.

(10) East Round pond -- A small vernal pond across hwy 101 from Round pond, this site fills only in wet years and even then often dries before larval salamanders are able to metamorphose. Nonetheless, larval densities may be high. [Note: This pond is now surrounded by Premiere Partners vineyard; S. Sweet, UCSB, pers. comm. 2004].

(11) Palmer Road S pond -- Another small vernal pond located W of hwy 101 near Palmer Rd, about 0.5 mi. N of Round pond, this site apparently lost much of its former catchment to a berm along hwy 101 that directs runoff to a bypass drainage. Like site 10, this pond fills only in wet years, though it is more persistent and generally generates juvenile salamanders. Densities are low to moderate.

Each of these ponds is located in an extensive grassland-oak savanna that has been virtually undisturbed save for relatively light grazing. The area controlled by Ms. Sainz (ponds 8,9 and 11) has never been plowed, and supports significant native grasses. Unfortunately, this situation has changed abruptly. Within the last month the entire east side of hwy 101 from Los Alamos to Solomon Summit has been cleared and is being converted to vineyards; E Round pond, though amply identified by the consulting biologist (L. Hunt) was disked to its margins and its catchment area essentially destroyed. Apparently a relatively trivial fine was imposed, considerably less than the annual expected profit per acre of the land as vineyard.

Within the last week I was informed that Ms. Sainz had leased the entire ranch to Kendall-Jackson winery; that corporation has employed Dr. Paul Collins (SBMNH) to advise them on vernal pond-related issues. I have now consulted with Dr. Collins and reviewed the maps generated by Kendall-Jackson. Unless significant reductions in vineyard areas occur, I feel that Ambystoma californiense will be extirpated from this entire area (excluding Careaga Divide pond, see below) at the time that the land is cleared. This will occur through direct mortality of juvenile and adult salamanders via direct excavation and the burial of small mammal burrow systems, loss of essentially all upland habitat around all ponds, and the comparatively rapid elimination of the ponds themselves via sedimentation. Further, there will be complete mutual isolation of ponds by alienated terrain.

(12) Careaga Divide pond -- This is a large natural pond in dense live oak woodland on the crest of Careaga Ridge about 3 mi. NW of the main Las Flores pond complex, on the Stevens Ranch adjoining Rancho Las Flores. Careaga pond fills in most years and supports a relatively large population of larval salamanders, with good recruitment success over time (vouchers, UCSB). It is unusual among sites in being enclosed in extensive dense woodlands, with grasslands limited to the high-water contour. Current land use is light grazing (apparently none in some years). I was recently made aware that the owner of this large ranch is interviewing

biological consultants to assist with its conversion to vineyards (and perhaps housing as well); details are scant at present.

(13) Campbell Road pond -- A large natural pond on the divide along hwy 246 between Buellton and Lompoc, this site has been modified by the excavation of a deep pit in the center, and the introduction of non-native fish. Prior to these changes (which occurred in ca. 1981) the Ambystoma population appeared to be larger than was noted in the mid-late 1980s, and larger then than at present. Another contributing factor in the apparent decline of this population may be increasing road traffic on hwy 246, and modifications to the roadway (principally high berms) that now prevent salamanders from crossing the road directly, instead causing them to travel along the traffic lands to reach a drain leading to the pond. Adult salamanders are known to occupy a sparse oak woodland on the north side of the pond (opposite the roadway)...Land use immediately adjacent to the pond continues to be relatively heavy grazing.

(14) Santa Rita Valley pond(s) -- One or more breeding ponds are assumed to occur in the Santa Rita Valley ca. 2 mi. W of Campbell Road pond along hwy 246. Small numbers of large adult salamanders have been found alive or DOR [dead on road] from the E margin of this valley approximately to its center, but not in the western half (vouchers at UCSB). It has not been clear from the travel directions observed whether the site is N or S of the highway, though a slight majority of animals suggests it is N. Land use visible from the roadway involves extensive row crops to the S, and formerly a mosaic of these, an orchard, and apparently fallow land to the N. Within the year most of the visible area N of hwy 246 has been converted to vineyards, as have parts of the flats to the S.

More than 30 new breeding sites have been discovered since 1998, including the East Los Alamos and Purisima Hills metapopulations in their entirety. However, because the soil types and topographic features required by CTS are commensurate with the criteria used to locate new vineyards, because vineyard development is continuing unabated and by individuals with considerable financial resources, and because vineyard conversion typically is not subject to CEQA review, there is little recourse for the species when faced with this severe threat.

Other projects documenting current and future threats to the CTS within the Santa Barbara Population Segment are included below.

Foxenwoods Townhomes: The project involves construction of 32 town homes on an 8.25-acre project site in the City of Santa Maria. According to the California Department of Fish and Game, CTS breeding ponds are documented to be located approximately 0.5 miles north of the project site. The Department concluded that because CTS are known to migrate to and occupy small mammal burrows up to 1.2 miles from a breeding pond the project has a potential for take of CTS (through construction activities) and therefore that an EIR must be prepared. The Department found further that if suitable small burrows existed on the project site prior to the disking of the project area, then the disking had potentially killed CTS. However, the City claims through its own surveys that project site is not within 1.2 miles of a known CTS breeding and therefore refused to prepare an EIR. A notice of determination for the project was entered on February 28, 2002 (See Appendix C at 71A-I and Appendix D, pg. 4).

Finally, non-native tiger salamanders have been found in two places near known CTS sites: at the mouth of Cebada Canyon, and a pond on the Lompoc Federal Penitentiary grounds (S. Sweet, UCSB, pers. comm.). The non-native tiger salamanders have established a breeding population at the latter site.

C. Central California

The Central California populations are threatened by conversion of natural habitat and grazing land to intensive agriculture and urban development. Urban development is particularly rapid in the East Bay and Sacramento areas. The average growth in human population within Central California counties that support CTS has been 19.5 percent (USFWS 2003b). Urban development has extirpated sub-populations at 41 records of the Central California tiger salamander from the CNDDB (USFWS 2003b). The CNDDB also documents that CTS in Alameda and Contra Costa counties, the "core population" of the species (which includes portions of the Bay Area and Central Valley populations), are impacted by off-road vehicle use, at least ten housing developments, 3 golf courses, and infrastructure construction and expansion. California tiger salamanders in the Livermore Valley are highly threatened by the conversion of 35,897 acres of grazing land to urban uses and vineyards (EBRPD 1999 in USFWS 2003b). Urban growth boundaries encompass 267,977 acres of urban development within and surrounding the Livermore Valley, including the Livermore, La Costa, Amador, Sunol, and Vallecitos valleys in eastern Alameda County and the Clayton, Lone Tree, Deer, and Briones valleys of eastern Contra Costa County (EBRPD 1999 in USFWS 2003b). As described in "Estimates of Range-wide Habitat Destruction to Date," Keeler-Wolff et al. (1998) listed 5 distinct vernal pool regions in the Central Valley as emergency high-priorities for conservation due to rapid loss of habitat, lack of protected areas, or other reasons (Northeastern Sacramento Valley, Southeastern Sacramento Valley, Livermore, San Joaquin Valley, and Southern Sierra Foothills). The Livermore area had <u>no</u> known protected vernal pools at the time of the report.

1. Current Threats

a. Bay Area

Thirty-two percent (194 of 608 Central California known sites up to 2002) of records are in the Bay Area sub-population, most of them in eastern Alameda and Santa Clara counties, and 49 of the records in the Bay Area DPS are considered extirpated (USFWS 2003b).

The East Bay, Livermore Valley populations of the Bay Area and Central California populations in eastern Alameda County and southern and eastern Contra Costa County, have been recognized as “core” populations by both Stebbins (1989) and Shaffer et al. (1993). These populations are the “core” in terms of both distribution and genetic variation. These populations are also some of the most threatened of all the populations statewide. Shaffer et al. (1993 at 9) wrote the following: “The parts of Alameda, Contra Costa, Sacramento and San Joaquin Counties that support the greatest densities of CTS, and the greatest genetic variation ... are in areas of tremendous development pressure from urban growth. The Bay Area, San Jose, and Sacramento use these areas for suburban growth, and the pressure to develop remaining open range lands is tremendous.” Shaffer et al. (1993 at 23) re-emphasize this point: “This region, called the “core” area by Stebbins in his assessment of the status of the CTS (Stebbins 1989), is in the East Bay and Sacramento regions, especially in the Livermore Valley region of Contra Costa County...These are among the fastest growing areas of human population in the state, and development that is not compatible with the salamanders seems inevitable under the current situation.” Since these 1993 statements, development pressure in the East Bay area has only intensified. This is apparent from the enormous number of projects listed for Alameda County in Appendices B and C, and also from the population growth projections contained in Table 7.

The East Bay and Livermore Valley regions have undergone intensive urban development in the past decade. From 1990 to 1996, 40,665 ac of native habitat in Santa Clara, Alameda, and San Benito counties were converted, 90 percent to urban uses (California Department of Conservation 1994, 1998 in USFWS 2003b). Most of the vernal pools in Livermore Valley have been destroyed or degraded by urban development, agriculture, water diversions, water pollution, and intensive livestock grazing (USFWS 2003b). Forty-three percent of CTS records at breeding sites identified by the USFWS are in stock, farm, or berm ponds used for grazing and irrigation and are by no means secure habitat.

Descriptions of specific major development projects in the range of the Bay Area DPS that have recently or soon may eliminate habitat known to be occupied by CTS follow below.

i. Alameda County

Happy Valley Specific Plan: The project includes the development of a golf course and single-family residences in the City of Pleasanton. Specifically the plan calls for development of a municipal 18-hole regulation golf course; with approximately 142 acres to be occupied by the golf course, practice facility, and clubhouse; 25 acres devoted to 34 home sites; and 176 acres dedicated to open space conservation. Suitable CTS habitat is identified as occurring within the plan area. DEIR states "[CTS] may use the aquatic habitats associated with [two] creeks and several stock ponds found within the study area. [CTS] have been reported to occur in garden and wetland habitats on property immediately adjacent to the study area." A survey was performed in 1997 and no CTS were observed. However, discussions with the City Planner revealed that pre-construction surveys identified CTS larvae. This discovery resulted in two conservation easements, on 173 and 107 acres respectively. These lands, known as the "Callipe Preserve" include mitigation lands for other species, not just CTS. Further project mitigation measures include implementation of a CTS Mitigation and Monitoring Plan. A notice of determination for the project was entered on January 24, 2001 (See Appendix C at 97A-I and Appendix D, pg. 4).

Vineyard Avenue Corridor Specific Plan: This Plan calls for construction and development of vineyards, 189 new single-family homes, an elementary school, a 20-acre park, and other commercial uses in the City of Pleasanton. Implementation of the proposed project would result in the loss of suitable upland habitat for the CTS. The loss of this potential CTS habitat is considered a potentially significant impact. No CTS individuals were found during field surveys. Mitigation measures include a minimum 100-foot setback from suitable CTS breeding habitat for all grading activities. Also the EIR calls for preservation of an equivalent amount of upland habitat to be preserved within the Plan Area to replace similar habitat that is removed during development of the proposed project. A notice of determination for the project was entered on February 19, 2002 (See Appendix C at 98A-I and Appendix D, pg. 5).

Oaks Business Park: The project consists of a Vesting Tentative Tract Map authorizing between 2.58 and 2.9 million square feet of light-industrial, research, development, and professional uses on a 151-acre project site. The EIR states "[c]onstruction activities will remove potential upland refugia for the [CTS]. This is a potentially significant impact." CTS have been identified near the project area. Both suitable breeding and upland habitat are identified as present on the site. Surveys conducted in 1989 and 1993 were used as the basis for determining potential presence of the CTS. No CTS were found during these surveys. A 2001 survey looked at two seasonal wetlands on the site and found no CTS. For mitigation, the EIR calls for a pre-construction survey conducted in accordance with USFWS and CDFG protocols prior to grading (See Appendix C at 88A-I and Appendix D, pg. 5).

Livermore Draft General Plan and Downtown Specific Plan: The DEIR states "[d]evelopment resulting from implementation of the Draft General Plan and Downtown Specific Plan could adversely affect areas of ecological sensitivity, including hillsides, alkali springs, creek corridors and watersheds. A number of species that inhabit grasslands could be adversely affected by development of the BART TOD area, Sensitive Habitat Parcels, Adventus site, Ferreri site, and the West Side are parcels. Of particular concern are impacts to CTS and burrowing owls," (See Appendix C at 90A-I and Appendix D, pg. 6).

CTS habitat is present within the planning area. However no surveys for CTS presence were undertaken. "Specific survey techniques are available to more completely assess presence and absence of [CTS], but implementation of such surveys is not required by any policy in the Draft General Plan." Mitigation measures included: cluster development, preservation of open space areas, implementation of creek setbacks, and avoidance of riparian woodlands and freshwater marshes and compensation for impacts to this habitat.

East Altamont Energy Center: The project would result in permanent removal of approximately 43.5 acres of prime agricultural land that also provides wildlife habitat. The project would also result in temporary loss habitat losses, which may impact CTS. The CTS is identified as species potentially occurring in the project area. No CTS were detected during surveys of the project area. However, CTS are assumed to be present in the area mainly because the project area provides extremely suitable habitat for the species. The species is locally abundant in the foothills 2 miles southwest of the project and may occur in these farm pond-type wetlands or may be temporarily present in any seasonally wet area. The CNDDB contains sightings for the salamander near the corner of Kelso and Bruns roads. The proposed project includes linear facilities on Kelso and Bruns roads that would pass through this CTS habitat (See Appendix C at 125A-I and Appendix D, pg. 6).

Mitigation calls for the applicant to obtain and comply with responsible wildlife agency permits; conduct pre-construction field surveys to identify potentially suitable habitat; and implement avoidance and minimization measures to protect habitat from impacts.

Altamont Water Treatment Plan: The project involves construction of a new water treatment plant in the area in order to provide up to 96 million gallons per day total municipal and industrial needs through the year 2020. CTS have been sighted in project area. Suitable CTS breeding and upland habitat has also been identified within project area. Residents of the area report sightings of CTS in the vicinity of the Dyer Road Site #1, and the species is known to occur in Frick Lane, south of Laughlin Road Site #3. These vernal ponds on Dyer Road Site #1 provide potential CTS breeding habitat (See Appendix C at 94A-I and Appendix D, pg. 7).

Mitigation calls for avoiding direct impacts to identified CTS habitat; no siting of facilities within 300 feet of a pond without consultation with USFWS and the Department; continued surveys in accordance with Department protocol; and preservation or replacement of CTS habitat on a 1:1 basis. A notice of determination for the project was entered on May 5, 2001.

Double Wood Golf Course: The proposed project calls for construction of a golf course construction in the City of Fremont. Suitable CTS habitat exists within project area. Detailed surveys were conducted and CTS larvae were found within the project area. One pond is slated for direct destruction to make way for the golf course. Also, additional loss of upland habitat is expected to result in direct CTS mortality (See Appendix C at 100A-I and Appendix D, pg. 8).

Mitigation measures include 3 options: 1) preserve pond and 300-foot buffer; 2) pond is filled, create new burrows and pond in suitable location (1,200 square ft, 4-ft deep, >2 ac upland) and transfer all larvae, pond water, and adults to new pond; or 3) pond is filled, mitigate by acquiring offsite habitat at undetermined replacement ratio.

Pacific Commons: The DSEIR calls for the addition of two parcels to the existing Catellus project site in the City of Fremont. CTS are known to occur within project area (according to both the CNDDB and DSEIR) (See Appendix C at 108A-I and Appendix D, pg. 8). No project-specific CTS surveys have been conducted.

Mitigation calls for surveys to be conducted in the areas proposed for development. If larvae are found, a mitigation plan is to be developed and requiring evidence of CTS densities and distribution in any created habitat for 2 successive years following implementation of the plan.

South Livermore Valley Area Plan/General Plan Amendment: Total land area of 49,850 acres in cumulative project list. The Amendment allows conversion of 3,250 acres of grasslands to vineyards/cultivated agriculture and about 350 new rural residential and commercial establishments, as well as loss of 1,600 acres of grassland to urban development. CTS are known to occur onsite (See Appendix C at 90A-I and Appendix D, pg. 8).

Destruction of CTS "could be mitigated by requiring a field survey." Wildlife surveys "should be conducted" according to protocol. Mitigation measures would include avoidance or reduction in acres placed under cultivation. Also, protect critical areas through conservation easements and direct purchase.

North Livermore Specific Plan: The project designates 13,500 acres for the development of approximately 12,500 dwelling unit, 77 acres for a Village Core and other commercial uses, and 10,000 acres for open space, habitat, schools, public amenities and onsite and offsite improvements. The CTS breeds in three ponds onsite and in one area adjacent to the project site (Springtown Alkali Sink) (See Appendix C at 92A-I and Appendix D, pg. 9).

Mitigation measures call for protection of all breeding ponds except for aestivation habitat adjacent to two of the ponds. A Resource Conservation Program is also called for which will purchase conservation easements for up to 8,300 acres of grassland. Movement barriers are also to be installed to direct CTS to away from developed areas into protected aestivation habitat.

ii. Santa Clara County

City of Morgan Hill General Plan Update: Implementation of the General Plan would include subsequent projects, in addition to the development of the land uses designated in the General Plan, which could result in many impacts to sensitive wildlife and plant habitats. These projects would include, among other actions, construction of roadways or roadway widening and installation of new infrastructure (e.g., water and sewer lines, and construction of new public facilities). The types of impacts that these subsequent projects could have on the biological resources include direct habitat loss (including wetlands and other sensitive natural communities), adverse effects on species of concern attributable to habitat loss or disruption, and indirect effects on habitats or species due to altered drainage, creation of barriers to wildlife movement, and increased human activity in natural areas. According to the DEIR, CTS "have been sighted throughout the planning area." However, no survey data is given "due to the generalized mapping of the CNDDB and potential for occurrence at other unsurveyed locations in the planning area." No CTS mitigation measures are mentioned in the document. A notice of determination for the project was entered on August 27, 2001 (See Appendix C at 181A-I and Appendix D, pg. 9).

City of Gilroy Revised General Plan: The DEIR looks at a revised general plan for the City of Gilroy. CTS are documented to occur in the Gilroy Planning Area. The CTS is said to have bred in Reservoir Canyon Pond in the past. CTS also are known to inhabit the southern portion of the Eagle Ridge property, located south of Uvas Creek and west of Santa Teresa Boulevard. CTS also breed in Farman Canyon Pond. At the time of the DEIR, the Eagle Ridge Development was under construction. This development is to include 853 homes, a golf course, 1,070 acres of open space, and 101.2 acres of CTS habitat located south of McCutchin Canyon.

Mitigation measures call for protection and maintenance of the above mentioned ponds, installation of 2 new ponds, salamander larvae introduction, installation of off-road vehicle barriers, installation of salamander barriers beside roads and backyards of developments, and installation of rounded curbs. A final document for the project was entered on July 22, 2002 (See Appendix C at 181A-I and Appendix D, pg. 9).

The Institute Golf Course: This golf course has already been constructed in the City of Morgan Hill (reconstruction of old and out-of-use golf course). However, the DEIR looks at the environmental consequences of operating and maintaining the new golf course. Ponds on site provide known CTS breeding habitat. One metamorph was found in 2001 by Dr. Mark Jennings, leading to the conclusion in the DEIR that CTS are at least using this particular pond for breeding. Other ponds on site are assumed to have been past habitat and possibly used currently by a remnant population. No further surveys are mentioned. The DEIR lists impacts of the project as including increased predation or disease by introduced bullfrogs and/or largemouth bass (*Micropterus salmoides*), contamination of breeding ponds from golf-course run-off, and further loss of individuals and habitat from future grading of areas adjacent to breeding areas (See Appendix C at 183A-I and Appendix D, pg. 10).

Mitigation measures include implementation of a 200-foot buffer zone for breeding ponds, a non-native predator management plan, and water quality measures.

iii. San Mateo County

Jefferson-Martin 230 kV Transmission Project: The project involves construction of a transmission line through four cities in San Mateo County. CTS habitat exists in the southern half of the transmission line alignment, but no breeding sites were identified during field surveys in 2002. Records of CTS individuals exist 5 miles south of the project in Lagunita Lake on the Stanford University campus. The DEIR does not mention any mitigation for the CTS or its habitat (See Appendix C at 192A-I and Appendix D, pg. 12).

Coyote Valley Research Park: The applicant proposes to develop approximately 400 acres of a 688-acre site, with up to 6.6 million square feet of buildings for office, research and development, assembly, light manufacturing, associated infrastructure, parking, and new internal roadways in the City of San Jose. The project includes the construction of 5 new bridges and the widening of an existing bridge and box culvert over Fischer Creek, 5 new storm drain outfalls, 2 improved existing outfalls, a new by-pass channel, and a flood detention basin. CTS were not found during surveys onsite, however both adult CTS and CTS larvae have been detected in a pond near to project site (See Appendix C at 143A-I and Appendix D, pg. 11).

Mitigation measures attempted to minimize impacts to wetlands, but the by-pass channel could constitute an unavoidable impact to CTS aestivation habitat. No other mitigation measures were proposed. A notice of determination for the project was entered on September 19, 2001.

Planned Development Rezoning Legacy Terrace Development Site: The project consists of a Planned Development Rezoning, Annexation, Planned Development Permit(s), and other related entitlements to allow development of approximately 1,015,000 sq. ft. of office, research and development facility, a 175-room hotel, a restaurant, and ancillary retail uses and associated improvements on 45.2 acres and permanent open space on 25.3 acres for a site containing a total of 70.5 acres located on the north side of State Route 237 between the Union/Southern Pacific Railroad and San Tomas Aquino Creek in the City of San Jose. CTS were not detected in focused upland and aquatic surveys. However, one pond dried early the year of the surveys. Additional surveys were being conducted at the time of DEIR (See Appendix C at 140A-I and Appendix D, pg. 11).

Mitigation measures call for the set aside and enhancement of available on-site aestivation habitat around breeding ponds (if follow-up surveys identified CTS), and creation of barriers between habitat and development. If on-site mitigation is infeasible, the mitigation measures calls for conservation of off-site habitat at 1:1 mitigation ratio is called. A notice of determination for the project was entered on June 26, 2001.

Metcalf Road Property Housing Project: The project involves construction of a residential subdivision of 213 detached units located near the City of San Jose between Highway 101 and Metcalf Road, on approximately 21.6 acres of a 257-gross-acre site. The project applicant has also applied for a Section 404 Permit application for fill of 1.22 acres of wetlands. CTS were found breeding in two ponds onsite, with potential to occur in two more ponds within the project area (See Appendix C at 155A-I and Appendix D, pg. 12).

Mitigation measures include construction of a 5 to 6-foot high wall between the pond and the housing development to direct CTS away from the development. The Corps Public Notice also calls for a 1.5:1 mitigation ratio for the Section 404 permit. A notice of determination for the project was entered on May 28, 2003.

iv. San Benito County

San Juan Vista Estates: The project includes mixed-use development on 195 acres, including 31 estate residential lots, a 150-room hotel, a service station/carwash, three restaurants and eight affordable housing units in the City of San Juan Bautista. CTS were identified on the project site in the vicinity of the stock pond during a January 1998 survey. A total of 8 salamanders were observed in 7 burrows in the grassland slope and berm adjacent to the stock pond. Development of the project could potentially affect CTS on the property as development of the commercial area will result in encroachment into the potential wetlands area below the stock pond. Other impacts to CTS and CTS habitat could come from installation of paved streets, driveways, and parking lots; changes in water quality and/or quantity of runoff into the stock pond; increased vehicular traffic; and increased human use of the site (See Appendix C at 199A-I and Appendix D, pg. 13).

Mitigation includes a CTS habitat management plan that calls for preservation and management of primary habitat (stock pond, adjacent slopes, and wetland mitigation area); maintenance of secondary habitat area (higher surrounding slopes and swales); and maintenance of a movement corridor to the adjacent open space.

San Juan Oaks Golf Club General Plan Amendment/Zone Change: Project includes a residential subdivision, a resort, a private/resort golf course, a public par 3 golf course, and village commercial uses on 2,000-acres. Suitable CTS habitat exists within the project area, and CTS are known to occur on the site (CNDDB 2003). Detailed surveys have been conducted and CTS larvae have also been found in project area. The project calls for direct destruction of 3 ponds and additional loss of upland habitat will likely result in direct mortality of CTS (See Appendix C at 202A-I and Appendix D, pg. 13).

Mitigation measures are combined with those for other listed species in the project area (no independent CTS mitigation). These measures include designating 738 acres (2 parcels) as permanent wildlife habitat through a conservation easement or deed restriction to the County, at a 1:1 mitigation ratio. However this habitat area is also to be used for flood control.

Generally, the populations in extreme western Merced and San Benito counties, in the Diablo Range, also have been severely affected by past habitat destruction from urban and agricultural development and face continuing threats from these factors. We know of no protected areas for the CTS in this area.

b. Central Valley

Forty-seven percent of Central California CTS localities (286 of 608 known sites up to 2002) are in the Central Valley sub-population, and populations at 37 locations are considered extirpated (USFWS 2003b). From 1996 to 1998, 35,487 ac of habitat were converted to urban and agricultural uses in Yolo, Solano, Contra Costa, Merced, Sacramento, San Joaquin, Stanislaus, and Madera counties (CDC 2000 in USFWS 2003b).

The East Bay region of the Central Valley DPS, part of the "core" population, has experienced massive loss of habitat in recent years. In 1993 more than 1,482 acres of occupied and/or potential habitat for the CTS was eliminated by the Los Vaqueros Dam project in Contra Costa County (USFWS 1993). More than 100 wetland areas with the potential to support CTS reproduction were eliminated by the project. Mitigation included the creation of 7.8 acres of wetland and the enhancement and maintenance of 80 sites, or approximately 50 acres. Now plans are underway for an expansion of the Los Vaqueros reservoir (CALFED 2003). An expansion of the Los Vaqueros project would eliminate a substantial portion of the habitat remaining for the species in the watershed and would further decrease the viability of the East Bay population. Recent surveys have located CTS throughout the project area (CALFED 2003, at 5.3-9). The expanded reservoir would directly inundate 991 to 1,703 acres of grasslands and 112 to 246 acres of oak woodlands, and facility and conveyance construction would temporarily degrade 231 acres of grassland and 5 acres of oak woodland, and permanently destroy up to 147 acres of grassland and up to 58 acres of oak woodlands. In all, the expansion of the Los Vaqueros Reservoir would result in the permanent destruction of 1,313-2,081 acres of grassland habitat and 133-

309 acres of oak woodland habitat, as well as 1.3 acres of wetland habitat (CALFED 2003, at 5.3-10 and 5.3-11). The mitigation measures proposed for the CTS in this expanded project are to "acquire protect, and manage 1 to 3 acres for each acre of effect or enhance or restore 1 to 5 acres of habitat near affected areas," (CALFED 2003, at 5.3-19). This mitigation could be interpreted as permitting the permanent destruction of thousands of acres of habitat without providing any additional protected habitat, as at a minimum the mere "enhancement" of already protected areas could be required. As stated *supra*, the creation of breeding ponds as mitigation is helpful but can also result in the loss of important upland habitat. In other words, restoring and enhancing existing protected areas surrounding the watershed, including the creation of new wetlands, ultimately would result in the net loss of CTS habitat and continue to shrink the amount of available habitat for the species.

Eastern Contra Costa County has entered the preliminary stages of a Habitat Conservation Plan for 170,000 acres of watersheds draining the eastern flanks of Mount Diablo, which lists the CTS as a covered species. Under the plan, from 2,013 to 5,374 acres of migration and aestivation habitat would be permitted for destruction (Jones and Stokes 2003). The HCP also provides for the capture and relocation of egg masses, larvae, juveniles, and adult CTS from construction areas into either unoccupied or occupied ponds. As documented *supra*, relocation is a poor conservation strategy, particularly for small numbers of endangered, threatened, or sensitive species, even into areas of excellent habitat quality (Griffith et al. 1989; Fischer and Lindenmayer 2000). In addition, translocations have the potential to spread introduced diseases such as chytridiomycosis.

The Northern Bay Area and Stanislaus County populations both appear to consist entirely or almost entirely of protected, but discrete populations. The CTS populations at the Jepson Prairie Preserve and Hickman Vernal Pool Complex do receive protection. It is believed that the CTS does not occur in ponds to the north or south of the Hickman complex (Geer 1994). CTS were found at some proposed power plant sites near Jepson Prairie (USFWS 2003b). Much more protection and preservation is needed in addition to these two areas in order to assure the long-term viability and the genetic variability of the species.

Large vineyards have been planted in areas along the San Joaquin-Sacramento County line, which has destroyed and degraded CTS habitat (USFWS 2003b). The species was considered extirpated in Stanislaus County until recently discovered by biologists surveying a potential route for a highway bypass near Oakdale (California Department of Transportation 2000 in USFWS 2003b). This route threatens the only known population of CTS in the Oakdale area. CTS were observed in a 144-acre unirrigated “pasture” with vernal pools in Stanislaus County in 1992, but the habitat on this site was destroyed shortly after the observation (Ford 1992).

The Sacramento area of the Central Valley population segment is threatened by ever-increasing development pressure. While area conservation plans are being developed, provisions for the CTS are inadequate. The Natomas Basin Habitat Conservation Plan in Sacramento and Sutter counties would permit the destruction of 21 of 96 acres of ponds and seasonally wet areas in the basin. Because CTS have the potential to occur within the basin, the draft EIS attempts to address the species by stating that the Vernal Pool Conservation Strategy would provide protection for aquatic habitat, but ignores the upland habitat necessary for the species to persist. The EIS notes that if pre-construction surveys determine the presence of the CTS, developers would be required to "consult with CDFG to determine appropriate measures to avoid and minimize take of individual animals," thus deferring the formulation of protective measures to some future time when the public has no opportunity to ensure that the species is adequately protected.

Recent CTS surveys that were conducted as part of a larger survey of the wildlife and rare plant ecology of Eastern Merced County have expanded the knowledge of CTS distribution in this area (Vollmar 2001b). The regional study area included the eastern 365,000 acres of Merced County, and was bounded by Highway 99 and the Merced County line (Volmar 2001b, at 10 and Figure 2.1). While most of the vernal pool landscape in western and central Merced County was lost years ago to intensive agriculture, urban and suburban development, and road and utility line construction, the vernal pool complexes of eastern Merced County occur on higher terrace soils less suitable for farming and large areas have been used primarily for ranching (Vollmar 2001a). Consequently, eastern Merced County contains the largest remaining block of vernal pool and grassland habitat in the state (Vollmar 2001b). Currently, approximately 150,000 acres of the study area is used for livestock grazing and contains very little urban development or physical fragmentation of any kind (Vollmar 2001b). The CTS was historically distributed throughout the regional study are prior to large-scale habitat conversion (Laabs et al. 2001). Over the past decade, intensive agriculture, primarily almond orchards and vineyards, has been expanding rapidly eastward (Vollmar 2001b). Urban development has also advanced eastward, primarily along major transit corridors such as Highway 140 and the Merced-Snelling Road (Vollmar 2001b).

In the winter and spring of 2001, amphibian surveys were conducted on twelve large ranches in the study area (Laabs et al. 2001). The study included both random stratified surveys of vernal pools and targeted, non-random sampling of large vernal pools and target, non-random sampling of stock ponds and reservoirs (Laabs et al. 2001). Of the 1,325 randomly sampled vernal pools, 10, or .8% contained CTS larvae (Laabs et al. 2001). Of the 280 targeted large vernal pools sampled, 27, or 9.6%, contained CTS, leading the authors to conclude that the distribution of the CTS is largely determined by the presence of larger (and deeper) vernal pools (Laabs et al. 2001). Of the 79 stock ponds surveyed, 13, or 16.5% contained CTS (Laabs et al. 2001). The authors cautioned that relatively low rainfall in the winter of 2000/2001 could have contributed to finding amphibian larvae in fewer vernal pools than would otherwise have been the case (Laabs et al. 2001). Of the 29 stock ponds surveyed that contained non-native fish, none contained CTS, demonstrating that CTS were not distributed randomly with respect to the presence of fish (Laabs et al. 2001). The bullfrog was found to be well established throughout the study area (Laabs et al. 2001). CTS were found less frequently than expected in stockponds that were occupied by bullfrogs. Although a larger area was surveyed north of Highway 140 than south of Highway 140, 79% of the pools and stock ponds that contained CTS larvae were found south of Highway 140 (Laabs et al. 2001). While there was no qualitative assessment of ground squirrel abundance in the survey area, the authors noted that the areas where CTS were most abundant had relatively high densities of ground squirrels (Laabs et al. 2001). While the study did not include genetic sampling, one abnormal looking CTS larvae was encountered and sent to the Shaffer lab at UC Davis for analysis (Laabs et al. 2001). This was subsequently confirmed as a hybrid, along with several other CTS collected in the spring of 2003 (B. Shaffer, UC Davis, pers. comm.). As discussed in more detail under "Hybridization," *supra*, the presence of hybrids in this area, which contains some of the best remaining CTS habitat in the state, represents a major threat to the species.

The new University of California Merced campus is proposed for construction at the Lake Yosemite Site in the middle of the regional study area described above. The current proposal includes the construction of a new campus on a 2,000-acre parcel that will be donated by the Virginia Smith Family Trust, the construction of a "university community," including a town center, and the construction of an infrastructure project to support the new development (USFWS 2002b). The proposed UC Merced project represents "leap frog" development into an area without infrastructure, and as such will be extremely growth inducing. The new town is proposed for an additional 5,000 acres owned by the Virginia Smith Family Trust, 3,100 acres owned by the Cyril Smith Family Trust, and 200 acres owned by the County of Merced (EIP Associates 1999a). This community is expected to support 30,000 people within the next 20 years, and has been described by earlier UC planning documents as twice the size of Berkeley. Also proposed is a new four to six lane highway, approximately 6.5 miles long, to connect Highway 99 to the new campus and city. Caltrans is currently preparing environmental review documents for this component. 65 Fed. Reg. 4015.

As described above, the proposed Lake Yosemite Site is located in the middle of the largest remaining continuous vernal pool landscape in California. The area where the campus will be situated, between the Merced River on the north and Bear Creek on the south, is about 60,000 acres of continuous unbroken, largely undeveloped landscape. Within the entire area there are only two roads, various farm tracks, a couple of houses and barns, and about one dozen windmills. Previous surveys conducted in 1999 and 2000 found CTS in 14 stock ponds, three clay playas, and one swale on the proposed campus and community site (EIP 1999b, 2000c).

The campus, new town, and infrastructure project will destroy thousands of acres of grassland habitat and over 92 acres of wetlands (USFWS 2002b). The project will also contribute to habitat fragmentation, introduction of non-native species, increased human disturbance, and will induce additional growth in the area (USFWS 2002b). Mitigation for this project is likely to involve the purchase and conservation of 26,068 acres of grassland habitat and monitoring and studying indirect impacts of development on vernal pool systems. While these lands are not currently managed for the protection of CTS, they are occupied by the species and may be managed for the protection of the CTS and other species in the future (USFWS 2002b). This mitigation package will result in a large block of conserved habitat for the species.[13] At least one hybrid salamander has been discovered in eastern Merced County, demonstrating that the non-native salamanders in this area are threatened by hybridization as well (B. Shaffer, UC Davis, pers. comm.). The mitigation package does not currently include monitoring and minimizing the spread of non-native tiger salamanders (see "Introduced Species," *supra*).

Merced County is also in the process of developing an NCCP/HCP for eastern Merced County. A target date of late 2004 has been set for completion of the plan. Information on the specific development to be permitted by the NCCP/HCP is not yet available.

Other projects documenting current and future threats to the CTS within the Central Valley Population Segment are included below.

i. Contra Costa County

State Route 4 Improvement: The applicant proposes to place rock rip rap in three locations (totaling approximately 650 feet) on Rodeo Creek and at a single location on Telephone Creek (totaling approximately 130 feet) and to install a second bridge approximately 30 feet downstream of the existing Highway 4 bridge. Suitable CTS habitat exists within the project area in the form of vernal pools. No CTS surveys were done. The DEIR includes an extremely weak absence argument, correlating a low number of small mammal burrows in the project with a presumed absence of the species. No habitat

[13] Unfortunately, while the UC Merced campus mitigation package represents at best the minimum mitigation that should be required by regulatory agencies for these types of impacts, in practice it probably represents the maximum that is ever required, with the vast majority of development projects providing far less.

mitigation measures are mentioned. A notice of determination for the project was entered on February 7, 2000 (See Appendix C at 235A-I and Appendix D, pg. 14).

Lafayette General Plan Revision: The plan revision increases residential units from 1,018 to 1,160 units and Commercial square footage from 146,065 to 241,831 square feet within the City of Lafayette planning area. Both CTS individuals and suitable CTS habitat exist within the Planning Area. No mitigation measures are mentioned (See Appendix C at 222A-I and Appendix D, pg. 14).

Hercules Redevelopment Plan Amendment: The Plan includes a buildout of the Redevelopment Plan Area that could result in the addition of up to 879 residential units, 142,800 square feet of retail uses, and 1,306,800 square feet of industrial uses in the City of Hercules planning area. The CTS is recognized as a species occurring or potentially occurring within the proposed redevelopment area. No CTS surveys are mentioned (See Appendix C at 218A-I and Appendix D, pg. 14,15).

Contra Costa Countywide Comprehensive Transportation Plan: The DEIR includes an assessment of plans for various transportation improvements. The CTS is identified as a species present in close proximity to 2 of the 3 transportation corridors slated for transportation improvements. No CTS are surveys mentioned (See Appendix C at 217A-I and Appendix D, pg. 15).

Several general methods are proscribed for mitigation (e.g., conduct surveys, use sensitive lighting, species sensitive construction schedules). However the DEIR notes that "[e]ven with the implementation of these mitigation measures, these impacts on biological resources could remain significant."

City of San Ramon 2020 General Plan: The DEIR assesses the new general plan for the City of San Ramon and finds that CTS habitat exists within the planning area, and that the species is listed as one that "may inhabit areas within the San Ramon Planning Area." Freshwater marsh, stock ponds, and perennial and seasonal drainages are included within the "sensitive habitats within the rural areas of the Planning Area" and where rural development is proposed. No CTS surveys are mentioned (See Appendix C at 251A-I and Appendix D, pg. 15).

The creation of a "San Ramon Habitat Protection Program" is proposed for mitigation.

City of Pittsburg General Plan: The General Plan buildout would result in a total of 4,640 new acres of residential land. The CTS is identified as a species known to occur or potentially occurring within the planning area. Suitable CTS habitat exists in the grassland hills in the southern portion of the Planning Area. No CTS surveys are mentioned, nor are any mitigation measures for the species or its habitat (See Appendix C at 236A-I and Appendix D, pg. 15,16).

City of Antioch Draft General Plan Update: General Plan calls for a maximum buildout of 37,978 single-family dwelling units, 13,968 multi-family dwelling units, 9,091,615 square feet of commercial office space, and 37,541,160 square feet of business park/industrial space within the study area. Implementation of the proposed General Plan would extend urban development into locations where sensitive natural communities are known and/or expected to occur. As a result of this expansion biological resources are expected to be directly or indirectly impacted by the Plan's implementation. The CTS is identified as a species potentially occurring in the General Plan area, with potential habitat in creeks and ponds throughout the plan area. CTS are also documented in a tributary to Sand Creek in southern portion of plan area. The DEIR lists "[d]irect mortality of listed, proposed, or candidate species or loss of habitat occupied by such species," and alteration and fragmentation of such habitat all as potential impacts of plan implementation. No CTS surveys or species mitigation measures are mentioned (See Appendix C at 256A-I and Appendix D, pg. 16).

Shady Willow Lane/Amber Lane Improvement Project: The project seeks to widen and extend two roads running through a currently sparsely developed rural area in the City of Brentwood. The CTS is identified as a species with potential to occur in project site, with the potential for migration through the agricultural portion of the project site. No breeding sites were identified on or adjacent to the site. However, CTS are known to occur in grasslands located within 2 miles south of the project site. The DEIR concludes that the project will have no impact to the CTS because the project site contains no suitable breeding habitat and because the project site is separated from known CTS occurrences by a residential development and other roads (See Appendix C at 250A-I and Appendix D, pg. 16,17).

A site survey was completed on March 28, 2003. The survey area includes a 200-foot wide corridor on either side of the existing and proposed alignment. No CTS mitigation measures are proposed.

Bancroft Gardens Residential Subdivision: The project consists of a 22-unit residential subdivision requesting approval of a tentative map in the City of Pittsburg. Suitable CTS habitat exists on the project site (pond). The Mitigated Negative Declaration ("MND") contains no discussion of actual CTS presence/absence and no surveys are mentioned. According to the MND, the proposed project could result in both a direct loss of CTS individuals and a loss of foraging and aestivation habitat if the pond immediately to the northeastern corner of the site is occupied (See Appendix C at 241A-I and Appendix D, pg. 17).

Bailey Road Estates: The project proposes to build a 319-unit single-family residential development on a 122-acre project site within a 265-acre parcel. Suitable CTS habitat exists within the project area. Detailed surveys have been conducted and a "high" number of CTS individuals are known to occur within project area. The project applicant has also applied for a CWA Section 404 permit to fill 1.48 acres of wetlands on project site. The only mitigation measure mentioned in the DEIR and the Corps Public Notice is relocation of individuals (See Appendix C at 239 A-I and Appendix D, pg. 17,18).

Alves Ranch Project: The project is a planned community near the Pittsburg/Bay Point BART station that includes a mixture of multi-family housing, townhouses, single-family (cluster and larger-lot) housing, custom residential lots, business commercial uses, a linear park, landscaped buffers, public and private roadways, and permanent hillside open space in the City of Pittsburg. The project applicant has also applied for CWA Section 404 permit for fill of 0.94 acres of wetland on the site (including; 0.62 acre freshwater seep, 0.22 acre of seasonal wetland). Suitable CTS habitat (ephemeral drainages & intermittent creeks) exists within the project area. The CTS has been observed within project area (See Appendix C at 240A-I and Appendix D, pg. 18).

A wetland mitigation plan for the CWS Section 404 permit includes a 2:1 compensation ratio to consist of creation of 1.88 acres of on-site seasonal pond habitat, restoration of a former 0.5-acre stock pond and preservation of 1.68 acres of on-site seeps. A final document for the project was entered on January 23, 2002.

Montreux: A Residential Subdivision: The project involves subdivision of a 158-acre site for a 152-unit single-family residential development in the City of Pittsburg. The CTS is identified as a species potentially occurring within the project area. Suitable CTS habitat exists within the project area but no survey for CTS were performed in preparation of the DEIR. The DEIR concludes that CTS may occur on project site. No CTS mitigation measures are proposed (See Appendix C at 237A-I and Appendix D, pg. 18).

ii. Solano County

City of Fairfield Comprehensive General Plan Amendment: The project components include a proposed Technology Park east of Peabody Road, the Travis Reserve area, the Rancho Solano North Master Plan Area, and the Train Station Site in the City of Fairfield. Potential CTS habitat exists on each of these project sites. Activities associated with these components could result in the loss of habitat and direct mortality to CTS, and would be considered take as defined under the ESA. The DEIR considers this impact to be significant. No CTS surveys are mentioned (See Appendix C at 269A-I and Appendix D, pg. 19).

Mitigation measures include a call for surveys for individual projects and consultation with the appropriate wildlife agencies. A notice of determination for the project was entered on June 19, 2002.

iii. Sacramento County

Laguna Ridge Specific Plan: This specific plan calls for development of 1,900 acres and changing the existing uses of the land from rural residential and agricultural to a mix of residential, commercial, office, industrial, and recreation in the City of Elk Grove. The project also provides for public schools, parks, and water treatment plants. CTS habitat exists within the project area, but the DEIR concludes CTS potential for occurrence is "[u]nlikely due to disturbed nature of onsite farmland wetlands and surrounding lands. However, no CTS surveys are mentioned (See Appendix C at 269A-I and Appendix D, pg. 19).

The lack of additional projects in Sacramento County is not due to a lack of projects with the potential to impact CTS, but rather to the failure of Sacramento County staff to provide copies of the requested CEQA documents. Of 39 projects with the potential to impact the CTS, we received the request documents for only 2 projects. For an additional 5 projects, we received an email from the contact person or planner stating that there were no CTS individuals or habitat on the project site. We will submit additional information on projects in Sacramento County when we obtain it.

iv. Amador County

Buena Vista Landfill: This landfill construction project would impact 4.279 acres of "wetland/pond" plant communities and 2.6 acres of "intermittent drainages" within the City of Ione. The CTS is identified as a species known or having the potential to occur in the vicinity of the study area. The DEIR states, "[t]here is a general lack of suitable habitat in the study area...[t]herefore, [no CTS] are expected to occur." However, no CTS surveys were conducted and the DEIR describes the drainages on the site as "small, shallow, and ephemeral...." No CTS mitigation measures are proposed (See Appendix C at 372A-I and Appendix D, pg. 19,20).

v. San Joaquin County

Manteca General Plan 2023: The project sets forth a plan for continued development within the City of Manteca. The CTS is identified as species potentially occurring with or adjacent to the study area. The DEIR points out that there are records of CTS on both the east and west sides of the county, and that 38 CTS occurrences, of which 30 define occupied habitat, are included in the project database. No specific CTS surveys are mentioned (See Appendix C at 396A-I and Appendix D, pg. 20).

The DEIR relies on the San Joaquin County Multi-Species Habitat Conservation and Open Space Plan for any and all mitigation without further discussion of impacts or specific measures for protection.

vi. Stanislaus County

Patterson Wastewater Master Plan and Diablo Grande Sewer Line: The proposed project would include construction of a sewer line and a 150-acre expansion of the City of Patterson's water treatment facility. The CTS is as a species with potential to occur in study area, with suitable aquatic habitat present in the pond at the western end of the study area. In addition, mammal burrows are present in the surrounding grasslands, providing suitable upland habitat. There are no known occurrences of CTS on the project site, but no surveys are mentioned. No CTS or CTS habitat mitigation measures are mentioned either (See Appendix C at 396A-I and Appendix D, pg. 20).

Westside 115-kV Transmission Project: The project involves installation of approximately 16.2 miles of transmission line in Stanislaus County. CTS have been located just northwest of the project area, and suitable breeding habitat exits on site in vernal pools along Link 1-6. Mitigation measures for the project include avoiding wetlands during construction; and staking and flagging of the vernal pools along link 1-6 (See Appendix C at 405A-I and Appendix D, pg. 21).

c. Southern San Joaquin Valley

Nine percent (56 of the 608 known sites as of 2002) occur in this sub-population (USFWS 2003b). Populations at 18 of recorded locations in the Southern San Joaquin population are considered extirpated (USFWS 2003b).

From 1996 to 1998, 11,142 ac of habitat for the CTS were converted to urban and agricultural uses in Fresno, Tulare, and Madera counties (CDC 2000 in USFWS 2003b). Shaffer et al. 1993 were unable to locate any protected populations in Fresno or Tulare County, and neither were we during our research. Where breeding ponds were identified, the species was generally absent (72 percent of 324 sampled ponds found no salamanders). These populations have been severely affected by past habitat destruction from urban and agricultural development, and face continuing threats from these factors. Large swaths of CTS habitat on the valley floor of Fresno, Madera, and Tulare counties were destroyed by agriculture, housing, roads, and commercial development during the 1970s and 1980s, reducing suitable CTS habitat to a small portion of the historic range (USFWS 2003b). Several water storage and delivery projects have been constructed in the region, flooding large areas of known and potential California tiger salamander habitat. The species is further threatened by several housing developments and golf courses around Millerton Lake in Fresno and Madera counties (The Keith Companies 1994 as cited in USFWS 2003b). Most remaining habitat on the eastern side of the Central Valley is on privately owned ranch land and is not protected from development that is incompatible with CTS survival.

d. Central Coast Range

Twelve percent (72 of the 608 known localities as of 2002) of CTS records occur in the Central Coast Range: nineteen of these sites are considered extirpated (USFWS 2003b).

From 1996 to 1998, 5,149 ac of habitat were converted to urban and agricultural uses in San Luis Obispo and Monterey counties. The annual loss of vernal pools from 1994 to 2000 in Monterey, San Benito, San Luis Obispo, Santa Barbara, and Ventura counties is accelerating to about 2 to 3 percent (Holland 2003 in USFWS 2003b). Two CTS sites are found within a 19,927-ac development project that makes up 14 percent of the Greater Monterey Peninsula Planning Area (USFWS 2003b). Eleven CTS localities occur on Fort Ord, two of which are within a highway easement and may be lost to future road construction, four of which are projected for development as recreational areas, commercial centers, and a university campus, and one of which is threatened with upland vegetation clearance for ordnance removal (USFWS 2003b, CNDDB 2003). Six breeding pools are threatened as part of military training on Fort Hunter Liggett; one in particular is threatened by vehicle traffic and a nearby conversion of a field to a vineyard (CNDDB 2003).

Hybridization with non-native tiger salamanders, *A. tigrinum*, is another severe threat to the persistence of the CTS in the Central Coast Range and southern portions of the Bay Area. For example, breeding salamanders were found in 11 ponds near Hastings Natural History Reserve on Oak Ridge Ranch; however this complex is entirely surrounded by ponds containing hybrids (B. Shaffer, UC Davis, pers. comm.). A detailed discussion of the negative effects of hybridization is discussed under "Other Natural or Manmade Factors Affecting the Continued Existence of the CTS," *supra.*

Other projects documenting current and future threats to the CTS within the Central Valley Population Segment are included below.

i. Monterey County

Handley Ranch Quarry: The project involves the construction of a granite quarry and associated aggregate processing facilities covering approximately 333 acres. Suitable CTS breeding habitat exists adjacent to the project site, about 1,320 feet from proposed quarry. No CTS were found during detailed surveys conducted in ponds on the project site (but the adjacent suitable breeding ponds were not surveyed) (See Appendix C at 493A-I and Appendix D, pg. 21,22).

For mitigation measures, the DEIR requires pre-construction surveys for CTS in wetlands only and not upland. If CTS are observed in such surveys, no machinery is to be brought within 300 feet of locations "unless evidence of compliance with CDFG requirements is submitted."

Salinas General Plan: The DEIR assesses the general plan for City of Salinas, which covers more than 84 square miles. Suitable CTS breeding and upland habitat exist in the project area (including oak/grassland, stockponds). Surveys are to be conducted at the individual project level. Mitigation measures include surveying within proposed project area and developing a Habitat Management Plan is CTS are found. If impacts are "deemed unavoidable, the plan shall identify mitigation measures," (See Appendix C at 490A-I and Appendix D, pg. 22).

ii. San Luis Obispo County

City of Paso Robles General Plan Update: The General Plan for the City of Paso Robles calls for a annexation of 524 acres, and a buildout/ of 7,149 dwelling units, 2,983,000 square feet of commercial development, and 1,543,000 square feet of industrial development. Approximately 497 acres of riparian habitat types and associated waterways and an unknown amount of wetland habitat types and associated waterbodies exist within area where development is authorized to occur. The CTS is identified as a species potentially occurring in the City and/or the potential annexation areas. Suitable CTS habitat is also present, but no CTS surveys are mentioned (See Appendix C at 523A-I and Appendix D, pg. 22).

Mitigation measures call for the protection of riparian and wetland habitat types through planning and education and require new development to avoid sensitive habitats *where feasible*.

III. Remaining Habitat on Existing Protected and Public Land is Inadequate to Ensure the Long Term Survival of the Species

A number of protected areas supporting CTS in the Central California population do exist. In the following analysis, we have attempted to quantify the general distribution of known breeding pools occurring within the parks, reserves, refuges, mitigation banks, or otherwise under protected ownership, by compiling information from the California Natural Diversity Database (CNDDB), USFWS (2003), LSA (1994), state and federal mitigation banks, and approved and in-progress Habitat Conservation Plans within the range of the Central California population. Overall, the amount of habitat on protected and/or public lands is insufficient to ensure the long-term survival of the species, in particular because populations on land that is protected from physical conversion face threats from introduced species and many other factors.

The USFWS (2003d) conducted a review within the range of the Central California population segments to determine acreage of habitat surrounding CTS sites. A more detailed description of the methodology and additional results are described under "CNDDB and Environmental Review Documents", *supra*. Table 12 below shows acres of CTS habitat under "protected" ownership within 1.5 miles of all CNDDB locations presumed extant (USFWS 2003d). Three caveats are: 1) it was unknown whether the locations were actually extant in 2003; 2) the management on lands considered as "protected" ownership might not be directed specifically towards CTS; and 3) the CNDDB is not comprehensive (i.e., additional locations may be known but not yet entered into the database). In addition, this study did not include an analysis of roads, pollution, overgrazing, alterations of hydrologic regimes, off-road vehicle activity, feral pigs, non-native predators, and myriad other negative impacts that potentially occur (and in fact can be widespread) on parklands and other public lands. Therefore, while the analysis defined the ownership as protected, some of these populations in reality may be in decline or extirpated.

Table 11. Protected Ownership (USFWS 2003d).

Protected Ownership	**Bay Area**	**Central Coast**	**Central Valley**	**Southern San Joaquin**	**Total Acres**
Bay Area Parks and Other	83,152		41,957		125,108
CDFG Admin	8	1,259	1,152		1,160
CDFG Ownership			317	1,390	2,967
Joint Venture			10,714		10,714
Merced County			8,989		8,981
Mitigation Banks			1,474		1,474
Public Lands	146	6,784	841	199	26,545
Refuges	2,650	39	23,856		7,970
Nature Conservancy		33	3,553	25	3,611
Wetland Reserve Program			1,500		1,500
TOTAL ACREAGE	85,956	8,115	94,343	1,614	190,028
Protected %	**7.7**	**0.7**	**8.5**	**0.2**	**17.1**

One notable result of the USFWS analysis is the relatively low percentage (17.1 %) of known remaining CTS habitat under public or otherwise "protected" ownership. In each of the Bay Area and Central Valley populations, portions of which comprise the "core" area for the species, less than 10% of the habitat acreage is considered "protected" from large-scale habitat conversion due to urbanization.

LSA (1994) gathered information on the current distribution of the CTS by pulling data from their own files, compiling records from the California Natural Diversity Database ("CNDDB"), and contacting agencies, consultants, and researchers. LSA biologists identified CTS breeding at 19 ponds for which no previous records had existed, and other sources provided additional 31 new locations. In terms of "protected" ponds, CTS were found breeding in Black Diamond Mines, Brushy Peak, and Contra Loma Regional Parks, San Francisco Water Department watershed lands, the Red Fern addition of Henry W. Coe State Park, and at Fort Hunger Liggett Military Reservation. Additional specific information from this study and others is discussed in the following sections by population segment.

East Bay Regional Parks The EBRPD includes a network of 64 parkland units that encompass over 96,000 acres of lands in Contra Costa and Alameda counties (Bobzien 2003). This network comprises a substantial portion of the "core" CTS population. Biologists for EBRPD have been monitoring and managing ponds for breeding CTS since 1990 (S. Bobzien, EBRPD, pers. comm). The EBRPD has documented 9 breeding ponds in Black Diamond Mines Regional Preserve; 8 ponds in Brushy Peak Regional Preserve; 3 ponds in the Clayton Ranch Regional Preserve; 3 ponds in Contra Loma Regional Park; 12 ponds in Del Valle Regional Park; 1 pond at Garin Regional Park; 22 at Ohlone Regional

Wilderness; 4 ponds at Mission Peak Regional Preserve; 2 ponds at Round Valley Regional Preserve; 1 pond at Sunol Regional Wilderness; 3 ponds at Vargas Plateau Regional Preserve; and 1 pond at Vasco Caves Regional Preserve. In the East Bay parks, the CTS generally occurs east of the Interstate 680 (S. Bobzien, EBRPD, pers. comm.). Overall, available data indicate the occurrence of about 69 total breeding ponds within the EPRPD. These breeding ponds all consist of stockponds grazed by cattle. Most of these parklands have abundant California ground squirrel populations or have other burrowing rodents including California vole (*Microtus californicus*) and Botta's pocket gopher (Bobzien 2003). This network of parklands in the East Bay constitutes a substantial amount of protected habitat, but the regional parks are separated from each other by major freeways and urban developments that constitute barriers to dispersal among pond complexes. For example, Highway 580, which runs east-west from Pleasanton to Tracy, as well as Vasco Road and Highway 680 from Pleasanton to Milpitas are absolute barriers between the Central Valley and Bay Area populations (S. Bobzien, EBRPD, pers. comm). These road barriers have isolated several EBRPD metapopulations, and local road improvements that facilitate more traffic, greater speeds, and encourage growth also may adversely impact CTS (Bobzien 2003).

<u>Bay Area</u> Additional CTS breeding ponds or pond complexes in the Bay Area population that can be presumed protected include one at the 300-acre "Haera" burrowing owl mitigation bank in east-central Alameda County south of the I-580, and possibly several protected ponds at the "Ohlone" mitigation bank for California red-legged frogs and CTS currently under development in south-central Alameda County (south of Livermore) (S. Wilson, CDFG, pers. comm.). CTS have been found recently at the Ohlone site (M. Jennings, pers. comm. 2003). Two breeding ponds were identified near the Calaveras Reservoir on the border of Santa Clara and Alameda counties, and CTS were found in 21 stockponds near the San Antonio Reservoir in Alameda County, all on lands administered by the San Francisco Water Department; bullfrogs were present in five of the San Antonio ponds (CNDDB 2003). A complex of vernal pools occurs on the San Francisco Bay National Wildlife Refuge in southern Alameda County, and a breeding site might occur on lands administered by the Santa Clara Valley Water District, as one adult was observed on a road in that vicinity (CNDDB 2003).

The Northern Bay Area and Stanislaus County populations both appear to consist entirely or almost entirely of protected, but discrete populations. The CTS populations at the Jepson Prairie Preserve and Hickman Vernal Pool Complex do receive protection. It is believed that the CTS does not occur in ponds to the north or south of the Hickman complex (Geer 1994).

A breeding population is known from Lake Lagunita on the Stanford University Campus in Santa Clara County (CNDDB 2003). However, this population faces substantial threats from encroaching urban developments, water drawdowns, and human impacts including vandalism (Stair 1999; Tucker-Mohl 1999; Committee for Green Foothills 2001; CNDDB 2003). Two breeding ponds may occur on Canada de Los Osos State Park, two breeding ponds were found at Grant County Park and one at Anderson Dam State Park, and three were located at Henry Coe State Park, all in Santa Clara County (CNDDB 2003). Shaffer (1992) has pointed out that while Henry Coe State Park area has a few populations that enjoy some degree of protection, this area has always been marginal habitat for the species.

<u>Central Valley</u> The range of the Central Valley population segment contains a number of ponds that might be presumed protected. In Solano County, a breeding pond occurs at a site that was formally the Nature Conservancy's Jepson Prairie Preserve, and was transferred to the Solano County Farmlands and Open Space in 1997 (CNDDB 2003). Another pond occurs on Jepson Prairie Preserve itself (LSA

1994). A number of breeding sites have been identified at Los Vaqueros Reservoir, an 85,000-acre watershed in central Contra Costa County, but some of these are in jeopardy due to a current proposal to expand the reservoir (LSA 1994; CALFED 2003). The recently created 4,000-acre John Marsh State Park may support CTS breeding habitat, although much of the area harbors introduced bullfrogs and game fish (CNDDB 2003; W. Rhodes, City of Brentwood, pers. comm.). The CNDDB notes a breeding pond at the "Source Pond Site" near Byron Airport apparently administered by the Department. The 92.5-acre "Springtown" mitigation bank under development in Alameda County near Livermore supports several alkali vernal pools used by CTS for breeding; however, the long-term viability of the species at this site is questionable due to its small size (S. Wilson, CDFG, pers. comm.). A small breeding pond occurs at the 140-acre "Byron" burrowing owl mitigation bank in northeast Alameda County, and at the 120-acre "Brushy Creek" mitigation bank north of Byron Airport in southern Contra Costa County (S. Wilson, CDFG, pers. comm.).

A complex of five breeding ponds occurs on the Concord Naval Weapons Station in Contra Costa County (CNDDB 2003). This population likely receives some degree of protection (Stitt and Downard 2000). In addition, a breeding pond is located on Department of Defense (Army) lands east of San Ramon in Contra Costa County (CNDDB 2003). However, since military installations are not managed primarily for their habitat value protection on these lands is by no means assured.

Several large scale Habitat Conservation Plans ("HCPs") are being developed within the range of the Central Valley population segment of the CTS. HCPs allow the incidental take of covered species, requiring a conservation plan as mitigation for the take. Conservation Plans, particularly those that cover multiple species and large regions, generally involve the establishment and management of preserves. HCPs covering the CTS include the Eastern Contra Costa County HCP, the Eastern Merced County HCP, and the San Joaquin Multi Species Conservation and Open Space Plan ("SJMSCP") covering all of San Joaquin County.

The proposed Eastern Contra Costa County HCP documents that 96 data records dated from 1920 to 1999 occur in the 89,822-acre project area: of these records, 45 were documented within the past 10 years. However, a comprehensive survey of the HCP inventory area has not been conducted, so neither the current population size nor all the locations are known (Jones and Stokes Associates 2002, pg. 2). The plan outlines three scenarios: 1) Urban Land Use Designations Inside the Urban Limit Line ("ULL"), which assumes that development will occur only on those lands inside the ULL; 2) All Non-protected Lands Inside the ULL, which assumes that with the exception of existing parks, development will occur on all lands inside the ULL; and 3) City General Plans, which assumes that, with the exception of existing parks, development will occur on all lands inside the ULL and that development will occur on lands outside the ULL and designated for development by approved City General Plans and not within lands already purchased for conservation. CTS habitat was defined as breeding ponds, migration and aestivation habitat. Scenario 1 assumes the most protection (impact to 2,013 acres of habitat) and scenario 3 assumes the least protection (impact to 5,374 acres of habitat) (Jones and Stokes Associates 2002). Mitigation for impacts would involve establishing and maintaining a habitat reserve system capable of sustaining an increased population of CTS in the inventory area, including: 1) protecting complexes of suitable habitat sufficiently large and connected to sustain populations; 2) emphasizing the protection of breeding sites that have been productive within the last 10 years; 3) enhancing protected areas by restoring or creating suitable aquatic and upland habitat; and 4) prohibiting habitat alterations that result in movement barriers or hazards between breeding and upland habitat including buffers around protected areas (Jones and Stokes Associates 2002). The goal is to create a

Preserve System that will protect 27-38 acres of potential breeding habitat and 24,479 to 33,282 acres of migration/aestivation habitat. It is not known how many breeding pools this preserve would include.

The SJMSCP authorizes the take of approximately 11,400 acres, or 12%, of potential habitat for the CTS in the project area; the amount of occupied habitat was unknown (SJCOG 2003). The plan notes that "...the California tiger salamander...ha[s] a patchy distribution in San Joaquin County, and the extent to which the species will ultimately benefit form the SJMSCP Preserve system is dependent upon the extent to which they occur on Preserve lands and the size, configuration, and location of those preserves...It is not expected that the 250-acre Vernal Pool Grassland Preserves alone would fully conserve the species. However, several factors should ensure that Vernal Pool Grassland Preserves will benefit tiger salamanders...(1) tiger salamander...are known to colonize artificial ephemeral wetlands; (2) many acres of vernal pool grasslands in the Vernal Pool Zone are expected to remain undisturbed under the SJMSCP...; and (3) the Southwest Zone Preserve system will also contribute to the conservation of these species...[T]he SJMSCP places a high priority on acquisition of Vernal Pool Grassland Preserves near known California tiger salamander breeding sites." The plan calls for the creation of 100,841 acres of preserves as compensation for Incidental Take on 109,302 acres converted from open space uses, and provides for funding for management of the preserve. The SJMSCP also requires the retention of known breeding sites (Section 5.2.4.6). However, the plan does not describe the short and long-term impacts of urbanization and isolation of breeding sites. Again, it is unknown how many breeding pools the Preserves will include.

The proposed Mount Diablo State Park HCP in Contra Costa County includes road and trail development and maintenance, which could negatively affect the CTS known to occur within the park. Mitigation measures are unknown, as only a Notice of Preparation of an Environmental Impact Statement is available. 68 Fed. Reg. 45850-45851. The Natomas Basin HCP in Sacramento and Sutter counties also includes the CTS as a covered species, but the species has not been located in the Natomas Basin (City of Sacramento et al. 2002).

Federal mitigation banks are currently being developed in the Central Valley for the CTS (as well as other sympatric species). These include the 780-acre Laguna Creek Conservation Bank in Sacramento County and the 333-acre Vieira-Sandy Mush Road Conservation Bank spanning Merced, Stanislaus, Madera, and Fresno counties (USFWS 2003c). A breeding pond occurs on property owned by Conservation Resources LLC, northwest of Ione in Sacramento County; this pond may be on the 240-acre Arroyo Seco Federal Conservation Bank (USFWS and CNDDB). In San Joaquin County, the Fitzgerald Ranch federal conservation bank has been set up for CTS and other species.

Additional vernal pools are being conserved on federal conservation banks for other vernal pool species in Sacramento County, but it is unknown whether these banks support breeding CTS. These conservation banks include the 573-acre Bryte Ranch Conservation Bank, the 405-acre Clay Station Conservation Bank, and the 482-acre Sunrise Douglas Preservation Bank (USFWS 2003c). Pleasanton Ridge, a 600-acre federal and state mitigation bank being developed in Alameda County to conserve riparian and oak woodlands for the federally listed California red-legged frog and Alameda whipsnake (*Masticophis lateralis euryxanthus*), has the potential to conserve CTS habitat as well (USFWS 2003c; CDFG 2002). State mitigation banks under development in the southern Sacramento/northern San Joaquin County region that might potentially conserve habitat for the CTS include the 488-acre Grizzly Slough mitigation bank, containing seasonal wetlands, uplands, and oak woodlands, and the 1,400-acre Barten Ranch bank for listed crustaceans, containing vernal pool and wetlands habitat (CDFG 2002). Again, it is unknown whether CTS breeding sites occur at these banks.

The CNDDB reports that CTS were found breeding at three national wildlife refuges in Merced County: Kesterson National Wildlife Refuge contains numerous vernal pools and other seasonal wetlands where breeding was observed; the Merced National Wildlife Refuge supports a complex of breeding pools, although these may be threatened by roads, marshes, canals, and other wetlands projects; and CTS were found breeding in many vernal pools and other seasonal wetlands on the San Luis National Wildlife Refuge, which may be threatened by non-native predators (CNDDB 2003).

Adult CTS have been observed dead on roadways at the Department of Parks and Recreation's Carnegie State Vehicle Recreation Area in San Joaquin County between Tracy and Livermore, indicating a possible breeding pool onsite (CNDDB 2003). In addition, a number of CTS were observed at the Great Valley Grassland State Park south of the San Joaquin River near Stevinson in Merced County, although channelization and diking may increase non-native predators (CNDDB 2003).

The County of Merced is in the process of developing an HCP, but its parameters are not yet known. Also in Merced County, the University of Merced campus and associated developments in Merced County will result in a significant loss of habitat for the CTS (2,000 acres of grasslands and 92 acres of wetlands). The University appears to have committed to a framework for mitigation which includes the purchase of 5,780 acres of grassland habitat for conservation, while the Wildlife Conservation Board in conjunction with the Department has purchased or is in the process of purchasing an additional 20,288 acres (USFWS 2002b). While these lands are not currently managed for the protection of CTS, they are occupied by the species and may be managed for the protection of the CTS and other species in the future (USFWS 2002b). The mitigation package will also include monitoring of indirect impacts to vernal pools from development that could provide valuable information on vernal pool hydrology, edge effect, and other issues (USFWS 2002b).

Southern San Joaquin: Protected habitats in the Southern San Joaquin population include a complex of breeding ponds at the Department's Stone Corral Ecological Reserve in Tulare County and three vernal pools at Millerton Lake State Recreation Area in Fresno County in which many salamanders were observed (CNDDB 2003).

Central Coast Range: In the Central Coast Range, adult CTS have been identified at Ellicott Pond in the Santa Cruz Long-toed Salamander (*Ambystoma macrodactylum croceum*) Ecological Reserve west of Watsonville. Ten breeding pools were found at Fort Ord Military Reservation, and 17 breeding ponds were located at Fort Hunter Liggett Military Reservation, all in Monterey County (CNDDB). The ponds at Fort Ord are potentially threatened with development after base closure, and all the CTS found at Fort Hunter Liggett are actually hybrids (CNDDB 2003; B. Shaffer, UC Davis, pers. comm.). In addition, a complex of ponds and a vernal pool supporting CTS larvae was identified at the Hollister Hills State Vehicle Recreation Area (LSA 1994).

Overall, we were able to identify about 102 CTS breeding sites, which may include individual ponds or pond complexes, scattered throughout the range of the Central California population that currently or in the near future could be considered protected. In addition, several major HCPs are under development that may protect some populations in proposed reserves, although these protections are not assured. While protection of these areas represents a small step towards the protection of the CTS, they are insufficient to ensure its long term survival in the wild for several reasons discussed below.

Many of the sites which are currently protected from physical conversion are isolated breeding ponds that are separated from other ponds by increasing urbanization, road expansions, and agricultural conversion - an inhospitable matrix for dispersal. In addition, the viability of many of these sites is questionable due to the small reserve size, additional threats such as ORV activity and non-native predators, and an inability for re-colonization should the local population become extirpated due to the inhospitable matrix. The best scientific data indicate that the smaller a breeding pond and its population of CTS, the less upland habitat surrounding the pond can be lost without the population becoming extirpated (B. Shaffer, UC Davis, pers. comm.). In other words, small isolated populations of CTS are seriously at risk without adequate conservation of intact upland habitat.

CTS populations that occur in the relatively small amount of habitat that is currently protected from conversion to urban or suburban uses or intensive agriculture in almost all cases face threats from one or more factors including isolation and habitat fragmentation from urbanization, freeways, and intensive agriculture, non-native predators such as bullfrogs and mosquitofish (including introduced diseases carried by them), feral pigs, alteration of hydrological regimes, ORV activity, rodent control and other agricultural practices, vandalism, and other associated impacts.

Most of the remaining habitat of the CTS, which has already undergone a drastic decline, is highly threatened by physical conversion to urban areas or intensive agriculture. The remaining areas, even absent other threats, are insufficient to ensure the long-term survival of the species. The species could be listed on the basis of threatened physical habitat destruction alone. However, the host of additional threats discussed below that face virtually all remaining CTS populations, including those which occur on the small percentage of otherwise protected land, greatly intensifies the threat to the species and adds urgency to the need for listing.

OVEREXPLOITATION

Overexploitation is not a major threat to the CTS (Shaffer et al. 1993; USFWS 2000b). Although larval tiger salamanders have been used for bait and imported larvae ("waterdogs") were the source of many hybrid salamander populations, the importation of live "waterdogs" has been prohibited by the Department. Further, the larvae of CTS are not bulky or lively enough to be used as bait (J. Brode, CDFG, pers. comm.).

PREDATION[14]

California tiger salamander larvae are preyed upon by many native species. Native predators include great blue herons (*Ardea herodias*) and egrets (*Casmerodius albus*), western pond turtles (*Clemmys marmorata*), various garter snakes (*Thamnophis* spp.), larger California tiger salamander larvae, larger western spadefoot larvae, and California red-legged frogs (USFWS 2000b). The Altamont Landfill attracts a large gull (*Larus* spp.) population that also forages at Frick Lake and several Brushy Peak Regional Preserve ponds that support CTS (Bobzien 2003). In healthy salamander populations such predation is probably not a significant threat, but when combined with other impacts, such as

[14] This section discusses predation upon the California tiger salamander by native species only. Predation by non-native, introduced species is discussed under "Other Factors," *supra.*

predation by nonnative species, contaminants, or habitat alteration, it may cause a significant decrease in population viability (USFWS 2000b).

COMPETITION

California tiger salamander populations face competition primarily from non-native, introduced species such as mosquitofish, bass, sunfish, catfish, and other introduced tiger salamander species, which feed on the same prey base. The effect of competition from non-native species is discussed under "Other Natural Events or Human-related Activities," *supra*.

DISEASE

The direct effect of disease on CTS is not known and the risks to the species have not been determined. Because CTS remain in relatively few localities, disease must be considered a potential threat.

Several pathogenic (disease-causing) agents, including at least one bacterium (Worthylake and Hovingh 1989), a water mold (fungus) (Kiesecker and Blaustein 1997; Lefcort et al. 1997), and a virus (McLean 1998), have been associated with die-offs of closely related tiger salamanders, as well as other amphibian species. Each of these pathogens could devastate remaining subpopulations or metapopulations if introduced into healthy CTS populations.

Worthylake and Hovingh (1989) reported on repeated die-offs of tiger salamanders *A. tigrinum* in Desolation Lake in the Wasatch Mountains of Utah. Affected salamanders had red, swollen hind legs and vents, and widespread hemorrhage of the skin and internal organs. The researchers determined that the die-offs were due to infection with the bacterium *Acinetobacter*. The number of bacteria in the lake increased with increasing nitrogen levels as the lake dried. The nitrogen was believed to come from both atmospheric deposition and waste from sheep grazing in the watershed (Worthylake and Hovingh 1989). *Acinetobacter* spp. are common in soil and animal feces. Overstocking of livestock in pond watersheds could lead to high levels of nitrogen in ponds and contribute to increased bacterial levels.

Lefcort et al. (1997), in Georgia, found that tiger salamanders raised in natural and artificial ponds contaminated with silt were susceptible to infection by the water mold *Saprolegnia parasitica*. The fungus first appeared on the feet, then spread to the entire leg. All infected animals died. Die-offs of western toads, Cascades frogs (*Rana cascadae*), and Pacific treefrogs also have been associated with *Saprolegnia* infections (Kiesecker and Blaustein 1997). *Saprolegnia* spp. are widespread in natural waters and commonly grow on dead organic material (Wise 1995).

High nitrogen and silt levels from overgrazing or other agricultural or urban runoff may increase susceptibility to disease and may interact with other risk factors (e.g., habitat loss, introduced species) to jeopardize the persistence of a local population. Additionally, an iridovirus (viruses with DNA as the genetic material that occur in insects, fish, and amphibians, and may cause death, skin lesions, or no symptoms) has been identified by the U.S. Geological Service (USGS), National Wildlife Health Center in Madison, Wisconsin, as the cause of deaths of large numbers of tiger salamanders at Desolation Lake, Utah. Infected salamanders moved slowly in circles and had trouble remaining upright. They had red spots and swollen areas on the skin. Viruses associated with die-offs of tiger and spotted salamanders in two other States, Maine and North Dakota, have been isolated (McLean 1998). In 1995, researchers reported similar die-offs attributed to an iridovirus in southern Arizona and near Regina, Saskatchewan, Canada (McLean 1998).

Iridoviruses are found in both fish and frogs and may have been introduced to some sites through fish stocking programs. Little is known about the historical distribution of iridoviruses in salamander populations. A virus could enter California via bait shops where eastern tiger salamanders are illegally sold. Birds, such as herons and egrets that feed on the salamanders, may carry the virus. Such a virus could be devastating to remaining populations of CTS.

In addition to the iridovirus, chytridiomycosis has recently been documented in several amphibian species in California. Chtridiomycosis is an emerging disease responsible for a series of global population declines, massive die-offs, and extinctions of amphibians (Mazzoni et al. 2003). Chytrid fungi have always been present in the environment as important decomposers of cellulose, chitin, and keratin, but have not previously been parasitic on vertebrates (Padgett-Flohr 2003). The chytrid fungus causing chytridiomycosis in amphibians, *Batrachochytrium dendrobatidis*, has been detected in California populations of California red-legged frogs, foothill yellow-legged frogs (*R. boylii*), mountain yellow-legged frogs (*R. muscosa*), Yosemite toads (*B. canorus*), Pacific treefrogs, canyon treefrogs (*H. arenicolor*), bullfrogs, laboratory populations of arroyo toads (*B. californicus*), and finally -- most disturbing for CTS -- in Santa Cruz long-toed salamanders (Padgett-Flohr 2003). The disease is fatal, using keratin from the host organism, and the fungus is held in reservoir and can infect new animals even when the host species has perished. The most important factor driving the emergence of the disease is the anthropogenic introduction of pathogens into new geographic areas (Mazzoni et al. 2003). Scientists do not know how the infection kills or how the fungus is transmitted, but have been advising against translocating any amphibians at this time due to the potential for spreading the disease (Padgett-Flohr 2003).

OTHER NATURAL EVENTS OR HUMAN-RELATED ACTIVITIES

I. Habitat Fragmentation

Amphibian populations, in general, are prone to local extinction due to habitat fragmentation (USFWS 2000b). The primary causes of habitat fragmentation within the range of the CTS are road construction, urbanization, and intensive agriculture (USFWS 2000b). CTS are particularly susceptible to the adverse affects of habitat fragmentation because of their low reproductive output and because they are distributed throughout the landscape in a metapopulation framework (Shaffer et al. 1993). Even under natural conditions, local populations of CTS are sometimes extirpated by natural factors such as drought (Shaffer et al. 1993). Under pristine conditions, these sites are recolonized by CTS from neighboring sites (Shaffer et al. 1993). However, habitat fragmentation makes it impossible for these sites to be recolonized. In addition, habitat fragmentation itself increases the chances of local extirpations since additional threats such as roads and contaminants accompany the fragmentation. Therefore, reducing the CTS's distribution to a few isolated ponds greatly reduces the species' ability to persist over time (Shaffer et al. 1993).

Roads and highways are one of the leading causes of habitat fragmentation. The actual construction of roads results in the death of slow-moving animals and causes soil compaction underneath and adjacent to the road bed (Shaffer et al. 1993). Any CTS in underground burrows in the path of the road or in the impact area are likely to be crushed during road construction (Shaffer et al. 1993). Once the road is open to traffic, salamanders are at risk of being run over on their first dispersal migration from the pond, and on future migrations to and from the ponds for breeding. Large roads and highways represent permanent physical obstacles and can block CTS from moving to new breeding habitat or prevent them from returning to their breeding ponds or aestivation sites.

Findlay and Houlahan (1996) found that roads within 2 km (1.2 mi) of wetlands adversely affected the number of amphibian species in the wetlands. Roads alter many of the physical characteristics of the environment that may be important to CTS, including soil density, soil water content, dust, surface-water flow, patterns of runoff, and sedimentation (Trombulak and Frissell 2000). The deleterious effects of roads on many ecological factors extend an average of 0.6 km (0.4 mi) from the road itself and are especially harmful to species such as salamanders that are often genetically programmed to migrate in a certain direction for breeding (Forman and Deblinger 2000).

Amphibians are especially vulnerable to being killed on roads due to life histories involving migration between breeding and upland habitats and their slow movements (Trombulak and Frissell 2000). Many of the specimens in Museum of Vertebrate Zoology at the University of California, Berkeley were collected as roadkills (Shaffer et al. 1993). Large numbers of CTS, up to 9 to 12 per km (15 to 20 per mi) of road (J. Medeiros, Sierra College, pers. comm. 1993, as cited in USFWS 2000), are killed as they cross the roads on breeding migrations (Hansen and Tremper 1993). Of CTS found on roads, 25 to 72 percent are dead (Twitty 1941; S. Sweet in *litt*. 1993; Launer and Fee 1996). Twenty-six CTS roadkills were discovered on Stony Point Road in fall 2001 in Sonoma County alone (Cook 2002). Curbs and berms as low as 9 to 12 cm (3.5 to 5 in), which allow salamanders to climb onto the road but can restrict or prevent their movements off the roads, are of particular concern, as they effectively turn the roads into death traps (Launer and Fee 1996; Sweet in *litt*. 1998a).

Because of these effects, putting in a road near a breeding pond can significantly reduce the breeding population of a pond and, in some cases, cause the loss of a large portion of a metapopulation. Habitat fragmentation and roads are one of the best examples of the synergistic threats that affect CTS. While healthy metapopulations of CTS might be able to sustain annual losses of adults due to roadkill, populations suffering from severe habitat fragmentation could be devastated by this mortality.

Railroads also contribute to habitat fragmentation and reduce migration and genetic interchange between ponds. In addition to the barriers created by fill deposited in small canyons and watercourses, the railroad tracks themselves can act as barriers to migrating salamanders. Because of their poor burrowing ability, the animals will have difficulty getting under the tracks unless adequate holes are present.

II. Hybridization With Introduced Tiger Salamanders

Various nonnative subspecies of the tiger salamander have been imported into much of California for use as fish bait. While this practice is now illegal, non-native salamanders and hybrids have become established in a large portion of the range of the CTS, these hybrids appear to be expanding their range, and there is also evidence that new introductions continue to occur. Shaffer et al. (1993) documented introduced tiger salamanders in several areas of the state, including localities in Merced, Monterey, San Benito and Sonoma counties. Introduced tiger salamanders harm native CTS through through hybridization.

Evidence suggests that introduced tiger salamanders can apparently successfully interbreed with the CTS, creating fertile hybrids that may become established (Shaffer et al. 1993). There are two problems caused by such introductions. First, these animals may successfully compete with, and ultimately replace the native species, contributing to local extirpation (Shaffer et al. 1993). Second, the introduced salamanders may thrive at first, but when faced with the unique conditions of the California grassland community, such as an exceptionally hot summer or drought year, they may perish (Shaffer et al. 1993). Thus, the situation could develop where hybridization occurs, hybrids thrive, but then the entire mixed population crashes in ecologically stressful times (Shaffer et al. 1993). The loss of any CTS populations to hybridization with or competition from introduced tiger salamanders is of serious concern.

Non-native *A. tigrinum* have spread into a large portion of the Central Coast Range and Bay Area populations, and several sites are now known in the Central Valley population (Shaffer and Trenham 2002). Recent genetic sampling from 1999 to 2002 has confirmed that the geographical extent of the introduced salamanders now includes most of Monterey and San Benito Counties and the southern half of Santa Clara County (Shaffer and Trenham 2002). The southern two thirds of the range of the Bay Area population appears to be dominated by hybrid populations; introduced *A. tigrinum* genes are common even in relatively remote sites such as the Gloria Valley on the San Benito/Monterey county line (Shaffer and Trenham 2002). All of the CTS at Fort Hunter Liggett are hybrids (B. Shaffer, UC Davis, pers. comm.).

Non-native tiger salamanders were also found at two sites in Santa Barbara County, at the mouth of Cebada Canyon, and in a pond on the Lompoc Federal Penitentiary grounds (S. Sweet, UCSB, pers. comm.). The penitentiary site supports a confirmed breeding population.

Recently, hybrid salamanders were confirmed from survey sites in eastern Merced County near the site of the proposed new UC Merced campus (B. Shaffer, UC Davis, pers. comm.; Laabs et al. 2001). Because of the isolation of the eastern Merced County population from the previously known hybrid site in western Merced County, it is very likely that these hybrids were introduced separately to the area by humans, but it is not known when the introduction occurred. The discovery of the hybridization threat in eastern Merced County is of enormous concern because this area contains some of the best remaining CTS habitat in the state, and was previously thought to be free from non-native and hybrid salamander populations.

Researchers have not yet determined to what extent the spread of non-native salamanders is due to new introductions by humans and to what extent it is do to the movement of introduced species and their offspring across the landscape on their own (B. Shaffer, UC Davis, pers. comm.).

Evidence suggests that the hybrids appear to do worse in more natural ponds, though more research is also needed on this topic (B. Shaffer, UC Davis, pers. comm.).

The Bay Area and Central Coast CTS populations are seriously threatened by hybridization, and these hybrids are difficult for surveyors to distinguish from pure *A. californiense*. The result is that the native CTS population in these regions may be overestimated. Shaffer and Trenham (2002) have noted "most of the populations that we have surveyed in San Benito County are mixed hybrids, yet the CNDDB registers these as CTS populations. Although the misidentification is understandable, it emphasizes that many apparently healthy CTS populations in this region may in reality be non-native exotics."

III. Other Introduced Species

Introduced species are one of the greatest threats to the survival and recovery of the CTS. Where habitat has not been destroyed outright, it has often been modified to the point where exotic species thrive and preclude occupation by CTS. This problem tends to be particularly severe in the flat valley habitat of the central valley, though it is a threat to all six populations of CTS throughout the state (Shaffer et al. 1993). Shaffer et al. (1993) have confirmed that the introduction of any fish, including mosquitofish, catfish, bass, sunfish, and perch to CTS breeding ponds will eliminate the salamanders from these areas. Other problem species include bullfrogs, non-native tiger salamanders, and crayfish. Data from the EBRPD show exotic predators have reduced the number of ponds suitable for breeding (Bobzien 2003). Each is discussed in turn below.

A. Mosquitofish

Mosquitofish are often introduced into ponds by vector control agencies to eliminate mosquitoes. Mosquitofish are used by every vector control district in the State and in some districts represent the majority of their control efforts (USFWS 2000b; USFWS 2003b). These fish were first introduced to California in 1922 and have since become well established throughout the State's water systems (USFWS 2000b). Mosquitofish quickly reproduce to the maximum population levels that a particular habitat may sustain. Mosquitofish are extremely tolerant of polluted water with low levels of dissolved oxygen and have an extremely wide range of temperature tolerance (USFWS 2000b). These fish eliminate CTS either by out-competing the salamander larvae for food, or by eating the small salamander larvae outright.

Both CTS and mosquitofish feed on micro and macro-invertebrates, and large numbers of mosquitofish may effectively eliminate the prey base for CTS larvae (USFWS 2000b).

There is also evidence that mosquitofish prey directly on CTS larvae. In a recent study, Leyse and Lawler (2001) found that stocking ponds with mosquitofish at high initial densities of 300 fish/pond, the fish presence significantly reduced the survival of *A. californiense* larvae to metamorphosis and also significantly reduced growth of those larvae that did reach metamorphosis.

Mosquitofish are known to prey on the California newt (*Taricha torosa*) and Pacific treefrog larvae in both field and laboratory experiments, even given the optional prey of mosquito larvae (USFWS 2000b). Both newt and Pacific treefrog larvae were found in stomachs of wild-caught mosquitofish (USFWS 2000b). Dr. Robert Stebbins observed mosquitofish ingesting and then spitting out California newt larvae, causing severe damage to the newts in the process (USFWS 2000b). Schmieder and Nauman (1994) found that mosquitofish significantly affected the survival of both prefeeding and large larvae of California red-legged frogs. Lawler et al. (1999) did not find a reduction in survival rates of California red-legged frog tadpoles raised in the presence of mosquitofish versus controls with no mosquitofish, but those tadpoles that did survive weighed less than control tadpoles and metamorphosed later, and most were injured by the fish. Smaller size at metamorphosis may reduce survival to breeding age and reproductive potential (Lawler et al. 1999).

California tiger salamanders may be especially vulnerable to mosquitofish predation due to their fluttering external gills, which may attract these visual predators (USFWS 2003b). A survey by Loredo-Prendeville et al. (1994) found no CTS in ponds with mosquitofish. Due to the documented effects of mosquitofish on other amphibian species, the USFWS believes that they are likely to have similar effects on CTS and that the use of mosquitofish in salamander habitat threatens the persistence of salamander populations (USFWS 2000b).

As urban areas continue to expand, the introduction of mosquitofish into previously untreated ponds may result in the elimination of CTS from additional breeding sites (USFWS 2000b).

B. Other Introduced Fish Species

The introduction of other fish either inadvertently or for recreational fishing or other purposes also poses a major threat to CTS. Fish such as bass (*Micropterus salmoides*, *M. dolomieu*), green sunfish (*L. cyanellus*), carp (*Cyprinus carpio*), fathead minnow (*Pimephales promelas*), and bullhead (*Ictalurus* spp.) may also compete with CTS for food and prey on CTS larvae (Shaffer et al. 1993). Many ranchers and other individuals regularly stock ponds on private lands to enhance local fishing opportunities.

C. Bullfrogs

Introduced bullfrogs also eliminate CTS populations. Shaffer et al. (1993) consider bullfrogs to be a biological indicator of ponds that have been disturbed to a degree that CTS are excluded. The finding of Laabs et al. (2001) that CTS larvae were not present in a single stock pond that was occupied by bullfrogs reinforces this conclusion. Bullfrogs prey on CTS larvae, juveniles, and adults (Morey and Guinn 1992; USFWS 2000b). Morey and Guinn (1992) documented a shift in amphibian community composition at a vernal pool complex, with CTS becoming proportionally less abundant as bullfrogs increased. Although bullfrogs are unable to establish permanent breeding populations in unaltered vernal pools and seasonal ponds, dispersing immature frogs take up residence in vernal pools during winter and spring (Morey and Guinn 1992) and prey on native amphibians, including larval CTS. Lawler et al. (1999) found that less than 5 percent of California red-legged frog tadpoles survived to metamorphosis when raised with bullfrog tadpoles.[15] Due to the documented effects of bullfrogs on other amphibian species, they are likely to have similar effects on CTS and that the presence of bullfrogs in salamander habitat threatens the persistence of salamander populations (USFWS 2000b). This conclusion is also supported by the findings of Laabs et al. (2001) discussed *supra*.

C. Crayfish

Introduced Louisiana red-swamp crayfish (*Procambarus clarki*) also apparently prey on CTS (Shaffer et al. 1993) and may have eliminated some populations (Jennings and Hayes 1994). The crayfish prey on California newt eggs and larvae, in spite of toxins that the species has developed, and

[15] Initially, ponds held 720 red-legged frog tadpoles and 50 bullfrog tadpoles; approximately 50 percent of the bullfrogs successfully metamorphosed.

may be a significant factor in the loss of newts from several streams in southern California (Gamradt and Kats 1996). This species also poses a threat to CTS survival and recovery.

D. Domestic Pets

Domestic dogs, cats, and other exotic species that inevitably accompany residential development can harm CTS by killing them, harassing them, and destroying or modifying their habitat (Cook and Northen 2001). For example, dogs may dig up rodent burrows being used by estivating CTS, and cats hunt gophers. Domestic animals should be considered a major threat to the species wherever CTS populations are adjacent or near to residential development.

IV. Contaminants

A wide variety of toxic substances are released into CTS habitat as a result of man's activities. Run-off from roads, the application of numerous chemicals for agricultural production, urban/suburban landscape maintenance, and rodent and vector control programs may all have negative effects on CTS populations, as detailed below.

A. Road Run-off

Oil and other hydrocarbon contaminants in road run-off have been detected in adjacent ponds and linked to die-offs of and deformities in CTS and western spadefoots, and die-offs of invertebrates that form most of both species' prey base (USFWS 2000b). Lefcort et al. (1997) found that oil had limited direct effects on 5-week-old marbled (*A. opacum*) and eastern tiger salamanders (*A. t. tigrinum*), but that salamanders from oil-contaminated natural ponds metamorphosed earlier at smaller sizes, and those from oil-contaminated artificial ponds had slower growth rates than larvae raised in non-contaminated ponds. Their studies did not address effects on eggs and early larval stages, which may be more pronounced. Hatch and Burton (1998) and Monson et al. (1999) investigated the effects of one component of petroleum products and urban runoff (fluoranthene, a polycyclic aromatic hydrocarbon) on spotted salamanders (*A. maculatum*), northern leopard frogs (*Rana pipiens*), and African clawed frogs (*Xenopus laevis*). In laboratory and outdoor experiments, using levels of the contaminant comparable to those found in service station and other urban runoff, the researchers found reduced survival and growth abnormalities in all species and that the effects were worse when the larvae were exposed to the contaminant under natural levels of sunlight, rather than in the laboratory under artificial light.

Sedimentation from road construction, maintenance, and run-off is another form of contamination that may affect CTS breeding ponds. Roads alter the hydrology of slopes, in part by diverting water into surface-water systems that can cause erosion, create gullies, and deposit increased loads of sediments into wetland systems (Trombulak and Frissell 2000). Road traffic can spread dust, which can settle into ponds, affecting aquatic and emergent vegetation and causing asphyxiation of eggs. Increased sedimentation could also degrade habitat by filling pools otherwise usable by the species. The ability of the CTS to detect aquatic food items could be impaired from increased sedimentation, as can susceptibility to diseases (USFWS 2000b).

Increasing urbanization goes hand-in-hand with increased road construction. The proliferation of urban development continues to exacerbate the problem of contamination from road run-off.

B. Agricultural Contaminants

Enormous amounts of chemicals are introduced into the environment every year by the California agriculture industry. The effects of pesticides, herbicides, fungicides, and nitrogen fertilizers on the landscape have been addressed only recently (USFWS 2000b). The Central Valley is home to both the CTS and the most intensive agriculture in the state. In 1986-87 and from 1993 to 1997, USGS and the California Department of Pesticide Regulation ("CDPR") personnel sampled well and ground water at 156 locations throughout the range of the CTS (CDPR 1998; Burow et al. 1998a, b). From these samples, 29 different chemicals potentially toxic to amphibians in general and CTS specifically were detected. In general, the concentrations of these chemicals and their immediate effects on various species have been difficult to assess mainly due to lack of water sample data and lack of samples close to the sources of application where the effects on wildlife are most severe. Data on various contaminants are presented below.

In the 17 counties that comprise the majority of the current range of the CTS, 86,425,399 lbs of pesticides were used in 2001 for production agriculture, postharvest fumigation, structural pest control, landscape maintenance, and other purposes (CDPR 2002). These chemicals included petroleum oil, chloropyrifos, copper sulfate, diazinon, malathion, mancozeb, metam-sodium, methyl bromide, methoxychlor, oryzalin, and phosmet; some of these are extremely toxic to aquatic organisms, including amphibians and the organisms on which they prey. Given that amphibians are extremely sensitive to pollutants due to their highly permeable skin (USFWS 2003b), these and many more agricultural chemicals may have lethal or sublethal effects on CTS; those discussed here provide only a sample of the actual and potential threats. Table 12 describes the types and amounts of chemicals applied in the counties that comprise most of the range of the CTS.

Table 12. Type and Amount of Pesticides Used in the Range of the California Tiger Salamander (California Department of Pesticide Regulation 2002).

County	Chemical	Pounds Applied	Chemical	Pounds Applied
Alameda	Aluminum Phosphide	2,624.3258	Metam-Sodium	1,083.3608
	Bacillus Thuringiensis I	31.0080	Methoprene	89.4598
	Chlorophacinone	2.1431	Methoxychlor	0.2314
	Chlorpyrifos	1,161.2035	Methyl Bromide	8,002.8734
	Copper Sulfate	1,924.6652	Oryzalin	2,465.0557
	Diazinon	5,302.6015	Petroleum Oil	1,816.2625
	Diphacinone	0.1880	Pyrethrins	73.3315
	Malathion	188.3340	Strychnine	2.8999
	Mancozeb	1,376.4345	Zinc Phosphide	5.9038
Colusa	Aluminum Phosphide	4,784.6199	Metam-Sodium	2,329.1065
	Bacillus Thuringiensis	n/a	Methoprene	1.2740
	Chlorophacinone	0.0014	Methyl Bromide	2,594.3860
	Chlorpyrifos	6,129.8840	Oryzalin	351.6276
	Copper Sulfate	38,725.3230	Petroleum Oil	76,768.2590
	Diazinon	1,411.0973	Phosmet	334.8100
	Diphacinone	0.0829	Pyrethrins	13.6276
	Malathion	10,205.2653	Strychnine	11.9449
	Mancozeb	6,967.1076	Zinc Phosphide	7.1200

Contra Costa	Aluminum Phosphide	684.8994	Metam-Sodium	3.9946
	Bacillus Thuringiensis I	25.5959	Methoprene	21.7719
	Chlorophacinone	1.2333	Methyl Bromide	3,785.6600
	Chlorpyrifos	12,246.1952	Oryzalin	2,936.3840
	Copper Sulfate	1,056.1401	Petroleum Oil	10,532.6950
	Diazinon	15,592.7866	Phosmet	5,431.1460
	Diphacinone	0.7287	Pyrethrins	54.9588
	Malathion	196.0264	Strychnine	6.6349
	Mancozeb	2,307.4055	Zinc Phosphide	10.1332
Fresno	Aluminum Phosphide	15,080.9830	Metam-Sodium	1,981,875.2816
	Bacillus Thuringiensis I	1,690.3241	Methoprene	15.6594
	Chlorophacinone	0.1511	Methyl Bromide	417,510.3194
	Chlorpyrifos	321,888.9509	Oryzalin	11,850.1164
	Copper Sulfate	115,084.1100	Petroleum Oil	2,329,338.9000
	Diazinon	70,289.4242	Phosmet	95,969.6584
	Diphacinone	0.7339	Pyrethrins	162.6464
	Malathion	43,158.9558	Strychnine	40.7266
	Mancozeb	37,528.9088	Zinc Phosphide	35.7129
Madera	Aluminum Phosphide	4,126.3020	Metam-Sodium	3,866.4429
	Bacillus Thuringiensis I	176.4242	Methoprene	34.8343
	Chlorophacinone	0.3018	Methoxychlor	37.5000
	Chlorpyrifos	40,472.0829	Methyl Bromide	19,645.1344
	Copper Sulfate	113,566.37	Oryzalin	2,654.9017
	Diazinon	23,110.9872	Petroleum Oil	892,336.3300
	Diphacinone	0.4290	Phosmet	16,407.1311
	Malathion	5,020.4948	Pyrethrins	191.1342
	Mancozeb	14,925.6298	Strychnine	62.1703
			Zinc Phosphide	64.6660
Merced	Aluminum Phosphide	2,971.6662	Metam-Sodium	422,398.3113
	Bacillus Thuringiensis I		Methoprene	157.8358
	Chlorophacinone	1.1929	Methyl Bromide	131,116.9563
	Chlorpyrifos	61,795.4767	Oryzalin	2,594.6929
	Copper Sulfate	105,569.4900	Petroleum Oil	569,390.7400
	Diazinon	23,995.9920	Phosmet	9,044.3520
	Diphacinone	0.8929	Pyrethrins	590.9544
	Malathion	17,868.8865	Strychnine	89.1223
	Mancozeb	8,991.6591	Zinc Phosphide	265.5314
Monterey	Aluminum Phosphide	2,165.5667	Metam-Sodium	120,904.0166
	Bacillus Thuringiensis I	1,067.8972	Methoprene	260.3458
	Chlorophacinone	1.4321	Methyl Bromide	1,503,912.3558
	Chlorpyrifos	54,923.8630	Oryzalin	2,906.2096
	Copper Sulfate	7,805.5607	Petroleum Oil	16,275.0936

	Diazinon	135,138.1360	Phosmet	1,400.3640
	Diphacinone	0.1130	Pyrethrins	119.6247
	Malathion	78,985.5191	Strychnine	102.6127
	Mancozeb	19,533.5630	Zinc Phosphide	66.6738
Sacramento	Aluminum Phosphide	1,957.8636	Metam-Sodium	34,853.1512
	Bacillus Thuringiensis I	77.9603	Methoprene	278.8712
	Chlorophacinone	0.1346	Methyl Bromide	9,339.2350
	Chlorpyrifos	29,307.3649	Oryzalin	6,544.5375
	Copper Sulfate	49,294.402	Petroleum Oil	223,652.1400
	Diazinon	14,780.1577	Phosmet	8,031.6110
	Diphacinone	0.3048	Pyrethrins	71.4711
	Malathion	2,852.0994	Strychnine	0.8122
	Mancozeb	11,154.9237	Zinc Phosphide	60.1408
San Benito	Aluminum Phosphide	439.5781	Metam-Sodium	5,887.3664
	Bacillus Thuringiensis I	0.0580	Methoprene	0.0022
	Chlorophacinone	0.9814	Methyl Bromide	33,258.4600
	Chlorpyrifos	4,124.4439	Oryzalin	1,399.1613
	Copper Sulfate	4,164.3716	Petroleum Oil	7,025.7242
	Diazinon	19,721.8091	Phosmet	651.7000
	Diphacinone	0.0160	Pyrethrins	10.2670
	Malathion	403.5151	Strychnine	2.1574
	Mancozeb	1,875.2705	Zinc Phosphide	6.9000
San Joaquin	Aluminum Phosphide	2,362.2914	Metam-Sodium	10,122.7993
	Bacillus Thuringiensis I	562.7223	Methoprene	95.2427
	Chlorophacinone	0.1439	Methyl Bromide	176,519.4093
	Chlorpyrifos	52,076.1370	Oryzalin	6,757.1516
	Copper Sulfate	100,613.6600	Petroleum Oil	534,153.4400
	Diazinon	17,664.0315	Phosmet	10,195.7060
	Diphacinone	0.3140	Pyrethrins	260.5963
	Malathion	11,265.6954	Strychnine	35.1823
	Mancozeb	23,385.1615	Zinc Phosphide	12.6028
San Luis Obispo	Aluminum Phosphide	440.4561	Metam-Sodium	274,996.3865
	Bacillus Thuringiensis I	4.0849	Methoprene	0.0086
	Chlorophacinone	0.5446	Methyl Bromide	77,262.2230
	Chlorpyrifos	13,002.1472	Oryzalin	3,833.8102
	Copper Sulfate	5,824.0145	Petroleum Oil	62,387.3620
	Diazinon	10,329.1198	Phosmet	1,246.6300
	Diphacinone	0.8330	Pyrethrins	37.4172
	Malathion	19,818.5193	Strychnine	86.8519
	Mancozeb	5,563.1753	Zinc Phosphide	19.0063
Santa Barbara	Aluminum Phosphide	311.2289	Metam-Sodium	570,007.8455
	Bacillus Thuringiensis I	9.3376	Methoprene	19.1871

	Chlorophacinone	0.1806	Methyl Bromide	430,571.1694
	Chlorpyrifos	28,583.0420	Oryzalin	1,598.6012
	Copper Sulfate	4,196.5090	Petroleum Oil	157,564.7900
	Diazinon	3,438.7671	Phosmet	1,040.7938
	Diphacinone	0.9994	Pyrethrins	65.1676
	Malathion	30,561.1262	Strychnine	61.5117
	Mancozeb	9,407.9657	Zinc Phosphide	13.5338
Santa Clara	Aluminum Phosphide	1,499.1398	Metam-Sodium	13,388.4056
	Bacillus Thuringiensis I	96.5555	Methoprene	79.7050
	Chlorophacinone	.2724	Methyl Bromide	40,104.9202
	Chlorpyrifos	4,981.3183	Oryzalin	5,162.2419
	Copper Sulfate	424.3015	Petroleum Oil	37,874.2485
	Diazinon	29,191.5328	Phosmet	63.9800
	Diphacinone	.1774	Pyrethrins	61.5555
	Malathion	1,324.0293	Strychnine	14.1609
	Mancozeb	1,834.6767	Zinc Phosphide	8.5264
Sonoma	Aluminum Phosphide	24.5603	Metam-Sodium	7,284.1627
	Bacillus Thuringiensis I	891.7145	Methoprene	37.3837
	Chlorophacinone	0.0299	Methoxychlor	0.1104
	Chlorpyrifos	3,346.9246	Methyl Bromide	32,386.2400
	Copper Sulfate	2,119.9628	Oryzalin	3,632.0700
	Diazinon	4,650.6452	Petroleum Oil	51,474.3180
	Diphacinone	0.0689	Phosmet	11,682.1661
	Malathion	154.5378	Pyrethrins	39.0810
	Mancozeb	22,955.6278	Strychnine	128.6815
			Zinc Phosphide	6.3592
Stanislaus	Aluminum Phosphide	6,014.6019	Metam-Sodium	191,629.6357
	Bacillus Thuringiensis I	433.3752	Methoprene	13.4703
	Chlorophacinone	4.0721	Methyl Bromide	77,934.8838
	Chlorpyrifos	84,146.3019	Oryzalin	1,933.4528
	Copper Sulfate	41,255.97	Petroleum Oil	377,394.51
	Diazinon	61,714.1984	Phosmet	20,861.3910
	Diphacinone	1.2160	Pyrethrins	81.1222
	Malathion	7,368.4370	Strychnine	30.8595
	Mancozeb	8,381.2268	Zinc Phosphide	12.8574
Tulare	Aluminum Phosphide	2,786.4064	Metam-Sodium	117,861.9303
	Bacillus Thuringiensis I	198.8293	Methoprene	0.6954
	Chlorophacinone	0.2265	Methyl Bromide	123,817.5579
	Chlorpyrifos	202,428.6137	Oryzalin	6,219.4719
	Copper Sulfate	267,978.4700	Petroleum Oil	2,978,688.3000
	Diazinon	43,560.2082	Phosmet	81,260.5161
	Diphacinone	1.1976	Pyrethrins	46.7505
	Malathion	25,292.3724	Strychnine	57.4777

	Mancozeb	16,267.6174	Zinc Phosphide	1.6000

Over the range of the CTS, 8,326,673.11 lbs of petroleum oil were applied as a pesticide over 1,100,792.55 acres in 2001 (CDPR 2002). The potential effect of oil on salamanders is discussed above in the section on road run-off.

Malathion, chylorpyrifos, and diazinon are organophosphorus pesticides that bind with cholinesterase in animals and disrupt neural functioning (Sparling et al. 2001). Chlorpyrifos is a highly toxic organophosphate insecticide applied as granules, wettable powder, dustable powder, or emulsifiable concentrate (EXTOXNET 2003). The compound is absorbed through the skin of mammals (EXTOXNET 2003); amphibians, with their more permeable skins, absorb the chemical even more readily. General agricultural use of chlorpyrifos is considered to pose a serious threat to wildlife (EXTOXNET 2003). Sublethal concentrations of chlorpyrifos were found to decrease temperature tolerance in western toads at 30 and 60 ppb, estimated by heating water at 1c/3min and using onset of spasms in frogs as the endpoint (Johnson and Prine 1976). About 114,121.71 lbs of chlorpyrifos, 244,458.5485 lbs of malathion, and 479,891.49 lbs of diazinon was used in the range of the CTS in 2001 (CDPR 2002).

Copper sulfate is a fungicide used to control bacterial and fungal diseases, it is used as a protective fungicide, and it is also used as an algacide and herbicide (EXTOXNET 2003). It is available as a dust, wettable powder, or liquid concentrate. More than 859,603.32 pounds of copper sulfate were used throughout the range of the CTS in 2001 (CDPR 2002). Copper sulfate is highly toxic to fish (Pimentel 1971). Even at recommended rates of application, this material may be poisonous to trout (*Salmo* spp. and *Oncohynchus* spp.) and other fish, especially in soft or acid waters. Its toxicity to fish generally decreases as water hardness increases. Fish eggs are more resistant than young fish fry to the toxic effects of copper sulfate (Gangstad 1986). Copper sulfate is toxic to aquatic invertebrates, such as crab, shrimp, and oysters. The 96-hour LC50 of copper sulfate to pond snails is 0.39 mg/L at 20 C. Higher concentrations of the material caused some behavioral changes, such as secretion of mucous, and discharge of eggs and embryos (USNLM 1995b; EXTOXNET 2003). Although no test data are available for amphibians, the effects are likely to be similar.

Mancozeb is used to protect many fruit, vegetable, nut and field crops against a wide spectrum of fungal diseases, including potato blight, leaf spot, and scab (EXTOXNET 2003). Mancozeb is available as dusts, liquids, water-dispersible granules, wettable powders, and as ready-to-use formulations. More than 192,456.35 lbs of Mancozeb were applied to over 150,667.67 acres in the range of the CTS in 2001 (CDPR 2002). Mancozeb is moderately to highly toxic to fish and aquatic organisms (USNLM 1995a; EXTOXNET 2003). Although no test data are available for amphibians, the effects are likely to be similar.

More than 3,758,492.20 lbs of Metam-sodium, a broad-spectrum carbamate used for soil sterilization, was applied to land in the range of the CTS in 2001 (CDPR 2002). Metam-sodium is extremely toxic to fish. Although no test data are available for amphibians, the effects are likely to be similar.

Although test data for amphibian species could not be found, methyl bromide is extremely toxic and is used to kill weeds, insects, nematodes, and rodents, (Salmon and Schmidt 1984), although according to the California Department of Food and Agriculture Integrated Pest Control Branch it was discontinued for ground squirrel control in the mid-1980s. Methyl bromide is moderately toxic to aquatic organisms. Acute toxicity in freshwater fish (bluegill sunfish) occurs at concentrations of 11 mg/L and in saltwater fish (tidewater silversides) at about 12 mg/L (USNLM 1995a). Methyl bromide is used primarily on grapes in Sonoma County. More than 3,087,760.86 lbs of methyl bromide were used in the range of the CTS in 2001 (CDPR 2002).

Methoxychlor is an organochlorine insecticide that is very highly toxic to fish and aquatic invertebrates (EXTOXNET 2003). Reported 96-hour LC50 values (for the technical grade material, ca. 90% pure) are less than 20 ug/L for cutthroat trout, atlantic salmon (*Salmo salar*), brook trout (*Salvelinus fontanalis*), lake trout (*Salvelinus nomecush*), northern pike (*Esox lucius*), and largemouth bass (Johnson and Finley 1980). Reported LC50 values are between 20 and 65 ug/L in rainbow trout, goldfish, fathead minnow, channel catfish, bluegill, and yellow perch (Johnson and Finley 1980). Aquatic invertebrates with 96- or 48-hour LC50 values of less than 0.1 mg/L include Daphnia, scuds, sideswimmers, and stoneflies (Johnson and Finley 1980). Methoxychlor likely accumulates in aquatic organisms that do not rapidly metabolize the compound. Methoxychlor was found to decrease mean days to hatching, larval startle response, and mean larval body weight of long-toed salamanders (*Ambystoma macrodactylum*) (Ingermann et al. 1997). A total of 37.8418 lbs of methoxychlor was applied in the range of the CTS in 2001 (CDPR 2002).

Oryzalin is a selective pre-emergence surface-applied herbicide used for control of annual grasses and broadleaf weeds (EXTOXNET 2003). It is available in aqueous suspension, dry flowable, and wettable powder formulations. More than 62,839.49 lbs of oryzalin were applied in the range of the CTS in 2001 (CDPR 2002). Oryzalin is highly toxic to fish, with reported 96-hour LC50 values of 2.88 mg/L in bluegill sunfish, 3.26 mg/L in rainbow trout, and greater than 1.4 mg/L in goldfish fingerlings (USNLM 1995b; EXTOXNET 2003). Although no test data are available for amphibians, the effects are likely to be similar.

Phosmet is a non-systemic, organophosphate insecticide used on both plants and animals. It is mainly used on apple trees for control of coddling moth, though it is also used on a wide range of fruit crops, ornamentals, and vines for the control of aphids, suckers, mites, and fruit flies (EXTOXNET 2003). More than 263,621 lbs of phosmet were applied to agricultural lands in the range of the CTS in 2001 (CDPR 2002). Phosmet's toxicity to aquatic organisms is species-specific, varying from highly to very highly toxic. The reported 96-hour LC50 values in aquatic invertebrates and crustaceans such as *Daphnia* spp., scuds, and sideswimmers indicate very high toxicity (Johnson and Finley 1980; EXTOXNET 2003).

There is a growing body of evidence that wind-blown pesticides play a role in the decline of amphibians (Sparling et al. 2001). Depressed levels of cholinesterase resulting from such chemicals as chlorpyrifos, malathion, and diazinon are associated with reduced activity, uncoordinated swimming, increased vulnerability to predators, depressed growth rates, and greater mortality in tadpoles (Sparling et al. 2001). While experimental data are not available for some of these pesticides, CTS (like all amphibians) are likely to be extremely sensitive to these chemicals due to their highly permeable skin.

C. Rodenticides

Widespread ground squirrel control programs were begun as early as 1910, and as of 1987 were carried out on more than 4 million ha (9.9 million ac) in California (Marsh 1987). Several of the chemicals currently and/or previously used can be toxic to CTS.

One such chemical compound is Compound 1080 (sodium fluoroacetate), which is extremely toxic to nontarget fish, birds, and mammals. Compound 1080 is no longer registered or used in California for controlling ground squirrels, but may have contributed to reductions in salamander populations in the areas where it was used previously used. Poisoned grains were the most common method used to control ground squirrels on rangelands. While there was little risk of ingestion by CTS, the use of these grains may have impacted the CTS indirectly if washed into burrows or ponds used by the species.

Currently, two of the most commonly used rodenticides, chlorophacinone and diphacinone, are anticoagulants that cause animals to bleed to death. They can be absorbed through the skin and are considered toxic to fish and wildlife (EXTOXNET 2003). A total of 13 lbs of chlorophacinone and 7.1831 lbs of diphacinone were used in the range of the CTS in 2001 (CDPR 2002). Zinc phosphide is an acute rodenticide and a restricted material, which turns into a toxic gas once ingested; a total of 597 lbs of this chemical were used in 2001 in the range of the CTS (CDPR 2002). Strychnine is an acute toxicant rodenticide used below ground; the California Department of Pesticide Regulation reported a total of 733 lbs of strychnine used in the range of the CTS in 2001. Gases, including aluminum phosphide, can be introduced into burrows either by using cartridges or by pumping. When such fumigants are used, all animals inhabiting the burrow are killed (Salmon and Schmidt 1984). Since CTS spend most of their lives estivating in ground squirrel burrows, this can be a significant source of mortality.

Although the effects of these poisons on CTS have not been assessed, use may result in contamination of salamander breeding ponds, with undetermined effects. In addition, most of the rodenticides can be absorbed through the skin; any CTS coming into contact with, for example, an uneaten poisoned bait pellet would be likely to absorb some of the toxic compounds they contain (Sweet 2003).

Other methods of rodent control and their impacts on the species are discussed below.

D. Chemicals used for Mosquito Abatement

Besides the introduction of mosquitofish, a variety of chemicals are used by mosquito abatement districts. The most toxic compounds, such as DDT, Chlordane, and Organophosphate and Carbamate insecticides were used extensively in the past and may have contributed to the historic decline of the CTS. These compounds are no longer used and increasing governmental regulation and the spreading resistance of many vector species to existing pesticides has changed the patterns of use of chemical control agents. However, various chemicals that are potentially harmful to the CTS are still in use, as detailed below.

One technique, used primarily for treehole mosquito control, is known as ultra-low volume (ULV) spray. A small quantity of pesticide is atomized into micron size particles and broadcast in a fog that drifts into sites where the adult mosquitoes hide. In recent years the use of vehicle-mounted units has decreased in favor of small, hand-carried dispersal units. This allows a more precise application of the pesticide. The pesticide used for ULV spraying is pyrethrum (sold as Pyrocide®); a naturally occurring substance harvested from two species of Old World chrysanthemums, or pyrethrum flowers. This material is the least toxic available for mosquito control, and it degrades into non-toxic by-products within 4 to 6 hours after spraying.

Larvicidal oils have been used for mosquito control for more than a century. The Marin/Sonoma district uses Golden Bear 1111®, a light viscosity oil that spreads quickly and evenly over the water surface, preventing larvae and pupae from obtaining oxygen through the surface film. The effects of oil applications on the salamander prey base have not been quantified.

A commonly used method to control mosquitoes, including in Sonoma County is the application of methoprene (sold under the name Altosid®), which increases the level of juvenile hormone in insect larvae and disrupts the molting process (USFWS 2002a). Lawrenz (1985) found that methoprene (Altosid SR- 10) retarded the development of selected crustacea that had the same molting hormones (i.e., juvenile hormone) as insects and anticipated that the same hormone may control metamorphosis in other arthropods (Lawrenz 1985). Because the success of many aquatic vertebrates relies on an abundance of invertebrates in temporary wetlands, any delay in insect growth could reduce the numbers and density of prey available (Lawrenz 1985). The use of methoprene thus could have an indirect adverse effect on the CTS by reducing the availability of prey (Lawrenz 1985). A total of 1105 lbs of methoprene were used in the range of the CTS in 2001 (CDPR 2002).

In more recent studies, although methoprene did not cause increased mortality of gray treefrog (*Hyla versicolor*) tadpoles (Sparling and Lowe 1998), it caused reduced survival rates and increased malformations in northern leopard frogs (*R. pipiens*) (Ankley et al. 1998) and increased malformations in southern leopard frogs (*R. utricularia*) (Sparling 1998; USFWS 2002a). Blumberg et al. (1998) also correlated exposure to methoprene with delayed metamorphosis and high mortality rates in northern leopard and mink (*R. septentrionalis*) frogs (Blumberg et al. 1998). Methoprene appears to have both direct and indirect effects on the growth and survival of larval amphibians. Other insecticides, for example temephos, have caused reductions in the growth rates of gray treefrog tadpoles, increased mortality rates in green frog (*R. clamitans*) tadpoles (Sparling and Lowe 1998), and increased mortality rates in southern leopard frogs (Sparling 1998). Few data are available on the effects of most insecticides on salamanders.

Another agent used for bacterium *Bacillus thuringensis israeli* (Bti) is used for mosquito control. When the bacteria Bti encysts, it produces a protein crystal toxic to mosquito and midge larvae. Once the bacteria have been ingested, the toxin disrupts the lining of the larvae's intestine. Bti strains are sold under the names Bactimos®, Teknar® and Vectobac®. It has no effect on a vast array of other aquatic organisms except midges in the same habitat, but its effects on the salamander prey base have not been quantified. A total of 4197.99 lbs of this agent were used in the range of the CTS in 2001 (CDPR 2002).

E. Urban and Suburban Landscaping Contamination

Fertilizers and pesticides used for urban and suburban landscaping can also harm CTS. These chemicals run off into streams and ponds and can affect whatever CTS habitat may remain in such areas. Golf courses are often suggested by development interests as ideal solutions to open-space mitigation for animals, since they are open space, often have ponds, and are free from automobile traffic. However, golf courses have enormous loads of fertilizers and pesticides, and burrowing rodent populations are normally completely removed.

V. Rodent Control

California tiger salamanders spend much of their lives in underground retreats, typically in the burrows of ground squirrels and gophers (Loredo et al. 1996; Trenham 1998). Because CTS have poor burrowing abilities, burrowing rodent populations are an essential component of CTS habitat. Active ground squirrel colonies probably are needed to sustain tiger salamanders because inactive burrow systems become progressively unsuitable over time. Loredo et al. (1996) found that burrow systems collapsed within 18 months following abandonment by or loss of the ground squirrels. Although the researchers found that CTS used both occupied and unoccupied burrows, they did not indicate that the salamanders used collapsed burrows.

Widespread ground squirrel control programs were begun as early as 1910 and are as of 1987 were carried out on more than 4 million ha (9.9 million ac) in California (Marsh 1987). In some primarily agricultural counties, the ground squirrel population has been reduced and maintained at perhaps 10 to 20 percent of the carrying capacity. Recommended eradication methods for California grounds squirrels are fumigation, toxic anticoagulant baits, shooting, trapping, and elimination of burrows by deep-ripping to at least 20 inches (UCIPM 2002). According to the California Department of Pesticide Regulation, 121,487 acres of rangeland and 30,801 acres of uncultivated agricultural lands were treated with chlorophacinone, 1,232 acres of rangeland and 3,365 acres of uncultivated agricultural lands were treated with diphacinone, and 4,502 acres of rangeland and 104 acres of uncultivated agricultural lands were treated with zinc phosphide in 2001. Petitioners report these figures based on the assumption that rangelands and uncultivated agricultural lands represent potential habitat for CTS. Individual landowners and managers on vineyard, and crop production lands also conduct rodent control programs (USFWS 2000b).

In addition to possible direct effects of rodent control chemicals, discussed *supra*, control programs probably have an adverse indirect effect on CTS populations. Control of ground squirrels could significantly reduce the number of burrows available for use by the species (USFWS 2000b). Because the burrow density required to support CTS in an area is not known, the loss of burrows as a result of control programs and its affect on salamanders cannot be quantified at this time. However, Shaffer et al. (1993) believe that rodent control programs may be responsible for the lack of CTS in some areas, such as Altamont Pass.

VI. Livestock Grazing

Livestock grazing by domestic cattle, sheep, and horses has occurred within the range of the CTS since Europeans first arrived in the 1770s in Monterey, California. Because lands used for grazing constitute some of the largest remaining areas of habitat for the CTS, the USFWS has advanced the proposition that livestock grazing in some cases may have positive, or at least neutral, effects on the CTS (USFWS 2003b). On the one hand, some livestock grazing does appear to be compatible with the persistence of CTS populations. Under some circumstances, and in the absence of native ungulates, which have been eliminated from large areas of the states by domestic livestock ranching, grazing does crop vegetation, improving habitat for ground squirrels and other native species, and may maintain a disturbance regime under which California's vernal pool systems and rangelands have evolved. CTS appear able to withstand mortality sustained due to trampling of individuals and burrows by livestock. Additionally, while elimination or alteration of natural vernal pool systems has reduced breeding sites for the salamander and other species, in many areas CTS now breed in developed stock ponds. The

EBRPD, whose lands constitute much of the "core" CTS population, has documented 69 CTS breeding ponds on their lands, all of which are stockponds grazed by livestock. The EBRPD noted that "the development of artificial ponds for livestock water has created highly suitable reproductive habitat which has supported the California tiger salamanders populations in the East Bay. On District lands California tiger salamanders breed exclusively in seasonal and perennial stock ponds. Due to the limited amount of vernal pool habitat in the Alameda and Contra Costa Counties, stock ponds are essential for reproduction and the long- term survival of the California tiger salamander populations," (Bobzien 2003). These stock ponds now provide the only remaining breeding habitat in some portions of the species' range.

Historical livestock grazing has advanced the invasion of non-native annual grasses throughout the habitat of the CTS. Proliferation of these grasses, such as medusa-head (*Taeniathrum caput-medusae*) and Italian ryegrass (*Lolium multiflorum*), can result in the accumulation of thatch, thereby depriving native flora of light and space (Robins and Vollmar 2001). Although there are no experimental data documenting the effect of thatch on CTS, some biologists have postulated that thick thatch may slow down migrating juveniles, rendering them more vulnerable to predation and dessication (Robins and Vollmar 2001). The CNDDB cites thatch as a possible threat to some breeding pools in Sonoma County. Grazing has been put forth as a possible tool to reduce thatch in both vernal pools and upland habitat. The EBRPD uses livestock grazing for vegetation management on their lands (Bobzien 2003). Uplands that have been seasonally grazed to retain 4 to 6 inches of standing vegetation or 700 to 1000 pounds of Residual Dry Matter (RDM) have provided suitable habitat for CTS on park district lands; there was a positive correlation between stock ponds within grazed grasslands, and the presence of breeding CTS with this grazing regime (EBRPD 2003; S. Bobzien, EBRPD 2003, pers. comm.).

Domestic livestock can cause significant trampling of vernal pool systems. Robins and Vollmar (2001) have suggested that such trampling may benefit vernal pools by increasing soil compaction, creating micro-topography, destroying standing biomass, and mixing pool sediments. Livestock grazing may increase water turbidity, thereby decreasing predation on CTS larvae and metamorphs (Robins and Vollmar 2001). A study of 275 freshwater ponds in the East Bay, including 61 distinct CTS breeding ponds all grazed by cattle, concluded that CTS are most reproductively successful in ponds with relatively low aquatic biodiversity (Bobzien 2003), possibly a result of reduced inter-specific competition for food (S. Bobzien, EBRPD, pers. comm.). In contrast, intensive livestock grazing alters natural hydrological patterns by extensively terracing hillsides, compacting the soil, and stripping the vegetative cover. Some researchers have proposed that soil compaction from cattle trampling can decrease infiltration and increase the period of inundation (see references in Robins and Vollmar 2001). A 3-year experimental grazing exclosure study at 36 vernal pools in the Central Valley found dramatic reductions in the average period pf pool inundation associated with changes in soil compaction and grass cover (Pyke and Marty in prep.). As a result, removal of cattle grazing could reduce the suitability of vernal pools for CTS breeding. Other researchers have noted that soil disturbance in naturally occurring vernal pools, in particular the puncturing or altering of caliche hardpan, could increase percolation rates and shorten the duration of pool life enough so that CTS could no longer metamorphose successfully in those pools (Jennings and Hayes 1994). Under a November to April grazing regime, CTS were either absent or diminished in numbers in areas of vernal pools heavily trampled by cattle (Melanson *in litt*. 1993).

The creation of micro-topography may negatively impact CTS. Deep hoof prints can attract and trap newly metamorphosed salamanders: it is possible that metamorphs are crushed when cattle re-trample those areas (Sweet 2003). In addition, domestic cattle tend to linger around water sources, often removing all vegetation and compacting the soil for tens of meters around the pond margin (Sweet 2003). This phenomenon creates a dead zone through which juvenile salamanders must travel during migration after pond draw-down, exposing them to increased predation and forcing them to travel longer distances to suitable refugia (Sweet 2003).

Some studies have documented CTS to be either absent or found in low numbers in portions of pools that were heavily trampled by cattle (USFWS 2000b, 2003b). Continued trampling of a pond's edge by cattle can increase the surface area of a pond, increase water temperature, and speed up the rate of evaporation, and thereby reduce the amount of time the pond contains enough water for metamorphosis (see discussion in USFWS 2000b, 2003b). However, there is observational evidence that even some heavily grazed ponds can sustain breeding CTS (S. Bobzien, EBRPD, pers. comm.).

Cattle excrement may reduce water quality, mainly by increasing potentially detrimental nitrogen levels, which could negatively impact salamanders. High nitrogen levels have been associated with blooms of deadly bacteria, and silt has been associated with fatal fungal infections (USFWS 2000b, 2003b). Worthylake and Hovingh (1989) reported on repeated die-offs of tiger salamanders in Desolation Lake in the Wasatch Mountains of Utah. Affected salamanders had red, swollen hind legs and vents, and widespread hemorrhage of the skin and internal organs. The researchers determined that the die-offs were due to infection with the bacterium *Acinetobacter*. The number of bacteria in the lake increased with increasing nitrogen levels as the lake dried. The nitrogen was believed to come from both atmospheric deposition and waste from sheep grazing in the watershed (Worthylake and Hovingh 1989).

The loss of natural vernal pools for a variety of reasons has led to CTS utilizing stockponds and other man-made water sources for breeding purposes. Researchers have noted that "in areas where most vernal pools have been eliminated...stock ponds can provide the only remaining suitable breeding habitat for California tiger salamanders," (Robins and Vollmer 2001). Past loss of natural vernal pools might be attributable in some part to the creation of stock ponds themselves, although this has not been quantified. Seasonal stock ponds often are created by berming up intermittent drainages or by diverting water from a perennial stream, which have undoubtedly created new breeding ponds for the CTS. However, some stock ponds are actually created by altering natural ponds, which comprised historical CTS breeding habitat. Biologists reporting CTS locations to the CNDDB describe habitat in which CTS were located, typically noted as a stock pond, man-made pond, or vernal pool, without further speculation as to how the pond was created. Yet, a closer look at some of the more detailed descriptions suggests that a number of the man-made ponds were actually natural ponds that had been altered. The following are examples of some of these altered ponds:

CNDDB 8: "Habitat consists of a large natural pond which has been modified by the excavation of a deep pit in the center and introduction of non-native fish..."

CNDDB 452: USFWS discovered CTS in a multiple-pool complex on property in Merced County; pools had been selectively disced and a V trench had been dug through several of the larger pools. This information was obtained from the original CNDDB data form, not the database.

Many man-made ponds support significant CTS breeding populations, however, the long-term value of these water sources can be questionable. Some routine management practices, including introduction of fish species to control aquatic vegetation and pests and chemical control of aquatic vegetation, particularly in deeper pools, can be harmful to CTS as described *supra*. Small, shallow livestock ponds are like natural vernal pools in that they are the only ponds likely to remain predator-free, but these small livestock ponds are more vulnerable to siltation or erosion during major precipitation events than natural vernal pools. Livestock excrement can reduce water quality, and trampling of pond edges by heavy livestock use also can increase the surface area of pond, increasing water temperature and evaporation rates and rendering the pond unsuitable for CTS breeding (USFWS 2003b). The CNDDB lists overgrazing as a threat to 75 documented CTS sites.

Robins and Vollmar (2001) note that undergrazing can lead to the build up of thatch around pool margins and surrounding uplands. CTS were most reproductively successful in ponds with little or no emergent or submerged vegetation in the Bay Area (EBRPD 2003), suggesting that grazing that reduces this vegetation can maintain suitability of stockponds for breeding (S. Bobzien, EBRPD, 2003). Thatch could also impede overland migration of juveniles and adults leading to increased predation and dessication (Robins and Vollmar 2001). While grazing can be beneficial to CTS by reducing thick thatch, and the creation of stock ponds has undoubtedly provided breeding habitat for the species in areas where natural vernal pools had been eliminated, it is important to recognize that some routine rangeland practices can have negative effects on the species. Discing and indiscriminate rodent control that often accompanies livestock grazing negatively impacts the CTS by reducing suitable habitat for aestivation and potentially directly poisoning the salamanders, as described *supra*. In addition, impacts of livestock grazing on CTS may vary by season. Robins and Vollmar (2001) have concluded that "some researchers believe that excessive use by cattle can negatively affect larval and juvenile amphibians through direct trampling both in the pools and in the uplands during overland migration. This might be especially true since the trampling and grazing pressure on the larger pools preferred by these species could increase in the late spring and early summer when larvae are transforming and juveniles begin migration." The authors then cautiously suggest that moderate grazing from late fall through mid spring might benefit CTS.

To the extent that the USFWS has hypothesized that livestock grazing is a beneficial or neutral impact to the CTS, such a general, sweeping statement is not necessarily borne out by the best available science or the literature. Available data on the effects of livestock grazing on CTS are equivocal. While some authors have cautiously suggested that there could be benefits under some conditions, some grazing regimes and routine rangeland practices can have negative impacts as well. The most accurate characterization of the interaction between livestock grazing and the CTS is that healthy CTS populations may be compatible with livestock grazing under certain seasonal and intensity regimes and without detrimental practices such as introduction of exotic predators, discing, and rodent control.

Alternative methods to reduce non-native grasses and create beneficial disturbances to vernal pool ecosystems can be used to improve CTS habitat, such as prescribed burning, mowing, hand-removal, and even re-introduction of native ungulates into some areas. We could not find any experimental studies comparing the effectiveness of these different methods and their subsequent effects on CTS. However, research on the effectiveness of these alternative tools for managing CTS and vernal pool systems would be extremely valuable.

VII. Water Draw Downs

Many ponds that are used or could be used by CTS are subject to drawdowns for various uses including irrigation, frost control, and flood control. Draining of these water bodies can have a two-fold effect on CTS inhabiting these ponds: (1) Salamander larvae and adults may be sucked into the pump mechanism during drawdowns for frost control, killing them in the process, and (2) ponds may be subject to premature drying in the spring and summer, resulting in the stranding of larvae before they are able to metamorphose (Barry and Shaffer 1994; USFWS 2000b). This two-fold problem was documented for the Lagunitas population by Barry and Shaffer (1994) but it undoubtedly affects other populations as well.

VIII. Vandalism

The CTS exists primarily in areas that are heavily populated and becoming more so every day. Vandalism and other human impacts must be considered a serious threat to the species. A few known incidences of vandalism are listed below. Most are never reported or discovered.

Incidences of Vandalism in Sonoma County

(1) South Sonoma Business Park Site

During studies conducted under CEQA, CTS larvae were discovered and translocated. The EIR claimed that the project area was unsuitable habitat and could not support the species. Development of the 35-acre site was approved contingent on the preservation of one of the on-site vernal pools supporting CTS until mitigation land was acquired and preserved. The preserved pool was vandalized and drained in the winter of 2001-2002 before the mitigation land was provided.

(2) Larsen Property Site

Between May 15 and May 30, 2002, a known CTS breeding pond on the Larsen property at the corner of Hwy 116 and Stony Point Road was drained and graded. Despite the commencement of an investigation by the Regional Water Quality Control Board, neither the Regional Board, Army Corps, Department of Fish and Game, U.S. Fish and Wildlife Service or Sonoma County took any enforcement action.

(3) Dutton Meadow Drive Site

In July 2002 a ditch was graded on a property at Dutton Meadow Drive for the apparent purpose of draining wetlands that could support the CTS. While the property is apparently the subject of or adjacent to the subject of a pending Clean Water Act Section 404 Permit and an ESA Section 7 consultation, neither these nor any other regulatory agencies took any enforcement action based on the illegal grading.

(4) Southwest Community Park Site

In late 2001 the City of Santa Rosa bulldozed berms surrounding the vernal pool at the Southwest Community Park, killing a high proportion of the CTS population at that site.

In 2001 an elementary school student killed an adult CTS (D. Cook, pers. com.).

Incidences of Vandalism in the Central California Population Segment

Brewer (2000) reported the illegal bulldozing of one CTS breeding pond in the Livermore area.

In Santa Clara County, the district attorney investigated allegations that Cinnabar Hills Golf Course developer Lee Brandenburg had bulldozed ponds near Calero Reservoir which biologists believed contained the rare species, but charges were never filed.

At Lake Lagunita on the Stanford Campus, students have been reported to violate the ban against bonfires enacted to protect the CTS (Stair 1999).

Table 12 below describes unpermitted conversions of wetlands and endangered species habitat in 5 counties in the San Joaquin Valley, as of September 23, 1999.

Table 13. Unpermitted Conversion of Wetlands/Endangered Species Habitat in Five Counties in the San Joaquin Valley, California (from USFWS 2002b)

County	Location
Fresno	Whites Bridge Lane Site - 200 acres - T14S R16E Section 15 (Jamesan Quad)*
Kern	Adams Site - 160 acres - T25S R24E NE 1/4 of Section 4 (Allensworth Quad)*
	Burgess Site - 5 acres - T28S R25 E SW 1/4 of Section 34 (Rio Bravo Quad)*
	Rio Bravo Site - 320 acres - T29S R25E N 1/2 of Section 19 (Rio Bravo Quad)*
	Valov Site - 640 acres - T25S R23E Section 36 (NW Wasco Quad)*
	Unnamed Kern Site #5 - 200 acres - T25S R24E E 1/3 of Section 2 (Delano West Quad)
Madera	Chowchilla Water District Site - 580 acres - T9S R16E S 1/2of Section 14, SW 1/4 of Section 13, NW 1/8 of Section 23 (LeGrand Quad)
	Costa View Dairy Site - 1,520 acres - T11S R15E Sections 12 and 13, T11S R16E Sections 7 and 18 (Firebaugh NE Quad)
	Richard Iest Site - 1,280 acres - T12S R15E Sections 17 and 18 (Firebaugh NE/Poso Farm Quads)
	Roland Smith Farms Site - 1,500 acres - T10S R19E Sections 30,31, and 32 (Daulton Quad)
	Unnamed Madera Site #4 - 160 acres - T12S R14E NE 1/4 of Section 24
Merced	Anguiano Site - 160 acres - T8S R13E SE 1/4 of Section 24 (El Nido Quad)
	Ingomar Packing Site - 20 acres - T9S R9E SE 1/4 of Section 15 (Ingomar Quad)
	Unnamed Merced Site #3 - 3,000 acres - T9S R16E Sections 2,3,4, N 1/2 of Sections 9,10,11, adn NW 1/4 of Section 12 (Le Grand Quad)
Tulare	Chroman Site - 70 acres - T24S R24E E 1/2 of SE 1/4 of Section 27 (Delano West Quad)
	Cochran Site - 5 acres - T23S R24E Section 25 (Pixley Quad)*

* These sites provided habitat for endangered species, but were not mapped by Holland (1998) as "vernal pool grasslands."

As a practical matter, the habitat of the CTS has very little protection. Breeding pools can be filled or graded, and upland habitat can be disked and plowed quite easily by landowners who are hostile to the endangered species on their property. The solution to the threat is a prompt listing of the CTS, coupled with a concerted public education campaign.

IX. Translocation

Translocation of CTS from areas slated for development either into areas already occupied by CTS or into newly created, unoccupied habitat does not ensure their survival. First, translocation into occupied habitat subjects the re-located individuals to competition from residents, often resulting in mortality of re-located animals (Northen 2002). Second, newly created, artificial habitat is likely to be less optimal for the species than the original habitat. For example, artificial vernal pools often are not placed in areas with appropriate amounts and quality of upland habitat (i.e., with ground squirrel activity). Also, creating artificial vernal pools within the range of the CTS as mitigation for destroying natural pools reduces the amount of available upland habitat, as pointed out by Northen (2002).

Scientific studies have identified general patterns suggesting that translocation of endangered species such as the CTS is not a viable conservation strategy. The majority of translocations that are used as a management tool to solve human-animal conflicts are unsuccessful -- particularly for threatened, endangered, or sensitive species, for translocations into fair or poor habitat conditions, and/or for when the initial cause of decline has not been eliminated (Griffith et al. 1989; Fischer and Lindenmayer 2000). In addition, due to the potential for transmitting diseases such as the lethal chytridiomycosis, scientists are advising against translocation of any amphibian species at this time (Padgett-Flohr 2003). While creation of habitat with translocations may be the only avenue left to save some populations that will become extinct if left alone (M. Jennings, pers. comm.), translocation should not be considered an initial conservation strategy for CTS to resolve salamander-human conflicts due to the reasons listed above.

X. Drought and Climate Change

Drought and global warming are ecological phenomena likely to impact CTS currently and in the future. The quality of vernal pool environments is correlated with timing and amount of precipitation, and with water temperature (Graham 1997). Successful metamorphosis of CTS occurs in larger pools with longer periods of inundation (Jennings and Hayes 1994). Pond duration is the most important factor to consider in relation to persistence and survival; for pools to support successful CTS breeding, the period of inundation must last at least 10 weeks (see "Reproduction and Growth," *supra*). Variation in annual rainfall causes is one of the most significant factors determining CTS annual reproductive success. Bobzien (2003) cites loss of reproductive ponds due to prolonged drought as a factor in the loss of local populations. Some stockponds on park district lands were unable to maintain CTS breeding during drought in the early 1990s, and many of the ponds did not support breeding CTS for several years, suggesting a possible lag effect of drought (S. Bobzien, EBRPD, pers. comm.). At least 3 of the ponds no longer support CTS breeding at all, because extended drought had cracked the hardpan and reduced the ponds' capability to support water (S. Bobzien, EBRPD, pers. comm.).

Climate studies indicate that California is likely to see average annual temperatures rise by 3–4 degrees Fahrenheit over the next century, with winters 5–6 degrees and summers 1–2 degrees warmer (Field et al. 1999). A small change in average temperature due to global climate change may alter vernal pool longevity enough to impact the ability of CTS larvae to metamorphose. Field et al. (1999) noted that "the seasonally filled vernal pools of the Central Valley...are especially sensitive to even slight increases in evaporation or reductions in rainfall because of their shallowness and seasonality." Because of their sensitivity to alterations in precipitation and temperature, vernal pools may be a good indicator system of how global climate change is affecting Mediterranean climates (Graham 1997).

As a result of climate change, winter precipitation in California is predicted to increase, particularly in the mountains, and more will fall as rain rather than snow; increased drought is also projected (Field et al. 1999). Greater winter precipitation is projected to lengthen periods of vernal pool inundation during the breeding season for CTS, a positive benefit (Pyke and Marty in prep.). However, El Niño conditions may occur more frequently, bringing more extreme weather events (Field et al. 1999). Thus, climate change is expected to result in greater frequency and intensity of severe storms and droughts, which in turn could impact CTS breeding habitat. Artificial stockponds require ongoing maintenance and are often temporary structures because natural soil erosion can cause them to silt in after just a few decades (USFWS 2003b). Stockponds dry out easily during drought, and flooding may destroy downstream impoundments or cause siltation (USFWS 2003b). Because stockponds are more vulnerable to siltation during major precipitation events, and because stockponds are now important breeding sites for CTS throughout its range due to loss of natural vernal pools (see "Livestock Grazing," *supra*), climate change may seriously compromise much of the remaining CTS breeding habitat without additional, extensive maintenance of stockponds.

In the long term, global climate change is causing alterations in timing of events such as breeding or blooming, and resulting in significant range shifts of many species (Root et al. 2003; Parmesan and Yohe 2003). Naturally isolated patches of vernal pools in the Central Valley are now so poorly connected with other patches due to urban development and intensive agriculture that migrations required by climate change (or natural recolonization after disturbance) may be difficult or impossible without human intervention (Field et al. 1999).

CURRENT MANAGEMENT

As the USFWS has recognized in each proposed, emergency, and final rule to list a CTS DPS, federal, state, and local laws have been insufficient to prevent past and ongoing losses of the limited habitat for the CTS, and are unlikely to prevent further declines of the species (*See*, *e.g*. USFWS 2003b). As discussed further below, current federal, state and local management has been and will continue to be inadequate to ensure the survival and recovery of the CTS.

I. Federal Management Provides Insufficient Protection

At present, the Sonoma and Santa Barbara DPSs are listed as endangered while the Central California DPS (defined by the USFWS as including the Bay Area, Central Valley, southern San Joaquin Valley, and central Coast Range populations) is proposed for threatened status (USFWS 2003b). In the same notice proposing to list the Central California DPS as threatened, the USFWS also proposed to downlist the Sonoma and Santa Barbara DPSs to threatened (USFWS 2003b). Under federal law, proposing to list a species as threatened and endangered confers little official protection to the species. Because the species throughout the majority of its geographic range has little protection, and because the listing of the Sonoma and Santa Barbara populations (particularly if they are downlisted to threatened) may prove inadequate to protect them, the Commission should promptly designate the CTS as an endangered species throughout its range under CESA.

A. Proposed Listing as Threatened under the Federal ESA Provides Inadequate Protection for the Central California DPS

The Central California DPS, as a proposed threatened species, receives little formal protection under the Federal ESA. The protections of Section 9 of the ESA (prohibiting “take” of the species) do not apply to species for which a listing determination has not been finalized. Under Section Section 7 of the ESA (requiring all federal agencies to insure that their activities do not jeopardize the continued existence of the species) federal agencies whose actions are likely to jeopardize the continued existence of a species proposed for listing or adversely modify its critical habitat must conduct a "conference" with the USFWS. 50 C.F.R. 402.10. The stated purpose of the conference regulation is to assist federal agencies and project applicants in identifying and resolving potential conflicts with endangered species as early as possible in the process. The USFWS, however, only has the power to make advisory recommendations, during the conference process, unless the federal action agency requests that the conference be conducted in accordance with the procedures for formal consultation for listed species (Id*).*

In addition, some Habitat Conservation Plans, completed under Section 10 of the ESA by project proponents in order to obtain a permit for take of species that would otherwise be prohibited under Section 9, may consider species proposed for listing and provide some mitigation for these species in return for a permit to take the species. However, any protection afforded a proposed species under Section 10 of the ESA would be implemented only at the discretion of the landowner or project applicant.

Species proposed for listing also lack the vital protections of critical habitat until the time or after the listing is finalized. Similarly, recovery plans are not prepared for proposed species until after the listing is finalized. The very limited and discretionary protections afforded proposed species are inadequate to protect the Central California DPS of the CTS, as confirmed by the ongoing threats to the species described in this Petition.

While the USFWS must make a final determination on the listing proposal by May 15, 2004, there is no guarantee that the species will be listed at that time, despite the overwhelming evidence of the need to do so, as the USFWS is under intense political pressure not to list the species. To date, the USFWS under the Bush Administration has not listed a single species nor designated critical habitat for a single species without a petition or lawsuit to compel it to do so. This refusal to protect species is unprecedented in the history of the ESA.

B. Final Listing as Federally Threatened Would Provide Inadequate Protection for the Species Throughout its Range

The USFWS currently proposes to list the Central California DPS as threatened and downlist the Sonoma and Santa Barbara DPSs from endangered to threatened (USFWS 2003b). The primary regulatory significance of listing as threatened as opposed to endangered is that the USFWS may promulgate exceptions to the take prohibitions for threatened, but not for endangered, species (USFWS 2003b). The USFWS has proposed to exempt the following activities by non-Federal entities on private and Tribal lands via the issuance of a regulation pursuant to Section 4(d) of the ESA ("4(d) Rule"):

(1) Livestock grazing according to normally acceptable and established levels of intensity in terms of the number of head of livestock per acre of rangeland;
(2) Control of ground-burrowing rodents using poisonous grain according to the labeled directions and local, State and Federal regulations and guidelines (the use of toxic or suffocating gases is not exempted);
(3) Control and management of burrow complexes using discing and grading to destroy burrows and fill openings. The exemption applies to discing or grading of up to 10 ac. within any one-quarter section of a single township and range for burrow control and management;
(4) Routine management and maintenance of stock ponds and berms to maintain livestock water supplies at levels present at the time of the listing of the Central California DPS (the introduction

of species into the stock ponds that may prey on CTS and the introduction of chemicals into the stock ponds that would result in take of the CTS is not exempted);

(5) Control and management of "noxious" weeds.

The proposed 4(d) Rule would undermine the protections of the federal ESA for the species throughout its range and would render the federal listing inadequate to ensure its long-term survival and recovery in the wild. The FWS estimates that the exemptions will apply to approximately 49% of the range of the Central California DPS. Estimates were not provided for Sonoma and Santa Barbara Counties. The proposed rule, however, states "[I]n Santa Barbara County, the only remaining sites with large amounts of suitable salamander habitat (eight ponds at five sites) are currently being grazed (USFWS 2003b at 28668). It therefore appears that the proposed 4(d) Rule would affect close to 100% of the species' range in Santa Barbara County.

Another major problem with the proposed rule is that "Livestock grazing according to normally acceptable and established levels of intensity in terms of the number of head of livestock per acre of rangeland," is a vague and undefined concept that appears designed to allow harmful overgrazing practices to continue. If grazing is beneficial or neutral to the CTS as the FWS postulates, then there is no need to exempt livestock grazing from the ordinary take prohibitions that apply to threatened species. Ranchers who are not causing take of the CTS will not be sued for take. To our knowledge, there has not been a single enforcement action taken against ranchers for take since the Santa Barbara and Sonoma County populations were listed, demonstrating that there is no need for a take exemption. If, on the other hand, livestock grazing (or overgrazing) does harm the CTS, then the activity should not be exempted. Exempting grazing at "normally acceptable and established levels of intensity" does nothing to address the overgrazing cited as a threat to the species in the CNDDB. "Established levels" could be interpreted to allow the continuation even of gross levels of overgrazing. The use of the term "normally acceptable" does nothing to address this problem as the FWS has failed to define "normally acceptable." An intense level of use may be "normally acceptable" to some may not be biologically acceptable for the survival and recovery of the CTS. As discussed *supra*, our review of the CNDDB found that 75 localities included a notation that the site was threatened by overgrazing.

The most fundamental flaw of the proposed 4(d) Rule is that it could be interpreted to allow the extinction of the CTS. While the FWS estimates that the rule will apply to 49% of the Central California populations range, we believe this percentage could be higher as the proposed rule purports to apply to private and Tribal land "currently in or that may become subject to ranching practices, such as grazing, rodent control, stock pond management, and noxious weed control," (USFWS 2003b at 28665). Thus, the 4(d) Rule could be interpreted as allowing any party to begin grazing previously ungrazed private or Tribal lands and enjoy the exemption from the normal take prohibitions of the ESA.

As demonstrated in this Petition and the literature, healthy rodent populations and an abundant supply of rodent burrows are essential components of high quality CTS habitat. As discussed *supra*, eliminating rodent populations from an area degrades the quality of the habitat for CTS and is incompatible with the survival and recovery of the species.

The proposed rule would allow virtually unlimited rodent killing with poisons, as well as the discing of up to 10 acres in each quarter section. The proposed rule allows landowners to completely extirpate native rodent populations on their property. The poisoning of rodent populations could also harm CTS, and the allowed disking would obviously kill any CTS present in their burrows. The activities allowed with regard to stockponds could also result in take of CTS via the grading, collapse, and crushing of burrows. Over time, landowners could completely eliminate the CTS from their property with a campaign of overgrazing, discing, poisoning, and bulldozing of stockponds and surrounding areas. Therefore, the proposed 4(d) Rule could lead directly to the extinction of the species. At a minimum, the 4(d) Rule is incompatible with the recovery of the species and its removal from the list of threatened and endangered species. The species already faces too high a degree of risk to sustain the amount of habitat loss and direct harm proposed by the FWS. We do not impugn the integrity of rural landowners in general, but the fact remains that there are many documented incidences of vandalism and the proposed 4(d) rule simply represents to great a threat to the species.

An additional problem with the proposed 4(d) Rule is that it would undercut the ability of the FWS and private parties to enforce Section 9's take prohibitions because an additional distinction between exempted and non-exempted activities would need to be made for successful enforcement. For example, in the absence of the 4(d) Rule discing of occupied CTS habitat would clearly be illegal take subject to agency or citizen enforcement. With the 4(d) Rule in place, would-be enforcers would also have to show that the discing occurred over an area of greater than 10 acres or was not for the purpose of rodent control, creating a higher bar for enforcement action. The FWS has repeatedly cited vandalism and intentional habitat destruction by landowners as threats to the continued survival of the CTS. The adoption of the 4(d) Rule would decrease the ability of the FWS and others to prevent intentional habitat destruction, and its adoption would therefore be arbitrary, capricious, and contrary to law.

We concur that the preservation of open space, including lands that are currently grazed, is beneficial to the CTS and is in fact necessary to its survival and recovery in the wild. However, the FWS has not made the link between the proposed 4(d) rule and achieving that goal. We support a proactive recovery program that includes many large acquisitions of and the placement of conservation easements on salamander habitat. Paying landowners fair market value for a conservation easement or fee title is one very effective way that the FWS can encourage the preservation of open space and conserve the CTS. Exempting some of the very activities that are driving the species to extinction, including discing and large scale rodent eradication, as currently written in the proposed 4(d) rule is not an effective way to preserve open space, and represents an additional threat to the species.

C. Final Listing as Federally Endangered Does Not Remove the Need for Listing Under CESA

Even assuming that the Sonoma and Santa Barbara federal endangered listings remain in place, and the Central California DPS is ultimately listed as federally endangered as well, this does not preclude the need for listing under CESA. The current management of the species is only one of many factors to be included in a petition and considered by the Department and the Commission. The decision to designate a species a candidate and to the decision to list a species are based primary on the "NATURE AND DEGREE OF THREAT" section, and only secondarily on other factors including Current Management, Habitat Requirements, etc. Basing a decision not to accept a petition or list a species on the existence of a federal ESA listing would violate the plain language of CESA and legislative intent.

Many species already listed under the federal ESA have been listed under CESA, including eighteen animals (the Delta smelt, Mohave tui chub, Colorado pikeminnow, Owens pupfish, unarmored threespine stickleback, Santa Cruz long-toed salamander, Coachella Valley fringe-toed lizard, blunt-nosed leopard lizard, California brown pelican, California condor, California clapper rail, light footed clapper rail, Yuma clapper rail, California least tern, Morro Bay kangaroo rat, Tipton kangaroo rat, Salt-marsh harvest mouse and San Joaquin kit fox) and eleven plants (the McDonald's rock cress, Sonoma sunshine, San Clemente Island Indian paintbrush, Loch Lomond button-celery, Contra Costa wallflower, San Clemente Island lotus, San Clemente Island bush mallow, Eureka Dunes evening-primrose, Antioch Dunes evening-primrose, Scott's Valley polygonum, and Eureka Valley dune grass. Clearly, previous federal listing is not a basis for denying a species protection under CESA.

D. Federal Listing of Other Species Within the Range of the California Tiger Salamander Provides Inadequate Protection

Listing under the federal ESA for other species that overlap with the CTS in habitat and range could provide some protection to the species. There are 16 species (1 beetle, 4 species of freshwater shrimp, and 11 species of plants) listed under the federal ESA within the range of the Central California DPS of the CTS and occur in association with vernal pools (USFWS 2003b). In some instances, for example proposed critical habitat for the 4 freshwater shrimp and 11 plant species, protections overlap with areas occupied by the CTS. However, such overlap is limited, and where it does occur the protections generally apply only to the wetlands areas (USFWS 2003b). Other federal listings are wholly insufficient to protect the uplands habitat of the CTS, in which it spends approximately 80 percent of its lifecycle (USFWS 2003b). In addition to this problem, there is no evidence that the federal listing of other species is adequate to protect them, as in many cases they continue to decline.

E. Section 404 of the Clean Water Act Does Not Provide Adequate Protection

Under Section 404 of the Clean Water Act, 33 U.S.C. §§ 1251 et seq. ("CWA"), discharge of pollutants, including dredged or fill material, into "Waters of the U.S." is prohibited absent a permit from the U.S. Army Corps of Engineers ("ACOE"). The definition of "Waters of the U.S." includes vernal pools. 33 CFR 328.3. However, in *Solid Waste Association of Northern Cook Counties v. United States Corps of Engineers*, 531 U.S. 159 (2001) ("*SWANCC*"), the U.S. Supreme Court invalidated one small piece of the CWA implementing regulations known as the "migratory bird rule." Subsequently, the Bush Administration has cited the *SWANCC* case as a justification for further narrowing the ACOE's jurisdiction under the CWA. In many instances since the *SWANCC* decision the ACOE has failed to assert jurisdiction over vernal pools. Destruction of CTS habitat that would previously have received review and permitting under the CWA has occurred without any such review. For example, in March, 2002, the ACOE refused to take jurisdiction over seasonal wetlands within the range of the Central California CTS, citing the *SWANCC* decision for the proposition that the wetlands were not "Waters of the U.S." (USFWS 2003b, citing ACOE File Number 19736N). The ACOE also cited the *SWANCC* decision for their failure to assert jurisdiction over fill of wetlands at the site of the South Sonoma Business Park in Sonoma County (USFWS 2003b, citing ACOE File Numbers 23540N, 249420N). Therefore, it appears that at present few, if any, vernal pools within the range of the CTS will, as a practical matter, receive protection under the CWA. Even assuming that the ACOE were to change its interpretation of the law following a court decision or change in administration, as discussed below the CWA would still prove inadequate to ensure the survival and recovery of the CTS.

In general, the implementation of the CWA regulatory scheme and the Section 404 program in particular have fallen far short of Congress's intent to protect wetlands and water quality. The loss of wetlands in the United States and in California to development and agriculture is a national tragedy. The National Research Council's report entitled "Compensating for Wetland Losses Under the Clean Water Act" concludes that the goal of no net loss has not been achieved through the ACOE regulatory program, and that Applicants often do not follow through on promised mitigation packages (National Research Council 2001). The study also concludes that in some circumstances, third party mitigation efforts (e.g. mitigation banking) have advantages over Applicant-directed mitigation. The study also recommends that mitigation lands be managed over the long term, not for the relatively short term horizons (e.g. 5-10 years) typically required (National Research Council 2001).

The failure of the ACOE regulatory scheme is due in part because the ACOE's implementation of the individual permitting process has simply permitted too much development while requiring too little avoidance and mitigation. The ACOE's Nationwide Permitting Program is designed such that it routinely allows the destruction of small pools that support or could support CTS.

Under the Nationwide Permit 26, in effect until July 6, 2000, all projects that destroyed less than 10 acres of isolated or headwater wetlands (e.g. vernal pools) were processed through a separate, much less stringent process. Under this permitting scheme, destruction of less than one acre of wetlands was essentially considered automatically permitted. For permits that would destroy between one and ten acres of wetlands, the ACOE would circulate a "predischarge notification" to the USFWS and other interested parties to determine whether an individual permit should be required or whether the project should be automatically permitted. While the ACOE retained discretion to require an individual permit if the resources involved were particularly important, in practice the ACOE virtually never required an individual permit for any project covered under Nationwide Permit 26 unless a federally listed species was involved. 59 Fed. Reg. 48150. In addition, the discontinuous distribution of vernal pools has allowed landowners to intentionally subdivide projects so as to obtain automatic permitting under Nationwide Permit 26. 59 Fed. Reg. 48150.

A 1992 USFWS report found that the Sacramento District ACOE office authorized the fill of 487 acres of wetlands between 1987 and 1992 under Nationwide Permit 26. This is an under-estimate because under Nationwide Permit 26, notification is not required for projects that destroy less than 1 acre of wetlands (Under this scheme, over 85 temporary pools with a surface area of 500 square feet could be destroyed without any notification). The USFWS estimates that the majority of wetlands destroyed in the Sacramento District were vernal pools. In addition, the USFWS (at 48143) identified 10 unauthorized projects in Sacramento and Butte Counties that destroyed or damaged between 21 and 37 acres of wetland habitat (The projects were not authorized because the landowners were either not required or failed to comply with the provisions of Section 404).

On March 6, 2000, in response to a lawsuit by the Natural Resources Defense Council, the ACOE published in the Federal Register a final rule that replaced Nationwide Permit 26. The final rule purported to increase environmental protections for wetlands by decreasing the amount of wetlands that can be destroyed with an automatic permit to ½ acre (over 43 pools with a surface area of 500 square feet could fit within ½ acre), and by adding additional restrictions on the new Nationwide Permits for activities in the 100-year floodplain, impaired waters, and critical resource waters. The new scheme took effect July 6, 2000. 65 Fed. Reg. 12818.

The new and modified NWPs[16] authorize many of the same activities that NWP 26 authorized, but are activity-specific. The maximum acreage limit of most of the new and modified NWPs is 0.2 ha (0.5 ac). Most of the new and modified NWPs require notification to the District Engineer for activities

[16] New NWPs 39, 41, 42, and 43, and modifications to NWPs 3, 7, 12, 14, 27, and 40 replace NWP 26 (65 FR 12817).

that result in the loss of greater than 0.04 ha (0.1 ac). These permits thus authorize less fill than the previous NWP 26.

Under several of the NWPs that authorize activities that might impact CTS, the filling of less than 0.04 ha (0.1 ac) of isolated waters can be undertaken without notifying the Corps of the proposed activity unless a listed species or designated critical habitat might be affected or is in the vicinity of the project (NWP General Condition 11). However, the determination of the potential presence of and/or impacts to listed species or designated critical habitat is left to the applicant, who may not have sufficient expertise to make such a determination and in almost all instances has a strong incentive to claim that no listed species or critical habitat will be impacted.

Under several NWPs, if the activity will affect between 0.04 and 0.2 ha (0.1 and 0.5 ac) of wetlands, an applicant is required to notify the Corps, but the Corps is not required to notify resource agencies unless the project may affect a listed species or designated critical habitat. Because vernal pools are often small and scattered across the landscape, even very large development projects that fill hundreds of vernal pools, can be authorized under NWPs. Numerous small projects in a given area also could be authorized, cumulatively resulting in the loss of significant amounts of wetland and associated upland habitats, with significant negative effects on local and regional biodiversity (Semlitsch and Brodie 1998).

Projects affecting more than 0.2 ha (0.5 ac) of isolated waters also can be authorized under NWPs after the Corps circulates a pre-construction notification (PCN) to the USFWS and other resource agencies for review and comments. For such projects, the Corps can place special conditions requiring minimization of impacts and/or compensatory mitigation on authorizations granted under NWPs. The Corps must require an individual permit for these projects if it determines the project will have more than minimal individual or cumulative effects. However, the Corps generally is reluctant to withhold authorization under NWPs unless a listed threatened or endangered species is known to be present.

An individual permit is required for projects that do not qualify under the terms of a General Permit, and for projects that are determined by the Corps to have greater than minimal impacts or to be contrary to the public interest. Individual permits are subject to review by the USFWS, other resource agencies, and the public. When the USFWS reviews the permit, they may recommend measures to avoid, minimize, or mitigate losses. In some cases, compensatory mitigation (e.g., the creation of artificial wetlands) is incorporated in the Corps permit as a Special Condition. However, problems associated with such compensatory measures often decrease or eliminate the habitat value for CTS at the sites, as described below (DeWeese 1994).

The creation of artificial wetlands and ponds as breeding habitat for tiger salamanders has been used as a compensatory mechanism for the loss of natural wetlands and pools. However, the long term viability and suitability of artificially created wetlands has not been established. In 1994, the USFWS completed a report evaluating 30 wetland creation projects authorized through the Corps of Engineers section 404 program (DeWeese 1994). Twenty-two projects ranged in age from 3 to 5 years old, and 8 projects were greater than 5 years old at the time of the study. The USFWS found that, although it appeared the goal of “no net loss of acreage” was being met or exceeded, the value of the habitat created, which included the local wildlife species that would be expected to use the habitat, was low. This was especially the case for vernal pools and seasonal wetlands that had a value of only 20 and 40 percent (respectively) of what existed previously. Particular problems were noted for these habitat types, which often were inundated (flooded) for longer or more frequently than natural systems. The study concluded that, of the 600 ac (243 ha) of proposed mitigation, half were meeting less than 75 percent of the mitigation conditions. Mitigation and compensation for impacts to larger wetlands under Section 404 have failed to reduce threats to the CTS. The USFWS has recently reiterated that there is a "low probability" that habitat functions needed by CTS will be adequately recreated via Section 404 mitigation requirements.

Another obstacle to protecting the CTS is that the ACOE typically confines its evaluation of impacts to the actual wetlands themselves, and ignores impacts to upland areas. Preservation of existing pools without protection of large blocks of suitable uplands is unlikely to result in the persistence of viable salamander populations because the salamanders require both aquatic and upland habitats during their life cycle. CTS spend as much as 95% of their lives in uplands. Thus, even with the new limits on filling of wetlands, section 404 is unlikely to provide sufficient protection of small isolated wetlands and the surrounding watersheds. One review of Ambystomatid salamander studies reported that 100 percent of post-breeding adults and newly metamorphosed juveniles were found outside the federally delineated wetland boundary (Semlitsch 1998). Thus, the ACOE CWA permitting usually is per se inadequate to protect the CTS.

In addition to the problems discussed above, many agricultural and farming practices such as overgrazing and disking destroy vernal pools within the range of the CTS. These activities, however, are exempt from the provisions of Section 404 of the Clean Water Act[17]. Projects that involve only the excavation of pools whereby the discharge is limited to "incidental fallback" of fill material, and projects that alter the watershed and hydrological regime of the pool but do not involve "discharge" into the pool, may also be considered exempt (Coe 1988).

For all the reasons discussed above, the Clean Water Act has been and will continue to be inadequate to insure the continued survival of the CTS.

II. State and Local Management Provides Insufficient Protection

The State of California recognizes the CTS as a Species of Special Concern ("CSC") under the California Endangered Species Act (CESA). The protections of the CSC designation are implemented primarily through the environmental review process under the California Environmental Quality Act ("CEQA"). Under CEQA, discretionary actions of state and local agencies that may have a significant impact on the environment (such as the approval of a residential subdivision) are subject to environmental review. For projects that may affect a rare, threatened, or endangered species, the proper level of review is an EIR. 14 Cal. Code Regs. § 15065. In an EIR, the lead agency must fully disclose all significant environmental impacts of the proposed project and must adopt all feasible mitigation measures and alternatives to reduce those impacts. However, if significant impacts remain after all mitigation measures and alternatives deemed feasible by the lead agency have been adopted, the lead

[17] However, deep-ripping of lands formerly used for ranching (i.e., grazing) or dry-land farming (e.g., non-irrigated hay production) represents a "change in use" of the lands and is not considered a normal and ongoing farming activity. As such, the practice triggers section 404(f)(2) of the CWA, and requires review by and a permit from the ACOE (R. H. Wayland III, EPA, and D. R. Burns, ACOE, in litt. 1996). However, as discussed previously, the Corps typically asserts jurisdiction only over the actual wetlands, not over the surrounding uplands. In some cases, the ACOE does not assert jurisdiction over actual wetlands, either. For example, repeated deep-ripping of a pond known to be breeding habitat for CTS occurred up until 2000 on the Lin/North Livermore property in Livermore, California. The ACOE had federally delineated the damaged wetland, but the ACOE (and the California Department of Fish and Game) failed to assert jurisdiction or take any action (C. Wilcox, pers. com., 2001).

agency is still free to approve the project despite those impacts if it finds that social or economic factors outweigh the environmental costs.

The benefit of the CSC designation and CEQA review to the CTS has been minimal. Lead agencies often do not assure that surveys for CTS are conducted to the Department's protocol, and survey results are commonly negative, even in apparently high-quality habitat. The destruction of purportedly unoccupied habitat is almost never considered a significant impact, despite the fact that habitat destruction and fragmentation are major factors driving the species towards extinction. Even when CTS are located, this may not be deemed a significant impact, as impacts to CSC species are often improperly deemed insignificant. Even if impacts to CTS and their habitat are deemed significant, the Department and lead agencies do not require more than a 1:1 mitigation ratio (C. Wilcox, CDFG, pers. comm.). "CEQA has proven to be a variable, and often inadequate, regulatory mechanism for providing protection to the CTS and its habitat." (USFWS 2003b). Moreover, neither CEQA nor any other state or local regulatory mechanism provides protection from other factors adversely impacting the CTS including fish stocking, mosquitofish stocking, rodent control, and hybridization with non-native tiger salamanders (USFWS 2003b).

Cook and Northen (2001) addressed the protection afforded the CTS by the CSC designation:

> CTS legal status as a CDFG Species of Special Concern has been inadequate to protect this species. The most recent and significant example is the proposed loss of two CTS breeding sites and surrounding upland habitat in western Cotati from an approved business park. CDFG approved the relocation of 37 CTS larvae found on-site to a constructed vernal pool at the Yuba Drive Preserve. Our surveys of the relocation pool in 2001 prior to the relocation efforts found no CTS larvae. Our negative finding suggests that this pool may not be suitable CTS habitat and relocated larvae may not have survived. Also, the observation of 37 larvae is greater than the cumulative observations of CTS larvae in 2001 at the eight preserves with CTS breeding sites! Clearly, there is insufficient protection of CTS habitat and highly productive breeding sites are being eliminated under the current status of Species of Special Concern (Cook and Northen 2001).

The CTS has also been placed on the list of protected amphibians, which means that it may not be taken without a special (i.e., scientific collecting) permit (CRC, Title 14, Section 41). However, this protection applies only to actual possession or intentional killing of individual animals, and affords no protection to habitat. Activities that destroy habitat and kill salamanders in the process are not regulated.

We have been unable to discover any local ordinances or regulations designed for the protection of the CTS. Local regulatory schemes for activities such as grading provide varying degrees of incidental protection to the CTS and its habitat. Sonoma County is an example of a jurisdiction with grading ordinances that provide absolutely no protection for the CTS or other species. A 2002 Memorandum from the County of Sonoma County Counsel and other parties (County of Sonoma 2002) summarized the many weaknesses of Sonoma County's grading ordinances including the following:

(1) Grading permits are ministerial approvals and are not subject to environmental review under CEQA unless associated with larger discretionary projects. The environmental impacts of the ministerial projects, including potential effects upon listed fish species, are not evaluated through the County's permit process;

(2) The County Code has no adopted standards for erosion and sediment control plans required for grading permits, and no clear enforcement authority regarding these plans;

(3) Grading permits are not required for public projects. Therefore, public projects are not reviewed by the County for conformance with Uniform Building Code grading standards, nor are they subject to review for specific erosion and sediment control measures;

(4) Code provisions relating to grading are not well organized or user friendly. Often the applicants for vineyards will bypass the County grading permit requirements all together, without any repercussions or enforcement.

County of Sonoma 2002.

Despite requests from the North Coast Regional Water Quality Control Board to adopt a grading ordinance to better address erosion and sediment control, additional riparian corridor protection, and time-of-year restrictions on grading, to our knowledge Sonoma County has yet to address the shortcomings of its grading ordinances. The lack of protection provided to the CTS (or any other species) is a probably contributing cause to the severe endangerment of the Sonoma County population segment.

RECOMMENDED MANAGEMENT AND RECOVERY ACTIONS

Although a comprehensive recovery strategy has not been developed for the CTS, available research does point to some management actions are needed with great urgency. These actions should focus on preventing further loss of populations and metapopulations, and on preserving the remaining genetic and ecological diversity found within the range of the species. Recommended management actions are discussed in turn below.

I. Preserve, Protect, and Restore Aquatic and Terrestrial Habitat

Clearly the most pressing management action is to preserve remaining habitat areas. There is substantial evidence that any remaining habitat loss in Sonoma County could preclude the continued survival of the CTS in Sonoma County. The Department has been permitting the destruction of large amounts of CTS habitat and has required insufficient mitigation requirements to protect the species. Therefore, the Department should not issue any take permits for this species in Sonoma County until the status of the species has been fully evaluated and potential mitigation strategies have been fully evaluated. If the Department does issue future take permits for the species, the mitigation ratio must be increased dramatically from the current 1:1 maximum ratio.

Throughout the range of the CTS, priority should be given to vernal pool complexes, large vernal pools, and surrounding terrestrial habitat. Research has clearly demonstrated that vernal pool complexes are essential to the long-term survival of the species, due to its population dynamics (Shaffer et al. 1993; USFWS 2000b). Within vernal pool complexes, larger pools also appear to be more important habitat. Shaffer et al. (1993) hypothesized that this is because larger pools harbor a greater number of individuals, thereby increasing the chances that at least some individuals will successfully reproduce each year. Smaller pools are subject to more frequent extirpations and are therefore more dependent on re-colonization from other areas.

Disturbance to aquatic habitats should be minimized during the breeding season to minimize disturbance to the CTS's more sensitive life stages and to reduce sedimentation and erosion into water bodies. Aquatic habitats should be protected from contamination by chemicals such as those used for agricultural purposes. Operators should use best management practices to avoid contaminating wetlands, and ranchers should avoid placing salt licks for livestock adjacent to CTS breeding ponds.

Terrestrial habitat of sufficient quality must also be preserved. While uplands habitat need not necessarily be pristine in order for CTS to survive, the presence of burrowing rodents does appear to be necessary (Shaffer et al. 1993). Small mammal populations should not be eliminated. To insure that a set of populations can survive into the future, Shaffer et al. (1993) recommend that the minimum preserve should be a complex of a dozen pools surrounded by 1,000 acres of suitable uplands habitat. Jones and Stokes (1990) suggest that vernal pool complexes of at least 200 acres are necessary to provide basic protection of the ecosystem. Shaffer et al. (1993) states that this number is too low for the CTS, due to the distance the species may migrate from its breeding pools.

Lowland valley habitat is the most critically endangered of all CTS habitats (Shaffer et al. 1993). For this reason, it is particularly important that protection of this habitat type be prioritized (Shaffer et al. 1993). Jepson Prairie, which supports a population of CTS, is perhaps the only block of high quality lowland valley habitat that is protected.

Within each genetically defined population, at least two major vernal pool complexes should be preserved. This includes, at a minimum, Sonoma County, the East Bay and Livermore Valley, the Sacramento region, Santa Barbara County, the southern east side of the Central Valley, the Hickman Vernal Pool Complex, the Diablo Range, and the Inner Coast Range (Shaffer et al. 1993). Remaining habitat is particularly scarce in Sonoma County.

Restoration efforts, particularly the removal of non-native species, are also necessary to increase available habitat for CTS and improve marginal habitat. Aquatic habitats should be free of non-native and introduced predators. Fish and bullfrog removal programs should be undertaken at appropriate locations. Human-made stockponds should be managed to prevent colonization by these predators. The stocking of non-native fish for mosquito abatement, fishing, or other purposes should be prohibited in all areas inhabited or potentially inhabited by CTS. Water drawdowns, wherever possible, should be timed so as to allow CTS to metamorphosize prior to draining of the ponds. Protections should be installed around drains and the draining should be conducted at a slow enough rate so that any remaining CTS larvae are not sucked down the drains and killed (Barry and Shaffer 1994).

Restoration efforts should prioritize areas necessary to create habitat areas large enough to meet the minimum requirements for sustainable populations, that is, areas of at least one dozen pools surrounded by 1,000 acres or more of uplands habitat. Wherever possible, habitat fragmentation should be reduced and migration corridors between populations and subpopulations should be established. One way of accomplishing this is by providing strategic tunnels under roads, along with drift fences to connect habitat (Shaffer et al. 1993). Road closures should be implemented during migration season on roads that are located particularly close to known breeding sites.

II. Provide for Monitoring and Potentially Moving Individuals Between Appropriate Populations

All genetic data indicates that migration over large areas is probably quite limited, at least by females (Shaffer et al. 1993). Adult CTS move across the landscape as they use the terrestrial habitat, but do not seem to routinely migrate large distances (Shaffer et al. 1993). This means that when a population is lost, it is gone for good (Shaffer et al. 1993). In some areas, the only solution for any type of protection will be the on-site protection of small, isolated ponds that may have a high probability of local extinction in the future (Shaffer et al. 1993). To protect against this, tissue samples should be obtained and analyzed at the allozyme and mtDNA levels from all such populations while they are still relatively intact (Shaffer et al. 1993). Monitoring is also critical, so that if a population becomes extinct animals from the appropriate genetic stocks can be reintroduced (Shaffer et al. 1993). This type of strategy mimics the natural processes of recolonization that occurs under pristine conditions but cannot happen when populations are physically isolated and restricted in size (Shaffer et al. 1993).

SIGNATURE PAGE

Submitted this 28th day of January, 2004

Kassie Siegel
Center for Biological Diversity
P.O. Box 493
Idyllwild, CA 92549
(909) 659-6053

Karen Kraus
Environmental Defense Center
906 Garden Street
Santa Barbara, CA 93101
(805) 963-1622

Kim Delfino
Defenders of Wildlife
926 J Street, Suite 522
Sacramento, CA 95814
(916) 313-5809

Carol Witham
VernalPools.Org
P.O. Box 2022
Davis, CA 95617
(916) 452-5440

Barbara Vlamis
Butte Environmental Council
116 W. Second St. #3
Chico, CA 95928

Peter Ashcroft
Sierra Club, Sonoma Group
404A Mendocino Ave/P.O. Box 466
Santa Rosa, CA 95401/95402

Iva Jones
Citizens for a Sustainable Cotati
P.O. Box 7233
Cotati, CA 94931

Florence LaRiviere
Citizen's Committee to Complete the Refuge
453 Tennessee Lane
Palo Alto, CA 94306

Evelyn Cormier
Ohlone Audubon Society
1922 Hillsdale St.
Hayward, CA 94541

The Center is a non-profit environmental organization dedicated to the protection of native species and their habitats through science, policy, and environmental law. The Center has over 9,000 members throughout California and the western United States.

Environmental Defense Center is a grassroots, public interest law firm working to advance environmental protection throughout the Tri-Counties of Ventura, Santa Barbara, and San Luis Obispo. Since 1977, EDC has provided advocacy, public education, and legal services to community groups on California's South Central Coast.

Defenders of Wildlife is a nonprofit organization dedicated to the protection of all native wild animals and plants in their natural communities. Defenders programs encourage protection of entire ecosystems and interconnected habitats while protecting predators that serve as indicator species for ecosystem health.

VernalPools.Org is a grassroots organization dedicated to saving California's vernal pool landscapes and the organisms that make them unique.

Butte Environmental Council is a non-profit organization with a twenty-eight year history as the leading voice for environmental conservation in the northern Sacramento Valley and foothill ecoregion. We educate and advocate for California's land, air, and water speaking for sustainable communities, healthy ecosystems, and the preservation of wild and agricultural land.

Sonoma Group of the Sierra Club represents a membership of 5,000 people living in Sonoma County. This membership base and a core of dedicated volunteers make the Sierra Club the largest and most influential environmental organization in the County.

Citizens for a Sustainable Cotati is an association of citizens concerned with the protection of habitat and environmental quality in and around the Cotati area in Sonoma County.

The mission of the Citizen's Committee to Complete the Refuge is to save the Bay's remaining wetlands by working to place them under the protection of the Don Edwards San Francisco Bay National Wildlife Refuge, and to foster worldwide education regarding the value of all wetlands. The 2,000 members have worked since 1985 to protect the Bay, its wetlands and the surrounding wetlands.

The purpose and objective of the Ohlone Audubon Society is to engage in any such educational, scientific, investigative, literary, historical, philanthropic and charitable pursuits as may be part of the stated purposes of the National Audubon Society, of which Ohlone Audubon Society shall function as a chapter.

INFORMATION SOURCES

I. Individuals Supporting Petitioned Action

Mr. Jeff Alvarez
Wildlife Project
P.O. Box 579805
Modesto, CA 95357

Mr. Don Ashton
Biological Consultant
EartHerp
1867 Park Street
Manila, CA 95521

Mr. Gary A. Beeman
Biological Consultant
777 Morago Road
Lafayette, CA 94549

Mr. Jamie Bettaso
Herpetologist
EartHerp
1867 Park Street
Manila, CA 95521

Mr. Steve Bobzien
Ecological Services Coordinator
East Bay Regional Parks District
2950 Peralta Oaks Court
Oakland, CA 94605

Mr. David Cook
Wildlife Biologist
833 Richardson Lane
Cotati, CA 94931

Mr. Joseph E. DiDonato
Wildlife Program Manager
East Bay Regional Parks District
2950 Peralta Oaks Court
Oakland, CA 94605

Dr. Dan C. Holland
Herpetologist
334A East Fallbrook
Fallbrook, CA 92028

Mr. Lawrence E. Hunt
Hunt and Associates Biological Consulting Services
5290 Overpass Road, Suite 108
Santa Barbara, CA 93111

Dr. Mark R. Jennings (supports threatened status for Central California)
Herpetologist/Fisheries Biologist
Rana Resources
39913 Sharon Ave.
Davis, CA 95616

Ms. Michelle Koo
California Academy of Sciences
Herpetology Department
55 Concourse Drive
Golden Gate Park
San Francisco, CA 94118-4599

Dr. Philip T. Northen
Professor and Chair, Department of Biology
Sonoma State University
1801 E. Cotati Ave.
Rohnert Park, CA 94928-3609

Mr. Jeff Oliver
Department of Entomology
University of Arizona, Tucson
Tucson, AZ 85721

Mr. Greg Pauly
Section of Integrative Biology
University of Texas, Austin
Austin, TX 78712

Dr. H. Bradley Shaffer
Section of Evolution and Ecology, and Center for Population Biology
University of California, Davis
Davis, CA 95616

Dr. Robert C. Stebbins
Emeritus Professor of Zoology
University of California, Berkeley
Emeritus Curator of Herpetology
University of California Museum of Vertebrate Zoology
Berkeley, CA 94720

Dr. Glenn R. Stewart
Professor of Zoology and Environmental Science
California State Polytechnic University, Pomona
3801 West Temple Ave.
Pomona, CA 91768-2557

Mr. Steve Sykes
Department of Ecology, Evolution, and Marine Biology
University of California, Santa Barbara
Santa Barbara, CA 93106

Dr. Samuel S. Sweet
Department of Ecology, Evolution, and Marine Biology
University of California, Santa Barbara
Santa Barbara, CA 93106

Ms. Trish Tatarian
Wildlife Research Associates
1010 Lakeville St. Suite 3A
Petaluma, CA 94952

Dr. Vance Vredenburg
Museum of Vertebrate Zoology and Department of Integrative Biology
University of California, Berkeley
Berkeley, CA 94720

Dr. David Wake
Professor of Integrative Biology
Curator of Herpetology
Museum of Vertebrate Zoology
University of California, Berkeley
Berkeley, CA 94720

Dr. Hartwell H. Welsh, Jr.
Redwood Sciences Lab
1700 Bayview Drive
Arcata, CA 95521

Ms. Carol W. Witham
Environmental Consultant
1028 Cypress Lane
Davis, CA 95616

II. Bibliography of Literature Cited

Anderson, J. D. 1968. *Rhyacotriton*, and *R. olympicus*. Catalogue of American Amphibians and Reptiles: 68.1-68.2

Anderson, P. R. 1968. The reproductive and developmental history of the California tiger salamander. Unpublished MA Thesis, Fresno State College, Fresno, California.

Ankley, G. T., J. E. Tietge, D. L. DeFoe, K. M. Jensen, G. W. Holcombe, E. J. Durhan, and S. A. Diamond. 1998. Effects of methoprene and ultraviolet light on survival and development of *Rana pipens*. Environmental Toxicology and Chemistry 17:2530-2542.

Association of Bay Area Governments ("ABAG"). 1999. Projections 2000. Forecasts for the San Francisco Bay Area to 2020 and beyond. December, 1999.

Austin, C. C. and H. B. Shaffer. 1992. Short-, medium-, and long-term repeatability of locomotor performance in the tiger salamander, *Ambystoma californiense*. Functional Ecology 6(2):145-153.

Barry, S. J. and H. B. Shaffer. 1994. The status of the California tiger salamander (*Ambystoma californiense*) at Lagunita: A 50-year update. Journal of Herpetology 28(2):159-164.

Bishop, S. C. 1943. Handbook of salamanders: The salamanders of the United States, of Canada, and of lower California. Comstock Publishing Company, Inc., Ithaca, New York.

Bobzien, S. 2003. Comments for the listing of the Central California Distinct Population Segment of the California tiger salamander (*Ambystoma californiense*), Proposed Rule.

Brewer, B. Biologist says salamander pond ruined. Contra Costa Times. July 29, 2000.

Blumberg, B., D. M. Gardiner, D. Hoppe, and R. M. Evans. 1998. Field and laboratory evidence for the role of retinoids in producing frog malformities. Abstract, Midwest Declining Amphibians Conference, March 20-21. Joint meeting of Great Lakes and Central Division working groups of the Declining Amphibian Populations Task Force. http://www.mpm.edu/collect/vertzo/herp/daptf/mwabst.html

Borland, J.N. 1857. List of reptiles collected in California by Mr. E. Samuals. Proc. Boston Soc. Nat Hist., 6, 192-194.

Ken Boyce, California Mosquito and Vector Control Association, *in litt*. 1994

Burow, K. R., J. L. Shelton, and N. M. Dubrovsky. 1998a. Occurrence of nitrate and pesticides in ground water beneath three agricultural settings in the eastern San Joaquin Valley, California, 1993-1995. U. S. Geological Survey, Water-Resources Investigations Report 97-4284. 51 pp.

Burow, K. R., S. V. Stork, and N. M. Dubrovsky. 1998b. Nitrate and pesticides in ground water in the eastern San Joaquin Valley, California: occurrence and trends. U. S. Geological Survey, Water-Resources Investigations Report 98-4040. 33 pp.

Bury, R. B. 1972. Status report on California's threatened amphibians and teptiles. California Department of Fish and Game, Inland Fisheies Administrative Report (72-2):1-31.

CALFED. 2003. Los Vaqueros Reservoir Expansion Studies. May 20, 2003.

California Department of Conservation (CDC). 2000. Farmland Conversion Reports 1990–2000. Farmland Mapping and Monitoring Program.

California Department of Fish and Game (CDFG). 2002. A catalogue of conservation banks in California.
http://www.dfg.ca.gov/hcpb/conplan/mitbank/catalogue/catalogue.shtml

CDFG. 2001a. Evaluation of petition: Request of the Center for Biological Diversity to list California tiger salamander (*Ambystoma californiense*) as endangered.

CDFG. 2001b. Draft Special Order Relating to Incidental Take of California Tiger Salamander (*Ambystoma californiense*) During Candidacy.

California Department of Pesticide Regulation (CDPR). 1998. Sampling for pesticide residues in California well water: 1997 update of well inventory database. Environmental Monitoring and Pest Management Branch, Sacramento, California.

California Department of Pesticide Regulation (CDPR). 2002. CDPR web site data.

California Natural Diversity Database (CNDDB). 2003. California Department of Fish and Game, Wildlife and Habitat Data Analysis Branch, Sacramento, CA.

Center for Biological Diversity. 2001. Petition to list the Sonoma County population of the California tiger salamander as endangered under the Endangered Species Act on an emergency basis. June 11, 2001. 65 pp.

CH2M Hill. 1995. Santa Rosa Plain Vernal Pool Ecosystem Preservation Plan. Phase 1 Final Report. Prepared for the Santa Rosa Plain Vernal Pool Task Force, June 30, 1995.

City of Sacramento, Sutter County, and the Natomas Basin Conservancy. 2002. Draft Natomas Basin Habitat Conservation Plan: Sacramento and Sutter Counties, California.

Paul Collins, Santa Barbara Museum of Natural History, *in litt.* 1998, 2000a,b

Coe, T. 1988. The application of section 404 of the Clean Water Act to vernal pools. Pp. 356-358 *in*: J. A. Kuslen, S. Daly, and G. Brooks, eds. Urban Wetlands. Proceedings of the National Wetlands Symposium, June 26-29, 1988.

Cook, D. 2003. Peer Review of the Proposed Rule to List the California Tiger Salamander as a Threatened Species.

Cook, D. 2002. Comments on the Proposed Listing of the Sonoma County Population of the California Tiger Salamander. Submitted to Wayne S. White of the Sacramento Fish and Wildlife Office of the U. S. Fish and Wildlife Service by David Cook, October 1, 2002.

Cook, D. and P. Northen. 2001. Draft. Status of California tiger salamander in Sonoma County. May 13.

Committee for Green Foothills. 2001. http://www.greenfoothills.org/carnegie.htm

County of Sonoma. 2002. Sonoma County Permit and Resource Management Department, County Counsel, Agricultural Commissioner's Office, and County Administrator. Staff Report for June 17, 2002 Grading Ordinance Workshop.

Davidson, C., H.B. Shaffer, and M.R. Jennings. 2002. Spatial tests of the pesticide drift, habitat destruction, UV-B and climate change hypotheses for California amphibian declines. Cons. Biology

DeWeese, J. 1994. An evaluation of selected wetland creation projects authorized through the Corps of Engineers section 404 program. U. S. Fish and Wildlife Service, Sacramento, California. 90 pp. plus appendices.

Dunn, E. R. 1940. The races of *Ambystoma tigrinum*. Copeia 1940(3):154-162.

EIP Associates. 2000c. UC Merced/University of Community Planning Area California Tiger Salamander Year 2000 Standard Aquatic Survey Report.

EIP Associates. 1999a. University Community Concept Planning Update. Volume 3 February 1999.

EIP Associates 1999b. UC Merced/University Community Planning Area, Federally-Listed Vernal Pool Crustaceans 1998/1999 Wet Season Survey Report. Unpublished report prepared for the University of California and Merced County. 46 pp. + appendices.

EXTOXNET (The Extension Toxicology Network, U. C. Davis). 2001. EXTOXNET web site data.

Feaver, P. E. 1971. Breeding pool selection and larval mortality of three California amphibians: *Ambystoma tigrinum californiense* Gray, *Hyla regilla* Baird and Girard, and *Scaphiopus hammondii* Girard. MA Thesis, Fresno State College, Fresno, California.

Field, C. B., G. C. Daily, F. W. Davis, S. Gaines, P. A. Matson, J. Melack, and N. I. Miller. 1999. Confronting Climate Change in California: Ecological Impacts on the Golden State. Union of Concerned Scientists, Cambridge MA and Ecological Society of America, Washington, D.C.

Findlay, C. S., and J. Houlahan. 1996. Anthropogenic correlates of species richness in southeastern Ontario wetlands. Conservation Biology 11(4): 1000-1009.

Fisher, J., and D.B. Lindenmayer. 2000. An Assessment of the Published Results of Animal Relocations. Biological Conseravation. 96 (2000), 1-11.

Fisher, R. N., and Shaffer, H. B. 1996. The decline of amphibians in California's Great Central Valley. Conservation Biology 10(5), 1387-1397.
Forman, R. T. T., and R. D. Deblinger. 2000. The ecological road-effect zone of a Massachusetts (U.S.A.) suburban highway. Conservation Biology 14(1):36-46.

Ford, T. 1992. Letter from Tim Ford, Stanislaus Natural Heritage Project, to Interested Parties, dated 29 March 1992.

Frost, D. R. (ed). 1985. Amphibian species of the world: A taxonomic and geographical reference. Allen Press, and the Association of Systematics Collections, Lawrence, Kansas. 732 p.

Gamradt, S. C. and L. B. Kats. 1996. Effect of introduced crayfish and mosquitofish on California newts. Conservation Biology 10(4), 1155-1162.

Gangstad, E. O. 1986. Freshwater vegetation management. Thomson Publication, Fresno, California, 1986.

Geer, K. 1994. Notes from phone conversation with Steve Morey 2/3/1994.

Gehlbach, F. R. 1967. *Ambystoma tigrinum*. Catalogue of American Amphibians and Reptiles:52.1-52.4.

Gibbs, J. P. 1998. Amphibian movements in response to forest edges, roads, and streambeds in southern New England. Journal of Wildlife Management 62(2), 584-589.

Graham, T. B. 1997. Climate change and ephemeral pool ecosystems: Potholes and vernal pools as potential indicator systems. Impact of Climate Change on Life and Ecosystems. U. S. Geological Survey.
Available at: http://geochange.er.usgs.gov/sw/impacts/biology/vernal/

Griffith, B., J.M. Scott, J.W. Carpenter, and C.Reed. 1989. Translocation as a Species Conservation Tool: Status and Strategy. Science. Vol. 245 pp. 477-480.

Grinnell, J. and C. L. Camp. 1917. A distributional list of the amphibians and reptiles of California. University of California Publications in Zoology 17: 127-208.

Hansen, R. W., and R. L. Tremper. 1993. Amphibians and reptiles of central California. California Natural History Guides. University of California Press, Berkeley. 11 pp.

Hatch, A. C., and G. A. Burton, Jr. 1998. Effects of photoinduced toxicity of fluoranthene on amphibian embryos and larvae. Environmental Toxicology and Chemistry 17: 1777-1785.

Heady, H.F. 1977. Valley Grassland. Pp. 491-514 in M.G. Barbour and J. Major, eds. Terrestrial Vegetation of California. California Native Plant Society, Special Pulbication #9.

Hickman, J. C. and W. L. Jepson. 1993. The Jepson Manual: Higher Plants of California. University of California Press, Berkeley, CA.

Holland, R. F. 1998a. No net loss? Changes in Great Valley vernal pool distribution from 1989 to 1997. Prepared for the California Department of Fish and Game, Natural Heritage Division, Sacramento, California.

Holland, R.F. 1998b. Great Valley vernal pool distribution, photorevised 1996. Pp. 71-75 *in* C.W. Withan, E.T. Bauder, D. Belk, W.R. Ferrent Jr., and R. Ornduff, Eds. Ecology, conservation, and management of vernal pool ecosystems – Proceedings of a 1996 Conference. California Native Plant Society, Sacramento, CA. 1998.

Lawrence Hunt, Biological Consultant, *in litt.* 1998.

Ingermann, R. L., D. C. Bencic and V. P. Eroschenko. 1997. Methoxychlor alters hatching and larval startle response in the salamander Ambystoma macrodactylum. Bulletin of Environmental Contaminants and Toxicology 59:815-821.

Irschick, D. J., and H. B. Shaffer. 1997. The polytypic species revisited: morphological differentiation among tiger salamanders (*Ambystoma tigrinum*) (*Amphibia: Caudata*). Herpetologica 53(1): 30-49.

Jennings, M. R. 1996. Geographic distribution: *Ambystoma californiense* (California tiger salamander). Herpetological Review, 27(3):147.

Jennings, M. R. 2000. California tiger salamander, *Ambystoma californiense*. Pages 193-196 In: P. R. Olofson (editor). Baylands Ecosystem Species and Community Profiles: Life Histories and Environmental Requirements of Key Plants, Fish and Wildlife. San Francisco Bay Area Wetland Goals Project, San Francisco Bay Regional Water Quality Control Board, Oakland, California. xvi+408 p.

Jennings, M. R., and M. P. Hayes. 1994. Amphibian and reptile species of special concern in California. Final Report #8023 Submitted to the California Department of Fish and Game.

Jennings, M. R. and G. E. Padgett-Flohr. 2003. Letter to the CTS Fund II regarding the Sonoma County California Tiger Salamander distribution map.

Johnson, W. W. and Finley, M. T. 1980. Handbook of acute toxicity of chemicals to fish and aquatic invertebrates. Resource Publication 137. U.S. Department of Interior, Fish and Wildlife Service, Washington, DC, 1980. 5-17.

Johnson, C. R. and J. E. Prine. 1976. The effects of sublethal concentrations of organophosphorus insecticides and an insect growth regulator on temperature tolerance in hydrated and dehydrated juvenile western toads, Bufo boreas. Comparative Biochemical Physiology 53:147-149.

Jones and Stokes Associates. 2003. Preliminary Impact Analysis of the East Contra Costa County HCPA.

Jones and Stokes Associates. 2002. Eastern Contra Costa County HCP/NCCP.

Jones and Stokes Associates. 1990. Sacramento County vernal pools: Their distribution, classification, ecology, and management. Prepared for County of Sacramento, California.

Jones and Stokes Associates. 1987. Sliding toward extinction: The state of California's natural heritage. Privately produced.

Thomas R. Jones, Museum of Zoology, University of Michigan, *in litt*. 1993.

Keeler-Wolf, T., D.R. Elam, K. Lweis, and S.A. Flint. 1998. California Vernal Pool Assessment Preliminary Report. California Department of Fish and Game, May 1998.

Kiesecker, J. M., and Blaustein, A. R. 1997. Influences of egg laying behavior on pathogenic infection of amphibian eggs. Conservation Biology 11(1), 214-220.

Laabs, D.M., S.g. Orloff, and M.L. Allaback. 2001. Pond and Stream-Breeding Amphibians pp. 191-230 *in* Vollmer, J. E., Ed. Wildlife and Rare Plant Ecology of Eastern Merced's Vernal Pool Grasslands http://www.mercednccp-hcp.net/vollmar/.

Launer, A., and C. Fee. 1996. Biological research on California tiger salamanders at Stanford University. 25 pp. plus figures, tables, and appendix.

Lawler, S. P., D. Dritz, T. Strange, and M. Holyoak. 1999. Effects of introduced mosquitofish and bullfrogs on the threatened California red-legged frog. Conservation Biology 13(3): 613-622.

Lawrenz, R. W. 1985. The response of invertebrates in temporary vernal wetlands to Altosid® SR-10 as used in mosquito abatement programs. Journal of the Minnesota Academy of Science 50: 31-34.

Lefcort, H., Hancock, K. A., Maur, K. M., and Rostal, D. C. 1997. The effects of used motor oil, silt, and the water mold Saprolegnia parasitica on the growth and survival of mole salamanders (Genus *Ambystoma*). Archives of Environmental Contamination and Toxicology 32(4), 383-388.

Leyse, K. and S. P. Lawler. 2000. Effects of mosquitofish (*Gambusia affinis*) on California tiger salamander (*Ambystoma californiense*) larvae in permanent ponds. Mosquito Control Research Annual Report 2000. University of California, Division of Agriculture and Natural Resources.

Loredo-Prendeville, I., D. Van Vuren, A. J. Kuenzi, and M. L. Morrison. 1994. California ground squirrels at Concord Naval Weapons Station: alternatives for control and the ecological consequences. Pp. 72-77 in: W. S. Halverson and A. C. Crabb, eds. Proceedings, 16th Vertebrate Pest Conference. University of California Pulications.

Loredo, I. and D. Van Vuren. 1996. Reproductive ecology of a population of the California tiger salamander. Copeia 1996:895-901.

Loredo, I., D. Van Vuren, and M. L. Morrison. 1996. Habitat use and migration behavior of the California tiger salamander. Journal of Herpetology 30:282-285.

LSA Associates. 1994. Distribution of the California Tiger Salamander. List of Localities. Presented to the U. S. Fish and Wildlife Service. Originally prepared in 1993 and revised in 1994.

LSA Associates. 2001. Review of the Petition to List the California Tiger Salamander Under the California Endangered Species Act. Submitted to the California Farm Bureau Federation.

Mader, H. J., 1984. Animal habitat isolation by roads and agricultural fields. Biological Conservation 29: 81-96.

Mallette, R. D., and S. J. Nicola (editors). 1980. At the crossroads; a report on the status of California's endangered and rare fish and wildlife. State of California Resources Agency, Fish and Game Commission and Department of Fish and Game, Sacramento, California.

Marsh, R. E. 1987. Ground squirrel control strategies in Californian agriculture. Pp. 261-277 *in*: C.G.J. Richards and T.Y. Ku, eds. Control of mammal pests. Taylor and Francis, London, New York and Philadelphia.

Mazzoni, R., A. A. Cunningham, P. Daszak, A. Apolo, E. Perdomo, and G. Speranza. 2003. Emerging pathogen of wild amphibians in frogs (Rana catesbeiana) farmed for international trade. Emerging Infectious Diseases. Volume 9 Number 8.

McKnight, M. L., and Shaffer, H. B. 1997. Large, Rapidly Evolving Intergenic Spacers in the Mitochondrial DNA of the Salamander Family Ambystomatidae (Amphibia: Caudata).

McLean, B. 1998. Wildlife health alert no. 98-02. Virus associated with tiger salamander mortality on Utah lake. National Wildlife Health Center, Madison, Wisconsin. 1 pg.

Sheri Melanson, U. S. Fish and Wildlife Service, *in litt*. 1993

Monson, P. D., D. J. Call, D. A. Cox, K. Liber, and G. T. Ankley. 1999. Photoinduced toxicity of fluoranthene to northern leopard frogs (*Rana pipiens*). Environmental Toxicology and Chemistry 18:308-312.

Morey, S. R. and D. A. Guinn. 1992. Activity patterns, food habits, and changing abundance in a community of vernal pool amphibians. pp. 149-158 *In*: D. F. Williams, S. Byrne, and T. A. Rado (editors), Endangered and sensitive species of the San Joaquin Valley, California: Their biology, management, and conservation. The California Energy Commission, Sacramento, California, and the Western Section of the Wildlife Society.

Morey, S. R. 1998. Pool duration influences age and body mass at metamorphosis in the western spadefoot toad: implications for vernal pool conservation. pp. 86-91 in: C.W. Witham, E.T. Bauder, D. Belk, W.R. Ferren Jr., and R. Ornduff (Editors). Ecology, Conservation, and Management of Vernal Pool Ecosystems - Proceedings from a 1996 Conference. California Native Plant Society, Sacramento, CA. 1998.

Myers, G. S. MS. Amphibians and reptiles of the urban area of Palo Alto and Stanford, California. Unpublished manuscript in the Smithsonian Institution Archives, Record Unit 7317, George Sprague Myer Papers, 1903-1986, and undated, Box 45, File2.

National Research Council. 2001. Compensating for wetlands under the Clean Water Act. National Academy Press. http://www.nap.edu/

Northen, Dr. P. T. 2002. Comments on the Proposed Listing of the Sonoma County Population of the California Tiger Salamander (CTS). Submitted to Wayne S. White of the Sacramento Fish and Wildlife Office of the U. S. Fish and Wildlife Service by Dr. Phillip T. Northern, Professor of Biology, Sonoma State University, October 15, 2002.

Padgett-Flohr, G. E. 2003. Chytridiomycosis: an informational brochure. Email: RanaResources@aol.com.

Parmesan, C. and G. Yohe. 2003. A globally coherent fingerprint of climate change impacts across natural systems. Nature 421:37-42.

Pechmann, J. H. K., D. E. Scott, J. W. Gibbons, and R. D. Semlitsch. 1988. Influence of wetland hydroperiod on diversity and abundance of metamorphosing juvenile amphibians. Wetlands Ecology and Management 1:1-9.

Pimentel, D. 1971. Ecological effects of pesticides on nontarget species. Executive Office of the President's Office of Science and Technology, U.S. Government Printing Office, Washington, DC, 1971.

Pyke, C. R. and J. Marty. In prep. Cows confound climate change.

Robins, J.D. and J.E. Vollmar. 2001. Livestock Grazing and Vernal Pools pp. 401- 430 *in* Vollmar, J. E., Ed. Wildlife and Rare Plant Ecology of Eastern Merced's Vernal Pool Grasslands http://www.mercednccp-hcp.net/vollmar/.

Root, T. L., J. T. Price, K. R. Hall, S. H. Schneider, C. Rosenzweig, and J. A. Pounds. 2003. Fingerprints of global warming on wild animals and plants. Nature 421:57-60/

Salmon, T. P., and R. H. Schmidt. 1984. An introductory overview to California ground squirrel control. Pp. 32-37 *in*: D. O. Clark, editor. Proceedings Eleventh Vertebrate Pest Conference, March 6-8, 1984, Sacramento, California.

San Joaquin Council of Governments. 2003. San Joaquin County Multi-Species Habitat Conservation and Open Space Plan. http://www.sjcog.org/sections/habitat/sjmscp.php

San Joaquin Valley Drainage Program. 1990. Unpublished report.

Santa Barbara County Planning and Development. 2002. Santa Barbara County 2030, The Open Lands, Agriculture and Open Space, November 2002 ("The Open Lands"). http://www.countyofsb.org/plandev/comp/programs/Newsletters/openlands/default.html

Santa Barbara County Planning & Development, Agricultural Commissioner, and UC Cooperative Extension. 1999. The Status of Agriculture in Santa Barbara County, April 1999.

Santa Barbara County Agricultural Commission (SBCAC). 1996. Crop Report.

SBCAC. 2001. Crop Report.

SBCAC. 2002. Crop Report.

Saunders, D. A., R. J. Hobbs, and C. R. Margules. 1991. Biological consequences of ecosystem fragmentation: a review. Conservation Biology 5(1): 18-32.

Schmieder, R. R. and R. S. Nauman. 1994. Effects of non-native aquatic predators on premetamorphic California red-legged frogs (*Rana aurora draytonii*). University of California, Santa Cruz. 12 pp.

Semlitsch, R. D. 1983. Burrowing ability and behavior of salamanders of the genus *Ambystoma*. Canadian Journal of Zoology 61(3):616-620.

Semlitsch, R. D., D. E. Scott, and J. H. K. Pechmann. 1988. Time and size at metamorphosis related to adult fitness in *Ambystoma talpoideum*. Ecology 69:184-192.

Semlitsch, R. D. and J. R. Brodie. 1998. Are small isolated wetlands expendable? Conservation Biology 12(5): 1129-1133.

Seymour, R., and M. Westphal. 1994. Final Report - Status and habitat correlates of California tiger salamanders in the eastern San Joaquin Valley: results of the 1994 survey. Prepared by Coyote Creek Riparian Station for U.S. Fish and Wildlife Service, Sacramento Office. 33 pp.

Seymour, R. and M. Westphal. 1995. Final report on 1995 surveys for California tiger salamander, *Ambystoma californiense*. Prepared by the Coyote Creek Riparian Station for the U. S. Fish and Wildlife Service, Fish and Wildlife Enhancement, Sacramento Field Office.

Shaffer, H. B. 1992. Petition to list the California Tiger Salamander (Ambystoma californiense) as an endangered species under Section 4 of the Endangered Species Act of 1973, as amended. 20 February 1992.

Shaffer, H. B. and S. Stanley. 1991. Final report to California Department of Fish and Game; California tiger salamander surveys, 1991 - Contract FG9422. California Department of Fish and Game, Inland Fisheries Division, Rancho Cordova, California.

Shaffer, H. B. and S. Stanley. 1992. Final report to California Department of Fish and Game; California tiger salamander surveys, 1991 - Contract FG9422. California Department of Fish and Game, Inland Fisheries Division, Rancho Cordova, California.

Shaffer, H. B., R. N. Fisher, and S. E. Stanley. 1993. Status Report: The California Tiger Salamander (*Ambystoma californiense*). Final report for the California Department of Fish and Game. 1993. Unpublished report.

Shaffer, H. B., and M. L. McKnight. 1996. The polytypic species revisited: differentiation and molecular phylogenetics of the tiger salamander *Ambystoma tigrinum* (Amphibia: Caudata) complex. Evolution 50: 417-433.

Shaffer, H. B., and P. C. Trenham. 2002. Distinct Population Segments of the California Tiger Salamander. Report to the U. S. Fish and Wildlife Service. Section of Evolution and Ecology, and Center for Population Biology, University of California.

Shaffer, H. B., and P. C. Trenham. 2003. *Ambystoma californiense*. Pp. 1093-1102. In Lannoo, M.J. (Ed.), Status and Conservation of U.S. Amphibians. Volume 2: Species Accounts. University of California Press, Berkeley, California.

H. Bradley Shaffer, University of California, Davis, *in litt*. 1999, 2000a,b.

Skelly, D. K, K. L, Yurewicz, E. E. Werner, and R. A. Relyea. 2003. Estimating decline and distributional change in amphibians. Conservation Biology 17(3):744-751.

Sparling, D. W. 1998. Field evidence for linking Altosid® applications with increased amphibian deformities in southern leopard frogs. Abstract, Midwest Declining Amphibians Conference, March 20-21. Joint meeting of Great Lakes and Central Division working groups of the Declining Amphibian Populations Task Force. http://www.mpm.edu/collect/vertzo/herp/daptf/ mwabst.html.

Sparling, D. W. and P. T. Lowe. 1998. Chemicals used to control mosquitoes on refuges differ in toxicity to tadpoles. Patuxent Wildlife Research Center, U.S. Geological Survey, Biological Resources. http://www.pwrc.nbs.gov/tadnew.htm (4/29/98).

Sparling, D. W., G. M. Fellers, and L. L. McConnell. 2001. Pesticides and Amphibian Population Declines in California, USA. Environmental Toxicology and Chemistry, Vol. 20:1591-1595.

Stair, P. 1999. Police will not press charges - Lagunita bonfire breaks regulations. Stanford Daily. Novemeber 18, 1999.

Stebbins, R. C. 1951. Amphibians of western North America. University of California Press, Berkeley, California.

Stebbins, R. C. 1989. Unpublished report.

Stebbins, R. C. 2003. A field guide to western reptiles and amphibians. Third edition, revised. Houghton Mifflin Company, Boston, Massachusetts.

Stitt, E. W. and G. T. Downard. 2000. Status of the California red-legged frog and California tiger salamander at Concord Naval Weapons Station, California. Transactions of the Western Section of the Wildlife Society 36: 32-39.

Storer, T. I. 1925. A synopsis of the amphibia of California. University of California Publications in Zoology 27:1-342.

Sam Sweet. 1993. U.C. Santa Barbara, *in litt.*, 1993

Sweet, S. S. 1998. Vineyard development posing an imminent threat to Ambystoma californiense in Santa Barbara County, California. Department of Ecology and Evolutionary Biology, University of California, Santa Barbara. 26 August 1998.

Sweet, S. S. 2003. Comments on the proposal to reclassify the Santa Barbara and Sonoma DPS's from endangered to threatened. Letter to USFWS Sacramento Fish & Wildlife Office, September 16, 2003.

Treanor, R. R. 2002. California Fish and Game Commission Notice of Findings.

Trenham, P. C., Jr. 1998. Demography, migration, and metapopulation structure of pond breeding salamanders. Unpublished Ph.D. dissertation, University of California, Davis, 96 p.

Trenham, P.C., H. B. Shaffer, W. D. Koenig and M. R. Stromberg. 2000. Life history and demographic variation in the California Tiger Salamander. Copeia 2000:365-377.

Trombulak, S. C. and C. A. Frissell. 2000. Review of ecological effects of roads on terrestrial and aquatic communities. Conservation Biology 14(2)18-30.

Tucker-Mohl, J. 1999. Student group faces uphill battle - Open Space Alliance rallies against Land Use Plan. Stanford Daily. November 18, 1999.

Twitty, V. C. 1941. Data on the life history of *Ambystoma tigrinum californiense* Gray. Copeia 1941:1-4.

UCIPM (U.C. Integrated Pest Management Program). 2002. California ground squirrel. UC Pest Management guidelines, January, 2002.

U.S. Army Corps of Engineers. 2002. Public Notice Number 26342N, September 6, 2002.

United States Fish and Wildlife Service (USFWS). 2003a. Final Rule to List the Sonoma County Distinct Population Segment of the California Tiger Salamander as Endangered. Federal Register, Vol. 68, Page 13497, March 19, 2003.

USFWS. 2003b. Proposed Rule to list the Central California distinct population segment of the California tiger salamander as threatened. Federal Register, Vol. 68, Page 28648, May 23, 2003.

USFWS. 2003c. Sacramento Fish and Wildlife Service Guide to Conservation Banks. http://sacramento.fws.gov/es/bank_list.htm.

USFWS. 2003d. Memorandum to Record: Explain methods and results of GIS model to evaluate threats, habitat, and protected lands for the Proposed Rule to list the California tiger salamander, *Ambystoma californiense*, as threatened, excluding the Santa Barbara and Sonoma sub-population. March 7, 2003.

USFWS 2003e. 2003. Matrix of Santa Barbara California Tiger Salamander Breeding Ponds in Santa Barbara County. September 5, 2003. Ventural Fish and Wildlife Office.

USFWS. 2002a. Emergency Rule to list the Sonoma County Distinct Population Segment of the California Tiger Salamander as Endangered. Federal Register, Vol. 67, Page 47726, July 22, 2002.

USFWS 2002b. Final Biological Opinion on the Proposed University of California Merced Campus, Phase I and Campus Buildout (Corps # 199900203) and Infrastructure Project (Corps # 200100570).

USFWS. 2000a. Emergency Rule to list the Santa Barbara County Distinct Population of the California tiger salamander as Endangered. Federal Register, Vol. 65, Page 3096, January 19, 2000.

USFWS. 2000b. Final Rule to list the Santa Barbara County Distinct Population of the California tiger salamander as Endangered. Federal Register, Vol. 65, Page 57242, September 21, 2000.

USFWS. 1994. 12-Month Petition Finding for the California Tiger Salamander. Federal Register, Vol. 59, Page 18353, April 18, 1994.

USFWS. 1993. Los Vaqueros Reservoir Project. Division of Ecological Services, Sacramento, California. September 1993.

USFWS. 1992. 90-Day Finding and Commencement of Status Review for a Petition to List the California Tiger Salamander. Federal Register, Vol. 57, Page 54545, November 19, 1992.

U.S. National Library of Medicine (USNLM). 1995a. Hazardous Substances Data Bank. Bethesda, Maryland, 1995. 4-5.

U.S. National Library of Medicine (USNLM). 1995b. Hazardous Substances Databank. Bethesda, Maryland, 1995. 10-9.

Vollmar, J.E. 2001a. Introduction pp. 1-6 *in* Vollmer, J. E., Ed. Wildlife and Rare Plant Ecology of Eastern Merced's Vernal Pool Grasslands http://www.mercednccp-hcp.net/vollmar/.

Vollmar, J.E. 2001b. Landscape Setting pp. 7-54 *in* Vollmer, J. E., Ed. Wildlife and Rare Plant Ecology of Eastern Merced's Vernal Pool Grasslands http://www.mercednccp-hcp.net/vollmar/.

Wayland, R.H. III, U.S. Environmental Protection Agency, and D.R. Burns, U.S. Army Corps of Engineers, *in litt.* 1996

Wilbur, H. M. and J. P. Collins. 1973. Ecological aspects of amphibian metamorphosis. Science 182:1305-1314.

Wise, D. 1995. Winter kill in channel catfish. Mississippi State University Extension Service Newsletter For Fish Farmers. http://ext.msstate.edu/newsletters/forfishfarmers/fff95d2.html

Worthylake, K. M. and P. Hovingh. 1989. Mass mortality of salamanders (*Ambystoma tigrinum*) by bacteria (*Acinetobacter*) in an oligotrophic seepage mountain lake. The Great Basin Naturalist 49:364-372.

Zander Associates. 2003. Biological Resource Assessment, Laguna Vista Site, Sebastapol, California. June 17, 2003.

Zeiner, D. C., W. F. Laudenslayer, Jr., and K. E. Mayer (compiling editors). 1988. California's wildlife. Volume I. Amphibians and reptiles. California Statewide Wildlife Habitat Relationships System, California Department of Fish and Game, Sacramento, California.

III. Personal Communication Sources

Bobzien, Steve. East Bay Regional Parks District. 2003.

Brode, John. California Department of Fish and Game (retired). 2003.

Cook, David. Wildlife Biologist. 2003.

Gevirtz, E. M. Vernal pool ecologist. 1999.

Jennings, Mark. Rana Resources. 2003.

Leland, Jim. Mission Valley Homes. 2002.

Mayer, Tim. Sonoma County Planning and Development Department. 2001.

Medeiros, Joe. Sierra College. 1993

Patterson, C. Wildlife Biologist. 2003.

Rhodes, Winston. City of Brentwood Planning Department. 2003.

Shaffer, Brad. U.C. Davis. 2003.

Sweet, Sam. U.C. Santa Barbara. 2004.

Trenham, Peter. U.C. Davis. 2003.

Wilcox, Carl. California Department of Fish and Game. 2001.

Wilson, Scott. California Department of Fish and Game. 2003.