BEFORE THE SECRETARY OF THE INTERIOR

PETITION TO LIST THE SONOMA COUNTY POPULATION OF THE CALIFORNIA TIGER SALMANDER AS ENDANGERED UNDER THE ENDANGERED SPECIES ACT ON AN EMERGENCY BASIS

CENTER FOR BIOLOGICAL DIVERSITY
CITIZENS FOR A SUSTAINABLE COTATI,
PETITIONERS

June 11, 2001

EXECUTIVE SUMMARY

The Sonoma County population of the California tiger salamander is one of the most imperiled species in the United States. On February 21, 1992 the U.S. Fish & Wildlife Service ("USFWS") received a formal petition from Dr. H. Bradley Shaffer, a leading scientific expert on the species, to list the California tiger salamander as an endangered species throughout its range. On August 13, 1993, Dr. Shaffer petitioned the USFWS for emergency listing of the Sonoma County and Santa Barbara County populations of the California tiger salamander. The USFWS responded to these petitions by classifying the species "Warranted But Precluded" and a "Candidate Species" in 1994. The Santa Barbara County population of the California tiger salamander, which has a similar conservation status and faces similar threats as to the Sonoma County population, was listed on an emergency basis on January 19, 2000. The Sonoma County population has inexplicably continued to languish in administrative purgatory.

Because the California tiger salamander is currently listed as a Candidate Species, the USFWS is required to implement a system to effectively monitor its status, and is required to make prompt use of its emergency listing authority to prevent a "significant risk to the species." 16 U.S.C. §1533(b)(3)(C)(iii) and (b)(7). This petition demonstrates that the Sonoma County population of the California tiger salamander faces a significant risk. The risk consists of two inter-related factors.

First, the range of the species has been drastically reduced, and the very few populations that do remain are all threatened by habitat destruction, modification, fragmentation, introduced species, or other species. Because the situation is so extreme, the species faces an imminent risk of extinction in the near future.

Second, research has shown that suitable habitat areas of 480 to 1000 acres containing multiple breeding sites are necessary in order to ensure the long-term survival of the species. There are no areas occupied by the California tiger salamander in Sonoma County that even come close to meeting this criterion. Furthermore, those areas that do exist are facing imminent development and are certain to shrink considerably in the very near future if the species is not protected. Because the long term survival of this species in the wild is already uncertain as of the current moment, the impending additional habitat destruction documented in this petition constitutes an emergency to which the USFWS is required to respond.

The Sonoma County population of the California tiger salamander was historically distributed primarily throughout the Santa Rosa Plain and the lowlands of the Upper Petaluma watershed. The species was likely distributed from the town of Windsor in the north, as far south as Petaluma and including the western portions of Santa Rosa, west to Sebastopol. This area was once a mosaic of valley oak woodlands and grasslands, crossed by creeks and tributary drainages, and containing numerous vernal pools. The California tiger salamander requires low elevation vernal pools or seasonal ponds for breeding, surrounded by upland habitat containing rodent burrows or other suitable dry season refugia for estivation during the dry months.

Nearly all suitable habitat for the California tiger salamander within the Santa Rosa Plain has been converted to urban or intensive agricultural uses. The species is now restricted to four small

islands of habitat on the fringe of the Santa Rosa Plain in West Santa Rosa, South Santa Rosa, and West Cotati, and in the Upper Petaluma watershed in South Cotati. The West Santa Rosa area contains the largest remaining populations of California tiger salamanders, but nearly all suitable terrestrial habitat is approved for residential and commercial development. Six breeding sites are preserved in this area, however, all the sites are severely impacted by habitat fragmentation, introduced species, and other threats. In South Santa Rosa, California tiger salamanders are threatened by urban expansion, rural development, and intensive agriculture. There is one protected pool in this area, but this pool may be too shallow for California tiger salamanders to successfully breed in most years. In West Cotati, there are three known breeding pools. Two will be destroyed by the approved South Sonoma Business Park, and the third is threatened by a proposed golf course. In South Cotati, there have been several California tiger salamander sightings but there are no known breeding pools. The species is threatened by intensive agricultural practices in this area.

There is substantial evidence suggesting that the species may not be able to survive in the wild if *any* remaining habitat is lost. Research has shown that California tiger salamanders need relatively large areas of suitable habitat in order for populations to persist over time. Optimal habitat areas would be at least 1,000 acres in size and contain multiple breeding sites. The minimum habitat area for a self-sustaining population would be 480 acres with a 600-1500 foot radius around each breeding site. There are no sites remaining in Sonoma County that even come close to meeting these requirements. All remaining sites are already much smaller than necessary to ensure the continued survival of this species in the wild, and every single remaining population faces immediate threats from urbanization, conversion to intensive agriculture, habitat fragmentation, introduced species, and other threats detailed in this petition.

Based on the information contained herein, the Sonoma County population of the California tiger salamander faces an imminent threat of extinction. The USFWS has a mandatory statutory duty to make prompt use of its authority under 16 U.S.C. 1533(b)(3)(C)(iii) and §1533(b)(7) to list the species on an emergency basis.

NOTICE OF PETITION

The Center for Biological Diversity and Citizens for a Sustainable Cotati formally request that the U.S. Fish & Wildlife Service (FWS) list the Sonoma County population of the California tiger salamander as an endangered species on an emergency basis under the federal Endangered Species Act, 16 U.S.C. §§1531-1544. This petition is filed under 5 U.S.C. §553(e) and 50 C.F.R. part 424.14.

The USFWS has the authority to promulgate an emergency listing rule for any species when an emergency exists that poses a significant risk to the species. 16 U.S.C. §1533(b)(7). Such rule shall take effect immediately upon publication in the Federal Register, and shall be effective for a maximum of 240 days. Id.

The California tiger salamander is currently designated as a Candidate Species. The USFWS has a mandatory duty to use its statutory authority to promulgate an emergency regulation to prevent a significant risk to any Candidate species ("The Secretary shall implement a system to monitor effectively the status of all species with respect to which a finding is made under subparagraph B(iii) and shall make prompt use of the authority under paragraph 7 to prevent a significant risk to the well being of any such species.") 16 U.S.C. §1533(b)(3)(C)(iii).

This petition demonstrates that the Sonoma County population of the California tiger salamander faces a significant risk. First, the species faces an imminent threat of extinction. Each of the few remaining populations is threatened by immediate habitat destruction or other factors. Second, there are no remaining areas that meet the minimum necessary size to ensure the long term survival of the species, and therefore on this basis alone the persistence of the species is highly uncertain. Due to this extreme situation, the threats documented in this petition constitute an emergency. Because this petition demonstrates that an emergency situation exists, the USFWS is obligated to immediately list the species to prevent further direct mortality and habitat destruction. If the USFWS fails to promptly fulfill its mandatory statutory duties under 16 U.S.C. §1533(b)(3)(C)(iii), this will constitute a violation of both the Endangered Species Act and the Administrative Procedures Act. Should the USFWS fail to act, the Center for Biological Diversity intends to promptly seek judicial review of this inaction.

PETITIONERS

The Center for Biological Diversity is a non-profit environmental organization dedicated to the protection of native species and their habitats in the Western Hemisphere through science, policy, and environmental law. The Center for Biological Diversity submits this petition on its own behalf and on behalf of its members and staff with an interest in protecting the Sonoma County population of the California Tiger Salamander and its habitat.

Citizens for a Sustainable Cotati is dedicated to creating a thriving community based on social, economic and environmental well being, and to this end, we are committed to purchasing and preserving a 35-acre parcel of property in the town of Cotati in Sonoma County, California, which includes a rare and sensitive wetlands habitat and supports a separate genetic species of the California Tiger Salamander found only in Sonoma. Citizens for a Sustainable Cotati submits this petition on its own behalf and on behalf of all Sonoma County residents who have supported our efforts in protecting this distinct species of California Tiger Salamander and its habitat.

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A. NATURAL HISTORY

1. Description

The California tiger salamander is a large, stocky, terrestrial salamander with a broad, rounded snout. 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. 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. Coloration consists of white or pale yellow spots or bars on a black background on the back and sides. 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. (USFWS 2000).

2. Taxonomy

The California tiger salamander was first described as a distinct species, *Ambystoma californiense*, by Gray in 1853 from specimens collected in Monterey. (Id.) 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 California tiger salamander 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.) The California tiger salamander was recognized by the U. S. Fish and Wildlife Service as a distinct species in the November 21, 1991, Animal Notice of Review. (USFWS 1991).

Mitochondrial DNA (mtDNA) sequence results (Shaffer et al. 1993) support the recognition of at least 7 distinct genetic units of California tiger salamanders. These are: Sonoma County, Northern Bay Area (Dunnigan to Jepson), Stanislaus County (Hickman Vernal Pool complex), southern populations from the east side of the Central Valley (Madera, Fresno, and northern Tulare Counties), the Diablo Range (western Merced and San Benito Counties), the Inner Coast Range (Monterey and San Luis Obispo Counties), and Santa Barbara County. 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 (in the area from Petaluma to Santa Rosa), and the Santa Barbara Distinct Population Segment

(DPS). These populations are extremely distinct genetically from other populations of California tiger salamanders. There is justification for recognizing these populations as separate species, and they may be recognized as such when they are formally described.

3. Reproduction and Growth

California tiger salamanders are often six years old before breeding for the first time. (Trenham 1998). Less than fifty percent of California tiger salamanders breed more than once in their lifetime. (Id.) Migration to breeding ponds is concentrated during a few rainy nights early in the winter, with males migrating before females. (USFWS 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. (Id.) In years where rainfall begins late in the season, females may forego breeding altogether. (Id.)

Female California tiger salamanders mate and lay their eggs singly or in small groups. (Id.) The number of eggs laid by a single female ranges from approximately 400 to 1,300 per breeding season. (Id.) The eggs typically are attached to vegetation near the edge of the breeding pond (Id.), 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 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. (USFWS 2000). Larvae feed on algae, small crustaceans, and mosquito larvae for about 6 weeks after hatching, when they switch to larger prey. (Id.) Larger larvae will consume smaller tadpoles of Pacific treefrogs (*Hyla regilla*), California red-legged frogs (*Rana aurora draytonii*), western toads (*Bufo boreas*), and spadefoot toads (*Scaphiopus hammondii*), as well as many aquatic insects and other aquatic invertebrates. (Id.) The larvae also will eat each other under certain conditions. (Id.) Captive salamanders appear to locate food by vision and smell. (Id.)

Amphibian larvae must grow to a critical minimum body size before they can metamorphose (change into a different physical form) to the terrestrial stage. (Jennings and Hayes 1994). Larvae require a minimum of ten weeks to metamorphose. (Cook and Northen 2001). 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. (Id.)

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. (Id.) 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).

Many of the pools in which California tiger salamanders lay eggs do not hold water long enough for successful metamorphosis. (Cook and Northen 2001). The larvae will desiccate (dry out and perish) if a site dries before larvae complete metamorphosis. (USFWS 2000). 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).

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 California tiger salamanders, 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. While individuals may survive for more than 10 years, less 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 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 that are too far from other ponds for migrating individuals to replenish the population can quickly drive a local population to extinction.

4. 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 California tiger salamanders spend much of their lives in small mammal burrows found in the upland component of their habitat, particularly those of ground squirrels and pocket gophers at depths ranging fom 20 centimeters (cm) (7.9 in) to 1 m (3.3 ft) beneath the ground surface. (Id.) 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; Shaffer et al. 1994; USFWS 2000). California tiger salamanders may remain active underground into summer, moving small distances within burrow systems. (USFWS 2000).

During estivation (a state of dormancy or inactivity in response to hot, dry weather), California tiger salamanders eat very little. (Shaffer et al. 1993). Once fall and winter rains begin, they emerge from these retreats on nights of high relative humidity and during rains to feed and to migrate to the breeding ponds. (Stebbins 1985, 1989; Shaffer et al. 1993). 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. (Stebbins 1989; Hunt 1998).

Dispersing juvenile California tiger salamanders have been trapped more than 360 m (1,200 ft) from their natal (birth) pond (USFWS 2000), and adults have been found along roads more than 2 km (1.2 mi) from breeding ponds. (Sweet in litt. 1998a). 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 (1900 ft) away to breed. (Trenham 1998; USFWS 2000). Non-dispersing California tiger salamanders, however, tend to stay closer to breeding ponds; 95 percent of California tiger salamanders at a study site in Monterey County stayed within 173 m (568 ft) of the pond in which they bred. (USFWS 2000).

Once established in underground burrows, California tiger salamanders 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 travel further in years with more precipitation. (Id.) As with migration distances, the number of ponds used by an individual over its lifetime will be dependent on landscape features.

5. Feeding

Adults emerging from burrows are generally emaciated, indicating that they feed very little during estivation. (Shaffer et al. 1993). 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. (USFWS 2000). Larger larvae will consume smaller tadpoles of Pacific treefrogs (*Hyla regilla*), California red-legged frogs (*Rana aurora draytonii*), western toads (*Bufo boreas*), and spadefoot toads (*Scaphiopus hammondii*), as well as many aquatic insects and other aquatic invertebrates. (Id.) The larvae also will eat each other under certain conditions. (Id.) Captive salamanders appear to locate food by vision and smell. (Anderson 1968a, 1968b).

6. Population Genetics

Using what is probably the largest genetic data set for a non-human vertebrate (USFWS 2000), Dr. H. Bradley Shaffer has analyzed the population genetics of the California tiger salamander. (Shaffer et al. 1993). This study used both allozyme and mitochondrial (mt) DNA sequence analysis. 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 California tiger salamander. (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. (Id.) The following clear conclusions have emerged from the extensive study of California tiger salamander genetics.

As mentioned above, mt DNA sequence results (Shaffer et al. 1993) support the recognition of at least 7 distinct genetic units of California tiger salamanders. These populations are as follows: Sonoma County, Northern Bay Area (Dunnigan to Jepson), Stanislaus County (Hickman Vernal Pool complex), southern populations from the east side of the Central Valley (Madera, Fresno, and northern Tulare Counties), the Diablo Range (western Merced and San Benito Counties), the Inner Coast Range (Monterey and San Luis Obispo Counties), and Santa Barbara County. (Id.)

Populations, or sets of populations, of the California tiger salamander are genetically isolated from each other. (Id.) This implies that when populations are lost, there is little chance of recolonization from other areas. (Id.) It also means that further isolation may have serious repercussions in reducing populations below minimum viable sizes. (Id.)

The populations from Sonoma and Santa Barbara counties are sufficiently distinct that they can reasonably be viewed as separate species, though they have not yet been formally named. (Shaffer 2001). They are genetically distinct, 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 California tiger salamanders. (Id.) In comparison, the Santa Barbara County DPS of California tiger salamanders, which was emergency listed on January 19, 2000 (USFWS 2000), 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 California tiger salamander as well. (Shaffer et al. 1993).

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 southern portion of the east side of the central valley, Hickman vernal pool area, northern central valley, Diablo Range, and Inner Coast Range. (Id.)

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 extremely low, leading to highly differentiated local populations. (Id.) It appears that in this case the high levels of genetic differentiation are due primarily to extremely low migration rates. (Id.) 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.) (Id.)

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. (Id.) This also suggests that this area has maintained the largest populations historically, and can correctly be viewed as the "core" of the California tiger salamander distribution, as proposed by Stebbins, 1989. (Id.)

There is a separation of populations from the east and west sides of the central valley. (Id.) Each of these is clearly a separate genetic entity requiring independent consideration and protection. (Id.)

The Sonoma County population of the California tiger salamander can reasonably be described as a separate species. As discussed in Section II, *supra*, the Sonoma County population of the California tiger salamander indisputably qualifies for listing under the Endangered Species Act as a distinct population segment ("DPS").

7. Habitat Requirements

The Sonoma County population of the California tiger salamander is endemic to the Santa Rosa Plain and adjacent lowlands. Within this area (Figure 1), California tiger salamanders occur only where their habitat requirements are met. Necessary habitat for the California tiger salamander can be succinctly described as low elevation vernal pools surrounded by upland habitat containing rodent burrows or other suitable dry season refugia.

The California tiger salamander is generally restricted to low elevations, typically below 427 meters (m) (1400 feet (ft)). (Id.) The precise reason for this low elevation habitat is unknown, however, the species is seldom found above 1500 feet in elevation. (Shaffer et al. 1993).

For breeding, the California tiger salamander requires long lasting rain pools. Although California tiger salamanders are adapted to natural vernal pools, 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 may be used for breeding (Stebbins 1985; Jennings and Hayes 1994) 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 California tiger salamanders in ponds surveyed throughout the state. They concluded, "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." (Shaffer et al. 1993 at 14 (emphasis in original)). This conclusion was confirmed in a subsequent study by Seymour and Westphal (1994).

Research has clearly demonstrated that vernal pool complexes are essential to the long term survival of species, due to its population dynamics. (Shaffer et al. 1993; USFWS 2000). 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 therefore more dependent on re-colonization from other areas.

Adults spend most of their lives underground, typically in burrows of badgers, gophers, and other animals (CH2M Hill 1995). In Sonoma County, burrows of Botta's pocket gopher (*Thomomys bottae*) are the primary refugia. (Cook and Northen 2001). These rodent burrows are presumed to be a necessary habitat requirement, since the species is absent from sites with otherwise suitable breeding habitat where surrounding hardpan soils lack small mammal burrows. (Austin and Shaffer 1992). The burrowing ability of California tiger salamanders is presumed to be poor (Jennings and Hayes 1994), similar to that of eastern species of the same genus. Certain man-made structures, such as wet basements, underground pipes, and septic tank drains may sometimes be used as dry season refugia. (USFWS 2000). California tiger salamanders prefer open grassland to areas of continuous woody vegetation. (Id.)

Research clearly shows that relatively large habitat preserves are essential for the long term survival of the species. Information on habitat requirements for long term persistence has been summarized by Cook and Northen (2001):

> Much of the scientifically-based conservation and management strategies for CTS has been developed by Dr. Brad Shaffer and his colleagues at the University of California at Davis. Their research indicates that large preserves are required to maintain viable breeding populations and to allow recolonization from natural local extinctions. Isolated CTS populations are vulnerable to extinction with no opportunity for recolonization from other sites. Therefore, protection of areas with multiple breeding sites is essential for the long-term viability of the species. However, Trenham (1998) suggested that preservation of highly productive breeding sites (source populations) with adequate surrounding terrestrial habitat may be sufficient to maintain a viable population. Barry and Shaffer (1994) indicated that CTS may be conserved despite urban encroachment if CTS breeding and terrestrial habitat of very large size is preserved. At a minimum, two major preserves are required for each of the genetically distinct populations in California (e.g., Sonoma County; Shaffer et. al. 1993). Preserves should include major vernal pool/grassland complexes that provide CTS breeding sites, abundant terrestrial habitat, and migration corridors. Optimally, each of the two preserves should be at least 1,000 acres in area with a dozen or more breeding sites (Shaffer et. al. 1993). Minimum preserve size should be 480 acres with a 600-1500 foot radius around each breeding site (Shaffer et. al. 1993).

These preserve criteria may not be feasible in all areas of the state. At smaller preserves, proper management of CTS may require monitoring isolated breeding sites and reestablishment of populations from nearby sites if a site should go extinct (Shaffer et. al. 1993). (Cook and Northen 2001).

Understanding these habitat requirements of the California tiger salamander is crucial to understanding the crisis the species faces in Sonoma County. As discussed in Section III, *supra*, there are no longer any areas which even approach the minimum necessary reserve size for the long-term survival of the species. There is also no management of current populations, as is required in the absence of sufficient habitat areas.

B. Distribution and Abundance

1. Historic Distribution

The Sonoma County population of the California tiger salamander is presumed to have historically occurred in suitable habitat throughout the Santa Rosa Plain, a relatively flat valley with low gradient watersheds extending approximately from the town of Windsor in the north, south to Rohnert Park and Cotati, and including the western portions of Santa Rosa, west to Sebastopol. (Cook and Northen 2001; CH2Mhill 1995; Stebbins 1985; Zeiner et al. 1988). 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 mid-1900s (Borland 1856) (Cook and Northen 2001). Some authors also include southern Marin and Napa counties within the historical range of the species. (Stebbins 1985; Zeiner 1988). The historic range of the Sonoma County population of the California tiger salamander within Sonoma County is shown in Figure 1.

2. Current Distribution

The California tiger salamander has indisputably been extirpated from much of its historic range, and is very limited in its remaining habitat. Shaffer et al. (1993) reached this conclusion nearly a decade ago, and since that time much more habitat has been lost. Cook and Northen (2001) state "Our data on the range and distribution of Sonoma County CTS differs from previous studies and suggests that this population has undergone a substantial range contraction."

There are two basic mechanisms whereby the species has been lost from its historic range. The first mechanism is destruction of the habitat due to factors such as urban development and conversion to intensive agriculture. The second mechanism is alteration of otherwise suitable habitat such that the species no longer occurs there. Examples include the introduction of non-native predators such as fish and bullfrogs and the accumulation of pesticides that eliminates all life forms in aquatic systems. These factors are discussed in detail in Section III of this Petition. This section simply summarizes the current known distribution of the species.

Cook and Northen (2001) have very recently summarized the current distribution of the Sonoma County Population of the California tiger salamander. The current distribution is 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 California tiger salamander is shown in Figure 1. For earlier reports of Sonoma County distribution, see Shaffer et al. (1993) (searched two historic localities in Sonoma County and found California tiger salamanders present at one locality, a 50% loss of historic localities), Jennings and Hayes (1994) (found California tiger salamanders 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 five salamander localities, concentrated within a few miles of each other around the old Santa Rosa Air Center.)

3. Abundance

Based on the large proportion of California tiger salamander habitat that has been destroyed or fragmented in the Santa Rosa Plain, it is apparent that average overall population numbers have declined. Because of the difficulties involved in estimating population numbers for an amphibian species like the California tiger salamander, there is currently no estimate of population numbers for the species as a whole, nor is there a historical population estimate. Because amphibian populations naturally undergo large fluctuations in population size as a result environmental conditions such as rainfall and fire, it would be difficult, if not impossible, to obtain accurate population counts.

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 not necessary in order to conclude that protection is warranted. (USFWS 2000). 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. The decision to list should be based on degree of threat faced by the species. Population counts may not be a particularly useful fact in determining the risk of extinction faced by the species.

It should be noted, however, that the number of larvae found during 2001 surveys is greatly alarming. On April 25, 2001, 37 California tiger salamander larvae were found on a 35 acre site just west of Cotati that is nearing final approval for development as the South Sonoma Business Park. (Cook and Northen 2001). While this number is not large, it is greater than the total number of larvae found in 2001 at all eight protected California tiger salamander localities that occur in Sonoma County. (Id.) At each protected site, all wetlands with the potential to contain the species were surveyed in 2001. (Id.) The extremely low level of recruitment suggested by these results is highly alarming and indicates that the species is at great risk of extinction.

It is also important to note that the species has been eliminated from most of its former range and has been restricted into isolated islands of habitat. These smaller, isolated populations are much more vulnerable to extinction than larger populations occurring in close proximity to each other because their ability to recolonize an area after a natural or anthropogenic extirpation is eliminated or greatly reduced. This threat is discussed in more detail below.

II. THE SONOMA COUNTY POPULATION OF THE CALIFORNIA TIGER SALAMANDER QUALIFIES FOR PROTECTION AS A SPECIES UNDER THE ESA

The Endangered Species Act ("ESA" or "Act") provides for the listing of all species warranting the protections afforded by the Act. The term "species" is defined broadly under the Act to include "any subspecies of fish or wildlife or plants and any distinct population segment of any species of vertebrate fish or wildlife which interbreeds when mature." 16 U.S.C. § 1532 (16). Petitioners believe that there is sufficient evidence, as discussed in the above section, "Population Genetics," for the Sonoma County population of the California tiger salamander to be listed as a separate species. However, in the alternative, it is indisputable that the California tiger salamander qualifies for listing as a "distinct population segment" under 16 U.S.C. § 1532 (16).

In the "Policy Regarding the Recognition of Distinct Vertebrate Population Segments under the Endangered Species Act," the FWS defined "distinct population segment" for purposes of listing under the ESA. (61 Fed. Reg. 4721). Under the policy, three elements are to be considered sequentially in determining the status of a potential DPS: (1) the discreteness of the population relative to the rest of the species; (2) the significance of the population segment to the species; and (3) the populations segment's conservation status in relation to the Act's standards for listing. (Id.) As discussed below, the Sonoma County population of the California tiger salamander clearly meets each of these criteria.

A population will be considered discrete if it satisfies one of the following criteria: (1) it is markedly separated from other populations of the same taxon as a consequence of physical, physiological, ecological, or behavioral factors, (2) it is delimited by international governmental boundaries within which differences in control of exploitation, management of habitat, conservation status, or regulatory mechanisms exist that are significant in light of section 4(a)(1)(D) of the Act. (Id.) Based upon what is probably the largest genetic data set for a non-human vertebrate (Shaffer in litt. 2000a), the sequence divergence between Sonoma County tiger salamanders and other samples from throughout the species' range is on the order of 2 percent or greater (the listed Santa Barbara population divergence was on the order of 1.7 to 1.8%.) (Shaffer et al. 1993; Shaffer in litt. 1998, 2000a). The Sonoma County population is completely physically separated from all other populations, that is, separated by a distance many times greater than any individual could conceivably migrate in its lifetime. (Cook and Northen 2001). There can be no question that the Sonoma County population of the California tiger salamander is discrete.

Turning to the second factor, the consideration of significance includes, but is not limited to, the following factors: (1) persistence of the discrete population segment in an ecological setting unusual or unique for the taxon, (2) evidence that the loss of the discrete population segment would result in a significant gap in the range of the taxon, (3) evidence that the discrete populations segment differs markedly from other populations of the species in its genetic characteristics. Clearly the Sonoma County population of the California tiger salamander is significant under these criteria. The Santa Rosa Plain is a unique ecological setting for this taxon, which occurs primarily in the Central Valley of California. Loss of the Sonoma County population would eliminate the most northern coastal extent of the species range. As discussed above, the Sonoma County population is the most genetically isolated of any of the seven California tiger salamander populations. The extinction of the Sonoma County California tiger salamander population would result in the loss of a significant genetic entity, the curtailment of the range of the species as a whole, the loss of a top predator in the aquatic systems that Sonoma County California tiger salamanders inhabit, and a significant and irretrievable loss of biological diversity.

The final criterion for classifying a DPS is the conservation status of the species. Not only is the Sonoma County population the most genetically isolated of the populations, it is also the most imperiled. Nearly a decade ago, an emergency listing petition was filed for the Sonoma County and the Santa Barbara population. Since that time, the Santa Barbara population has been listed as endangered, but the Sonoma County population has received no protection. The high degree of endangerment of the Sonoma County population clearly establishes the importance of listing it as a distinct population segment.

Sufficient evidence exists to list the Sonoma County population of the California tiger salamander as a separate species, and it is indisputable that the population qualifies as a distinct population segment. As discussed below, this species must be emergency listed either as a separate species or as a distinct population segment.

III. The Sonoma County Population of the California Tiger Salamander Must Be Emergency Listed Under the Endangered Species Act

The Sonoma County population of the California tiger salamander indisputably merits immediate emergency listing under the ESA. Furthermore, the listing decision must be made solely on the basis of the best scientific and commercial data available. 16 U.S.C. § 1533(b)(1)(A). The legislative history of this provision clearly states the intent of Congress to "ensure" that listing decisions are "based solely on biological criteria and to prevent non-biological criteria from affecting such decisions." H.R. Rep. No. 97-835, 97th Cong. 2d Sess. 19 (1982). As further stated in the legislative history, "economic considerations have no relevance to determinations regarding the status of species." Therefore, political and economic arguments may not be considered by the USFWS in its determination of whether to list this species. The numerous factors threatening the continued survival of the Sonoma County population of the California tiger salamander are detailed below.

A. The USFWS Has Already Acknowledged that the Sonoma County Population of the California Tiger Salamander Warrants Listing Under the Endangered Species Act

The threat to the continued survival of the California tiger salamander has been known for decades. As early as 1966, Dr. Robert Stebbins suggested that the species be included on the first federal endangered species list. (Barry and Shaffer 1994). On September 18, 1985, the USFWS designated the California tiger salamander as a category 2 candidate species. (USFWS 2000). This designation was for taxa for which the USFWS had information indicating that listing might be appropriate but for which additional data are needed to support a listing proposal. (The category 2 designation has since been abolished.) On February 21, 1992 the USFWS received a formal petition from Dr. H. Bradley Shaffer of the University of California, Davis, to list the California tiger salamander as an endangered species throughout its range. (Id.) On November 19, 1992 (nearly nine months after the statutory deadline) the UFWS published a positive 90-Day finding on the petition concluding that the petition presented substantial information indicating that listing may be warranted. On August 13, 1993, Dr. H. Bradley Shaffer petitioned the USFWS for emergency listing of the Sonoma County and Santa Barbara County populations of the California tiger salamander.

On April 18, 1994 (nearly 14 months past the statutory deadline for responding to the first petition) the USFWS finally responded to the petitions with a 12-month finding that concluded that listing of the California tiger salamander was warranted but precluded by higher priority listing actions. (USFWS 1994). At this time, the USFWS stated, "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)." (Id.) At the same time, the species was designated a Candidate 1 species, indicating that sufficient information was currently on file with the USFWS to warrant listing. The USFWS's primary rationale for concluding that the listing of the California tiger salamander was precluded by other listing actions of higher priority was that "tiger salamander localities in portions of the Diablo Range, inner Coast Ranges, and Sierra Nevada foothills are not significantly threatened at the present time." (Id.) The 12-Month Finding failed to properly consider the Sonoma County and the Santa Barbara populations separately as DPSs, despite the fact that the USFWS had received a petition requesting emergency listing for each population as such. Had the USFWS properly considered the Sonoma County population as a DPS in 1994, the agency could only have concluded that listing was warranted at that time.

On January 19, 2000, the Santa Barbara County of the California tiger salamander was listed as an endangered species on an emergency basis. Emergency listing is effective for only 240 days, and so, on September 21, 2000, the USFWS published a final rule listing the Santa Barbara population as endangered. (USFWS 2000). The Sonoma County population of the California tiger salamander has a similar conservation status and faces similar threats as the Santa Barbara population. Inexplicably, the USFWS has taken no action to list the Sonoma County population.

The USFWS acknowledged in 1994 that the Sonoma County population of the California tiger salamander warranted listing. Since that time, a large portion of the species' remaining habitat has been destroyed, degraded, and increasingly fragmented. The species has continued to experience increasing mortality from factors such as traffic and introduced species. The species now faces a significant threat of immediate extinction. There is substantial evidence that the species will not be able to survive in the wild if any remaining habitat is lost. The USFWS has a mandatory statutory duty to promptly exercise its emergency listing authority to prevent the further decline to this species. 16 U.S.C. §1533(b)(3)(C)(iii). The factors that threaten this species with extinction and that create the need for this emergency action are documented below.

B. Present or Threatened Modification or Destruction of its Habitat

The most serious threat to the continued survival of the Sonoma County population of the California tiger salamander is habitat destruction and modification, primarily due to land conversion to urban and agricultural uses. Because of overlapping land use jurisdictions within the Santa Rosa Plain, no agency has tracked the total extent of land conversion to urban and agricultural uses, let alone tracked the affect of that conversion on the California tiger salamander. This section presents available information on California tiger salmander habitat loss in Sonoma County, presents information from Cook and Northen (2001) discussing the specific threats to each of the four extant California tiger salamander populations in Sonoma County, and presents aerial photos of the area.

In general, nearly all historic California tiger salamander habitat in Sonoma County has been eliminated by urban or intensive agricultural uses. What little habitat remains has been degraded by rural residential development and less intensive agricultural practices. Many of the extant populations occur in areas facing an immediate threat of development. Those populations that enjoy some degree of protection are either located on fragmented parcels that are too small to be expected to maintain populations in the long term, or are faced with other threats, such as introduced predators. Because of this extreme situation, the Sonoma County population of the California tiger salamander merits immediate emergency listing under the ESA.

1. General Information on California Tiger Salamander Habitat Destruction in Sonoma County

The Sonoma County population of the California tiger salamander historically occurred throughout the Santa Rosa Plain, a relatively flat valley with low gradient watersheds extending approximately from the town of Windsor in the north, south to Rohnert Park and Cotati, and including the western portions of Santa Rosa, west to Sebastopol. (CH2M Hill 1995). (See Figure 1). The species also likely occurred in the upper Petaluma watershed, from Cotati to the town of Petaluma. (Cook and Northen 2001). The species may also have occurred in southern Marin and Napa counties. (Stebbins 1985; Zeiner 1988).

The Santa Rosa Plain includes the Laguna de Santa Rosa as well as its flood plain, Santa Rosa Creek, Mark West Creek, Roseland Creek, and their watersheds. The Plain was once a mosaic of valley oak woodlands and grasslands, crossed by these creeks and tributary drainages. The flat terrain, clay soils, and relatively high rainfall contributed to once widespread occurrence of seasonally ponded or saturated areas including vernal pools and swales. (CH2M Hill 1995).

Prior to European contact, the Santa Rosa Plain had a vast network of wetlands, year round and intermittent creeks, marshes, ponds, and seasonal pools and swales. During the last century, agricultural development - typically dairy farms, pasture, orchards, and vineyards - altered the existing ecosystem, and many oak woodlands and wetlands were lost or altered. In the last half century, the Santa Rosa Plain has undergone a significant transformation from an area that was largely rural residential, diverse agriculture, and extensive open space, with seasonal and perennial wetlands, grasslands, and oak woodlands, to more urbanized and intensive agriculture. The previous land uses were more compatible with the continued survival of the California tiger salamander and its habitat. In the last three to four decades, the changes have accelerated with the advance of commercial and residential development. Today, little of the original mosaic and relatively few of the natural areas remain. (Id.)

In general, the habitats used by the California tiger salamander, California grasslands, oak woodland and savannah, and vernal pools, are some of the most endangered habitats in the world. 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 most extensive study to date, by Holland (1998), 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 1998a). Holland concluded that approximately 960,382 acres of vernal pool habitat remain, down from an estimated four million acres in pre-agricultural times. (Id.) Holland further concluded that at the current rate of loss, the remaining total in 1997 will shrink by one-half, or to a mere twelve percent of the historical total, by the year 2044. 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. Interestingly, 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.

Holland also summarized vernal pool loss on a county by county basis. In Sonoma County, 770 acres of vernal pools disappeared between 1986 and 1997. This represents a loss of 70 acres per year, a 17.2 percent loss of the interval, and a 1.6 percent loss per year.

Habitat for the California tiger salamander within the Santa Rosa Plain has been lost primarily as a result of land conversion to urban development and intensive agriculture. A 1990 study of the Santa Rosa Plain found that 25% of a 28,000 acre study area had been converted to subdivisions, "ranchettes," golf courses, and commercial buildings. (Waaland et al. 1990). An additional 17% of the study area had been converted to agricultural uses. (Id.) Since 1990, many more acres have been urbanized and converted to intensive agriculture, particularly vineyards. The California tiger salamander has effectively been eliminated from all urbanized and intensively farmed areas in the Santa Rosa Plain.

Another way of assessing the current threat to the California tiger salamander is to look at current and projected population growth within the range of the species. 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). In Sonoma County, the population will grow by 64 percent. (Id.) This increased development pressure from the additional population is certain to compound the already critical rate of habitat destruction. The booming economy, increasing population, and intense development pressure within the range of the Sonoma County population of the California tiger salamander are readily apparent from a drive down Route 101 from Santa Rosa to Petaluma, a drive down the parallel Stony Point Road, or a visit to any of the local planning departments.

2. Habitat Loss Due to Vineyard Proliferation

The affect on the California tiger salamander of the conversion of native habitats to agricultural 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 conversion of low-intensity agricultural land to vineyards. Grape production requires 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). Once planted, vineyards are regularly disced and/or plowed. Deep ripping, along with repeated discing and plowing techniques, will permanently alter the hydrology area and eliminate suitable habitat for California tiger salamanders. Of course, these practices also kill adult California tiger salamanders in their burrows. Irrigation practices also eliminate suitable California tiger salamander habitat when seasonal ponds are drained, lands leveled, and hydrological patterns altered.

The conversion of lower intensity agricultural land to vineyards is a particularly urgent threat to the California tiger salamander because the conversion typically requires no environmental review or permits, and because grapes are currently a highly profitable crop. While conversion to various agricultural uses was well underway in the early part of the 19th Century, a relatively recent and continuing trend is the proliferation of vineyards. Additional land is continually being converted for vineyard expansion within the Santa Rosa Plain, as the California wine industry continues to boom. The acreage of vineyards in Sonoma County increased 42% in 6 years, from 36,330 acres in 1995 to 51,437 acres in 2000. (Cree Morgan, Sonoma County Planning and Development Department, pers. comm. 2001). There is also evidence that these numbers may represent an underestimate of actual vineyard acreages. (Heaton and Merenlender 2000; Merenlender 2000).

One example of a recent vineyard conversion that threatens the Sonoma County Population of the California tiger salamander is the Gallo Corporation's expansion of the Dry Creek Vineyard. (Gallo 2001; personal observation). This area, which likely served as California tiger salamander estivation and migration habitat, has now been converted to vineyards and is completely unusable as habitat for the species.

Conversion of habitat to vineyards is clearly a major threat to the Sonoma County population of the California tiger salamander. The Center for Biological Diversity is close to completing a mapping project showing recent vineyard conversions within the range of the species. This information will be submitted shortly as further support for this petition.

Some agricultural uses, such as light grazing and/or low-intensity farming, while still degrading the quality of the natural habitat for California tiger salamanders, may be somewhat more compatible with the continued survival of the species. Since nearly all natural habitats within the Santa Rosa Plain have been altered in one way or another, the best remaining habitat tends to be in areas that have been farmed, grazed, or cleared in a less intensive fashion. (As discussed below, however, intensive grazing is not compatible with California tiger salamander habitat as it removes vegetative cover and leads to extensive terracing of hillsides.)

3. Specific Threats to the Sonoma County Population of the California Tiger Salamander as Presented by Cook and Northen (2001)

Cook and Northen (2001) discuss threats to the Sonoma County population of the California tiger salamander in each of the four areas that still support the animals: the West Santa Rosa area, South Santa Rosa area, West Cotati area, and South Cotati area. A portion of this draft report is excerpted below:

> ***West Santa Rosa Area***
> Based on our data, the West Santa Rosa Area supports the largest number of CTS and contains the majority of the known CTS breeding sites. Unfortunately, CTS in this area are the most threatened despite the existence of six preserves. There are 18 reports of CTS in the West Santa Rosa Area. The primary threat to CTS is from the westward urban expansion of Santa Rosa. This development is related to the Southwest Area Plan and Southwest Redevelopment Plan (Southwest Plans; EIP Associates 2000a). Other threats to this area include hybridization with non-native tiger salamander (*Ambystoma tigrinum*) and agricultural practices (Shaffer et. al. 1993).
>
> A large number of CTS occurrences are in and around the old Santa Rosa Air Center (Air Center). There are at least eight CTS breeding sites at or near the Air Center. CTS in the vicinity of the Air Center are threatened by the build-out of the Southwest Plans. This plan would eliminate most CTS grassland habitat at the Air Center; fragment CTS habitats, isolate CTS breeding sites, and obstruct CTS migration from the construction of buildings, roads, curbs, and storm drains. At least four CTS breeding sites would be isolated from other sites at build-out. An increase in roads and traffic will result in CTS road kills. Roadside curbs can be barriers to migrating CTS and direct salamanders to storm drains (D. Cook unpubl. data), which likely result in mortality. Also, Patterson (CNDDB 2001; see CTS Occurrence No. 235, 236, 237, 344, 345, and 346) indicated that threats to CTS include rural development, exotic predators (e.g., dogs, cats, crayfish), invasive weeds, thatch, grazing, and mowing/discing. Breeding sites at the FEMA/Broadmore North Preserves, located in the southeastern corner of the Air Center have been protected; however, most of the surrounding grassland habitat is developed or planned for development.
>
> There are six grassland/wetland preserves in the West Santa Rosa Area that have reports of CTS. Preserve size ranges from approximately 1-183 ac and most contain a single documented breeding site. The following describes CTS habitat, productivity, and threats of each preserve.
>
> <u>Southwest Community Park</u>: The large vernal pool at Southwest Community Park is probably the most productive CTS breeding site in the county. (B. Cox pers. comm. and authors unpubl. data). Unfortunately, this site is also the most isolated and smallest preserve in the county at approximately 1 ac. Approximately 95% of the grassland habitat around the pool has been developed. In 1999 a large subdivision south and west of the park eliminated 50% of the surrounding upland habitat. Construction of curbs and storm drains along Hearn Avenue (EIP Associates 1995) and two residential roads adjacent to the park have erected barriers to migrating CTS and increased mortality. The vernal pool is now isolated from other CTS breeding sites. There are approximately 2

acres of grassland remaining at the park and two nearby open fields that are occupied by CTS. (D. Cook unpubl. data). These remaining grasslands are threatened by a proposed Boy Scout Center and tennis court at the park, and a road extension. Also, the two fields are privately owned and are under threat of development. One of these sites is proposed for development. (Sonya Benindyk, City of Santa Rosa Planner, pers. comm).

FEMA and Broadmore North Preserves: The second most productive CTS breeding site is the FEMA preserve, which is contiguous with the Broadmore North Preserve. Together these two preserves are 74.9 ac and include at least three reported CTS breeding sites. The FEMA Preserve has two large, deep pools that remain hydrated late in the season and probably produce CTS offspring during most years. (CNDDB 2001 and D. Cook unpubl. data).

Yuba Drive Wetland Mitigation Preserve: This preserve is approximately 14 ac and consists of constructed vernal pools, a drainage ditch, and oak woodlands. The CNDDB provides no specific information on the record of CTS from this site. The preserve is separated from Broadmore North by rural residential development that probably allows migration between the preserves. Surveys in spring 2001 found no CTS larvae. (D. Cook unpubl. data).

Hall Road Preserve: The Hall Road Preserve is the largest preserve in the county at 183 ac and includes four reported CTS breeding sites. (Patterson 1993; B. Cox pers. comm.; D. Cook unpubl. data). However, these breeding sites are relatively shallow vernal pools that may not hydrate sufficiently in moderate to low rainfall years for successful larval metamorphoses. Other vernal pools at the preserve may be too ephemeral to support CTS breeding and the creeks are occupied by exotic predators. (D. Cook unpubl. data). The land surrounding the preserve is privately owned and is under threat of development. The area east and adjacent to the preserve has been developed. In addition, proposed construction of wetlands at the preserve will eliminate CTS upland habitat.

Alton Road Wetland Mitigation Preserve: The Alton Road Wetland Mitigation Preserve has a single documented CTS breeding site reported in 1996; however, subsequent annual investigations from 1997-2001 have had negative findings. (B. Cox pers. comm.; D. Cook unpubl. data). Most of the wetlands at the preserve are artificial and do not appear to be adequate breeding habitat for CTS, water depths are too shallow and water persistence too ephemeral. This breeding population may be extinct or at critically low numbers. The surrounding undeveloped lands are threatened by rural development and vineyard development.

Todd Road Wetland Mitigation Preserve: Larval CTS were found at the Todd Road Wetland Mitigation Preserve in 1996; however, subsequent annual visits in 2000 and 2001 had negative findings. (B. Cox pers. comm. and D. Cook unpubl. data). The hydrology of the breeding site may have been altered resulting in unsuitable breeding habitat. (M. Waaland pers. comm.). Most of the wetlands at the preserve are artificial and do not appear to be adequate breeding habitat for CTS, water depths are too shallow and water persistence too ephemeral. This breeding population may be extinct or at critically low numbers.

South Santa Rosa Area

There are five reports of CTS in the South Santa Rosa Area, located south of Santa Rosa and west of U. S. Highway 101 and Rohnert Park. This area is characterized by rural residence and agricultural lands used primarily for livestock grazing and hay production. The primary threats to CTS in this area are from urban expansion, rural development, and agricultural practices (e.g., plowing and discing fields). There is one protected CTS breeding site in this area. The 16.9-ac Scenic Avenue Preserve has one documented CTS breeding site at an incised vernal swale. Reproductive success at this site may be marginal. Surveys in 2000 and 2001 suggest that CTS productivity is low at this site due to short hydroperiod. (D. Cook unpubl. data). CTS larvae observed in 2000 probably did not metamorphose prior to the site drying and no larvae were observed in 2001.

West Cotati Area

There are six reports of CTS in the West Cotati Area, located west of Cotati in the vicinity of Gravenstein Highway and Stony Point Road. Three of the six reports are known breeding sites. This area is characterized by rural residence, commercial businesses, and agricultural lands used primarily for livestock grazing and hay production. The primary threats to CTS in this area are from the westerly urban expansion of Cotati and agricultural practices (e.g., plowing and discing fields, and vineyard development). Two breeding sites and approximately 34 acres of surrounding habitat will be eliminated for an approved business park in western Cotati. Thirty-seven CTS larvae were removed from this site and relocated to the Yuba Drive Preserve in spring 2001 with the approval of CDFG to make way for the business park. CTS at the third known breeding site may be impacted from a proposed golf course that would eliminate approximately 20 ac of potential CTS upland habitat. There are no protected CTS breeding sites in this area.

South Cotati Area

There are six reports of CTS in the South Cotati Area, located in the vicinity of East Railroad and West Railroad avenues between Stony Point Road and Petaluma Hill Road. All of these reports are likely observations of adult CTS crossing roads. There are no reports of CTS breeding sites. This area is characterized by rural residence, agricultural lands used primarily for vineyard, livestock grazing, and hay production. The primary threats to CTS in this area are from agricultural practices (e.g., plowing and discing fields, and vineyard development). A large residential development is proposed in southwestern Cotati that would eliminate grassland habitat. Recent road surveys for adult CTS and larval surveys at two potential breeding sites in this area resulted in negative findings (D. Cook and J. Martini-Lamb unpubl. data). There are no CTS preserves in this area and recent studies suggest a decrease in CTS numbers.

… **DISCUSSION**

The prospect for Sonoma County CTS is not bright. Development has and continues to substantially affect CTS in the county. Conservation efforts have been inadequate. A likely scenario for Sonoma County CTS is the continual loss, alteration, and fragmentation of habitat with an ineffective piecemeal approach to conservation. The isolation of small remnant populations of CTS will result in the local extirpation of these sites from a variety of threats with no or limited opportunity for recolonization. This will ultimately cause the extinction of the Sonoma County CTS.

Inadequacy of Existing Preserves
No existing preserves in Sonoma County have self-supporting, viable populations of CTS. Based on CTS ecological studies by Shaffer et. al. (1993) and Trenham (1998), conservation of Sonoma County CTS will require at least two grassland/vernal pool preserves at least 420 acres in size each, at least one highly productive breeding site (although multiple breeding sites are preferable) per preserve, and a minimum of 600 ft of terrestrial habitat to buffer each breeding site. It is our opinion that four preserves that meet the preserve criteria are necessary, one for each of the four areas with persisting CTS. All existing preserves fall drastically short of the minimum size and buffer area criteria. The highly productive breeding site criterion is met only by the Southwest Community Park and FEMA/Broadmore North preserves. Southwest Park is surrounded by development and only 1 acre has been preserved. The FEMA/Broadmore North preserves are only 18% of the required size and the Southwest Area Plan proposes urban development surrounding these preserves. Hall Road Preserve is the largest preserve at 183 acres but is only 44% the required size. Three of the four known vernal pool breeding sites are located near or on the preserve boundary and hence fail the buffer area criteria. Also, these four vernal pools are shallow and do not appear to be highly productive for CTS. The remaining preserves are all too small, appear to have marginal breeding habitat, and are isolated from other preserves. CTS terrestrial habitat is threatened by the construction of artificial wetlands at Hall Road, Alton Road Wetland Mitigation, and Todd Road Wetland Mitigation preserves. In addition, CTS at all of the existing preserves have ongoing threats, such as urban and agricultural encroachment, and exotic predators.

…In conclusion, the Sonoma County population of CTS is endanger of extinction and should be listed as an endangered species under the state and federal ESA. We base this decision on our research that indicates 1) this taxon is currently in the midst of a drastic range contraction and is geographically isolated from CTS elsewhere in the state; 2) threats from urban and agricultural development are accelerating; and 3) current conservation efforts and existing environmental regulations have been ineffective to protect this species from extinction. (Cook and Northen 2001).

The portions excerpted from the status review by Cook and Northen (2001) above present sufficient evidence that the Sonoma County population of the California tiger salamander faces a sufficient risk to warrant immediate emergency listing. However, the next section presents maps and additional information showing the extent of habitat destruction.

4. Aerial Photos and Additional Threats

Figure 2 (poster) shows the core of the range of the Sonoma County population of the California tiger salamander in 1968. Figure 3 (poster) shows the same area as of April 14, 1999. Two facts that have already been discussed are evident from these photos. First, the species was already heavily impacted by 1968. Second, since 1968, an enormous amount of additional habitat has been lost.

A variety of projects that are discussed in Cook and Northen (2001), and additional major projects that have been constructed, approved, or proposed since the 1999 photos were taken are discussed below. It should be noted that compiling information on development within the range of this species is extremely difficult due to the fact that multiple jurisdictions exist in this area (e.g. the City of Cotati, City of Santa Rosa, and Sonoma County). None of these jurisdictions keep master lists of approved or constructed projects, nor are their files indexed or searchable by the public (the public, of course, may inspect any particular file, but only by specifically referencing it). Because of these difficulties, the following discussion represents a minimum estimate of projects that have been built or proposed since the 1999 aerial photos were taken. Our research has undoubtedly missed some major projects that have either been built, approved, or proposed since 1999. Small projects, particularly those not requiring CEQA review, and most agricultural development has been excluded from this analysis. The cumulative impact of habitat destruction from small projects is certainly significant, however it was simply not possible to ensure that every project was discovered. This simply demonstrates the importance of listing the California tiger salamander, because once listed, all projects that will harm the species will theoretically be monitored by the USFWS.

In addition to the projects discussed below, Appendices A and B presents additional projects that may threaten the Sonoma County population of the California tiger salamander. Appendix A presents the most recent list of approved and proposed projects for the Southwest Area Plan posted by the City of Santa Rosa. This list, however, is incomplete and out of date. (Lisa Krantz, City of Santa Rosa, pers. comm.). Also, the list does not include projects that have already been built. (Id.) Once projects are built, they are removed from this list. (Id.) Therefore, Appendix A also represents a minimum estimate of approved and proposed development for the Southwest Santa Rosa area.

Appendix B presents a list of projects proposed and approved in and around the range of the Sonoma County population of the California tiger salamander. This list was compiled from CEQANet, a searchable database provided by the Office of Planning and Research. (http://www.ceqanet.ca.gov/) This database, however, can currently only provide summaries of CEQA documents for the last two years or so. Therefore, this list also represents a minimum estimate of projects approved and proposed.

(1) 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 shows the 35 projects planned for the area. Appendix C contains summaries of each of these projects. Figure X shows the future projected street network in the area. (Discussed in

more detail under "Habitat Fragmentation," *supra*.) These projects are, for the most part, approved, and many are already built or under construction. There is very little protection or mitigation being provided for the California tiger salamander pursuant to this plan. The few areas that are being "preserved" typically consist only of breeding pools, while terrestrial habitat is almost entirely eliminated. As discussed under "The Inadequacy of Current Regulatory Mechanisms," *supra*, there are no regulatory mechanisms that are sufficient to ensure the survival of the Sonoma County population of the California tiger salamander in this area. Given the habitat requirements of the California tiger salamander, the buildout of the Southwest Area Redevelopment Plan is highly likely to eliminate the largest remaining population of the Sonoma County population of the California tiger salamander.

(2) The South Sonoma Business Park 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 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, despite the fact that the mitigation proposed by the project applicant has been deemed inadequate by both the CDFG and the USFWS, and despite the fact that there is evidence that there may be no possible mitigation site available for purchase.

(3) A Comfort Inn is proposed for a 2.34 acre parcel at the corner of West Sierra Ave. and Highway 116, across the street from the South Sonoma Business Park site. (City of Cotati 2000). This project will pave potential California tiger salamander estivation and/or migration areas, and will add to the overall urbanization of the area.

(4) The Kandy Business Park is located on a 12.14 acre parcel near the South Sonoma Business Park Site. (Macmillan Consulting 2000). The Kandy Business park is bounded by the Laguna de Santa Rosa, Helman Lane, and to the east by the recently constructed Marin Sonoma Mosquito Abatement and Vector Control District. (Id.) The project destroyed wetlands on the site, destroyed potential California tiger salamander estivation and migration habitat, and added to the overall urbanization of the area.

(5) The "Golf Learning Center" is an approximately 20 acre development proposed for 1475 W. Sierra Avenue. (Undated Memo obtained from the County of Sonoma, File UPE 00-0064). This area likely constitutes terrestrial habitat for the California tiger salamander. Despite the fact that golf courses are almost certainly unusable by California tiger salamanders, (Shaffer et al. 1993) and may represent population sinks for the species, the CDFG approved the project with only minor setbacks from Washoe Creek and minor onsite mitigation measures.

(CDFG 2000). No offsite mitigation was required for this project, which appears to be in the final stages of approval.

(6) The Twin Creeks Subdivision project will subdivide a vacant 5 acre lot into residential parcels. (City of Cotati 1999). A new road will be built over an existing creek to access the new subdivision. (Id.) This project will eliminate potential California tiger salamander estivation and migration habitat and add to the overall development and fragmentation of the area.

(7) The Sonoma County Central Disposal Site Improvement Program is an extension of a Sonoma County Landfill on a 389 acre parcel southwest of Cotati. (URS Greniner Woodward Clyde 1998). This area may have been terrestrial habitat for the Sonoma County population of the California tiger salamander. Construction is currently underway at the project site. (Tim Mayer, pers. comm.).

(8) Stony Point road was recently widened 24 feet from Petaluma Blvd. to Hearn Avenue by the County of Sonoma. (Tim Mayer, pers. comm.). Road widening makes crossing more difficult for California tiger salamanders and increases California tiger salamander mortality during migration, and adds to the overall urbanization of the area. No mitigation was provided for impacts to California tiger salamanders in regards to this project. (Id.)

It is clear that all four remaining meta-populations in Sonoma County are threatened by imminent habitat destruction. Two of the four meta-populations, the west Santa Rosa meta-population and the west Cotati meta-population, have projects either constructed, approved, or in the final stages of approval that would ensure the extirpation of those meta-populations. The massive development pressure in the area, the lack of reserves of sufficient size and quality to ensure the survival of the species in the long term, and the lack of adequate regulatory mechanisms make it likely that projects will be approved (or, in the case of vineyard conversion, simply implemented since usually no environmental review or approval is required) that will ensure the extirpation of the south Santa Rosa and south Cotati populations as well. Therefore, on the basis of the factor "Current or Threatened Destruction or Modification of Habitat" alone, an emergency exists regarding this species. The USFWS must act immediately on the basis of this factor alone to list the Sonoma County population of the California tiger salamander. However, the additional factors discussed below intensify the threat faced by the species.

C. OTHER NATURAL EVENTS OR HUMAN-RELATED ACTIVITIES

1. Habitat Fragmentation

Habitat fragmentation is one of the primary threats to the continued survival of the Sonoma County population of the California tiger salamander. A comparison of the 1968 aerial photographs (Figure 2) to the 1999 aerial photographs (Figure 3) shows the large increase in fragmentation in recent decades. Since 1999, habitat fragmentation has continued to increase. Appendices A, B and C list some of the numerous projects approved, proposed, and constructed since 1999. The ways in which habitat fragmentation can adversely affect, and ultimately extirpate, California tiger salamander populations are discussed below.

The four areas where the California tiger salamander still exist in Sonoma County are experiencing severe habitat fragmentation. The most heavily impacted area is the west Santa Rosa area, which has been the stronghold for the California tiger salamander. (Cook and Northen 2001). This area will be almost completely subdivided pursuant to the Southwest Redevelopment Plan. (EIP Associates 2000a). Figure 5 shows the future street network of the area at build-out. Comparing Figure 5 with Figures 3 (1999 aerials) and 2 (1968 aerials) shows the increasing habitat fragmentation.

While the south Santa Rosa, west Cotati, and south Cotati do not have the same level of development explicitly planned at this point, these areas are also experiencing increasing fragmentation and development pressure. In particular, numerous road improvement projects and increased traffic volumes threaten the survival of the species. Recent increases in traffic volumes along Stony Point provide a good example. Sonoma County does not regularly monitor traffic volumes, but rather conducts studies and publishes reports "on demand." (Tim Mayer, Sonoma County, pers. comm.). Available data on traffic volumes through 1998 along Stony Point road is shown in Appendix C. For example, on June 19, 1996, total 24 hour traffic volume at the intersection of Stony Point Road and Highway 116 was 5,772 vehicles. On July 9, 1998, total 24 hour traffic volume at the same area was 7,656 vehicles (Sonoma County 1999), a 32.6% increase over the interval. At the intersection of Stony Point Road and Todd Road, total 24 hour traffic volume was 10,923 vehicles on April 9, 1996, and 15,037 vehicles on August 4, 1998 (Id.), a 37.66% increase over the interval. Traffic volumes have undoubtedly grown at an even faster rate since 1998, as the Southwest Area Plan and Southwest Redevelopment Plan have been implemented. The Southwest Redevelopment Plan will generate a massive amount of new traffic. (EIP Associates 2000a). For more details of traffic generation from this area, see EIP Associates 2000a. The ways in which additional roads, wider roads, and increased traffic volumes threaten the California tiger salamander are discussed in more detail below.

Amphibian populations, in general, are prone to local extinction due to habitat fragmentation. (USFWS 2000). The primary causes of habitat fragmentation within the range of the California tiger salamander are road construction, urbanization, and intensive agriculture (Id.) California tiger salamanders are particularly susceptible 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 California tiger salamanders are sometimes extirpated by natural factors such as drought. (Id.) Under pristine conditions, these sites are recolonized by California tiger salamanders from neighboring sites. (Id.) 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 California tiger salamander's distribution to a few isolated ponds greatly reduces the species' ability to persist over time. (Id.)

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. (Id.) Any California tiger salamanders in underground burrows in the path of the road or in the impact area are likely to be crushed during road construction. (Id.) 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 California tiger salamanders from moving to new breeding habitat or prevent them from returning to their breeding ponds or estivation 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 California tiger salamanders, including soil density, soil water content, dust, surface-water flow, patterns of runoff, and sedimentation. (USFWS 2000). The deleterious effects of roads on many ecological factors reach 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 California tiger salamanders, up to 9 to 12 per km (15 to 20 per mi) are killed as they cross the roads on breeding migrations. (USFWS 2000). Of California tiger salamanders found on roads, 25 to 72 percent are dead. (Id.) 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. (Id.) Road berms can prevent California tiger salamanders from leaving the road and can lead the animals towards storm drains, which is likely to cause mortality. (Cook and Northen 2001).

Because of these affects, 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 to California tiger salamanders. While healthy metapopulations of California tiger salamanders 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. (USFWS 2000). California tiger salamanders in the South Cotati are affected by a railroad that bisects the area.

2. Introduced Species

Introduced species are one of the greatest threats to the survival and recovery of the California tiger salamander. Where habitat has not been destroyed outright, it has often been modified to the point where exotic species thrive and preclude occupation by California tiger salamanders. 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 California tiger salamanders throughout the state, including the Sonoma County population. (Shaffer et al. 1993). Shaffer et al. (1993) have confirmed that the introduction of any fish, including mosquitofish, catfish, bass, sunfish, and perch to California tiger salamander breeding ponds will eliminate the salamanders from these areas. Other problem species are bullfrogs, non-native tiger salamanders, and crayfish. Each is discussed in turn below.

a. Mosquito Fish

Mosquitofish (*Gambusia affinis*) 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 2000). These fish were first introduced to California in 1922 and have since become well-established throughout the State's water systems. (Id.) Mosquito fish quickly reproduce to the maximum population levels that a particular habitat can sustain. Mosquitofish are extremely tolerant of polluted water with low levels of dissolved oxygen and have an extremely wide range of temperature tolerance. (Id.) Both California tiger salamanders and mosquitofish feed on micro and macro-invertebrates, and large numbers of mosquitofish may effectively eliminate the prey base for California tiger salamander larvae. These fish eliminate tiger salamanders either by out-competing the salamander larvae for food, or by eating the salamander larvae outright.

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

Mosquito fish are known to prey on the California newt (*Taricha torosa*) and Pacific treefrog (*Hyla regilla)* larvae in both field and laboratory experiments, even given the optional prey of mosquito larvae. (USFWS 2000). Both newt and Pacific treefrog larvae were found in stomachs of wild-caught mosquito fish. (Id.) Dr. Robert Stebbins observed mosquito fish ingesting and then spitting out California newt larvae, causing severe damage to the newts in the process. (Id.) Schmieder and Nauman (1994) found that mosquito fish significantly affected the survival of both prefeeding and large larvae of California red-legged frogs. (Id.) Lawler et al.

(1999) did not find a reduction in survival rates of California red-legged frog tadpoles raised in the presence of mosquito fish versus controls with no mosquito fish, but those tadpoles that did survive weighed less than control tadpoles and metamorphosed later, and most were injured by the fish. (Id.) Smaller size at metamorphosis may reduce survival to breeding age and reproductive potential. (Id.)

California tiger salamanders may be especially vulnerable to mosquito fish predation due to their fluttering external gills, which may attract these visual predators. (Graf 1993). A survey by Loredo-Prendeville et al. (1994) found no California tiger salamanders in ponds with mosquito fish. Due to the documented effects of mosquitofish on other amphibian species, the U.S. Fish and Wildlife Service believes that they are likely to have similar effects on California tiger salamanders and that the use of mosquito fish in salamander habitat threatens the persistence of salamander populations. (USFWS 2000).

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 California tiger salamanders. 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 California tiger salamanders for food and prey on California tiger salamander larvae. (Shaffer et al. 1993).

c. Bullfrogs

Introduced bullfrogs (*Rana catesbeiana*) also eliminate California tiger salamander populations. Shaffer et al. (1993) consider bullfrogs to be a biological indicator of ponds that have been disturbed to a degree that California tiger salamanders are excluded. Bullfrogs prey on California tiger salamander larvae. (USFWS 2000). Morey and Guinn (1992) documented a shift in amphibian community composition at a vernal pool complex, with California tiger salamanders 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 California tiger salamanders. Lawler et al. (1999) found that less than 5 percent of California red-legged frog tadpoles survived to metamorphosis when raised with bullfrog tadpoles[3]. Due to the documented effects of bullfrogs on other amphibian species, the USFWS believes that they are likely to have similar effects on California tiger salamanders and that the presence of bullfrogs in salamander habitat threatens the persistence of salamander populations. (USFWS 2000).

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

d. Introduced Tiger Salamanders

Various nonnative subspecies of the tiger salamander, *Ambystoma tigrinum*, have been imported into much of California for use as fish bait. The practice is still legal in California but is now restricted to fewer counties and is regulated by the California Department of Fish and Game (CCR Title 14, Division 1, Subdivision 1, Chapter 2, Article 3, Section 4 1999). 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 California tiger salamanders through competition for food and through hybridization.

Recent evidence suggests that introduced tiger salamanders can apparently successfully interbreed with the California tiger salamander, creating 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. (Id.) 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 draught year, they may perish. (Id.) Thus, the situation could easily occur where hybridization occurs, hybrids thrive, but then the entire mixed population crashes in ecologically stressful times. (Id.) Another possibility is that the introduced salamanders may interbreed with the natives to create hybrids that are not reproductively viable past the first or second generations. (Id.) California tiger salamanders in the West Santa Rosa area are threatened by hybridization with non-native tiger salamanders. (Cook and Northen 2001).

e. Crayfish

Introduced Louisiana red swamp crayfish (*Procambarus clarki*) also apparently prey on California tiger salamanders (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 may be a significant factor in the loss of newts from several streams in southern California (Gamradt and Kats 1996). California tiger salamanders in at least two locations in the West Santa Rosa Area are threatened by introduced crayfish. (Cook and Northen 2001). This introduced species must be considered a threat to the survival and recovery of the Sonoma County population of the California tiger salamander.

f. Domestic Pets

Domestic dogs, cats, and other exotic species that inevitably accompany residential development can harm California tiger salamanders 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 California tiger salamanders, and cats hunt gophers. Because every extant population of California tiger salamanders in Sonoma County is surrounded by or adjacent to residential development, domestic animals must be considered a major threat to the species.

3. Contaminants

A wide variety of toxic substances are released into California tiger salamander 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 tiger salamander 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 California tiger salamanders and spadefoot toads, and die-offs of invertebrates that form most of both species' prey base. (USFWS 2000).
Lefcort et al. (1997) found that oil had limited direct effects on 5-week-old marbled (*Ambystoma 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, where the effects 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 runoff is another form of contamination that may affect California tiger salamander 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 California tiger salamander to detect aquatic food items could be impaired from increased sedimentation, as can susceptibility to diseases. (USFWS 2000).

b. Agricultural Contaminants

The amount of chemicals used in California agriculture is nothing short of staggering. The effects of pesticides, herbicides, fungicides, and nitrogen fertilizers on the landscape have been addressed only recently. (USFWS 2000). Data on various contaminants in Sonoma County is presented below.

In Sonoma County, more than 3.7 million pounds of chemicals were used in 1999 for agricultural pest control (primarily for grape vineyards and apple orchards), structural pest control, landscape maintenance, and right of way maintenance. (CDPR 2001). These chemicals included petroleum oil, methyl bromide, chloropyrifos, metam-sodium, mancozeb, phosmet, oryzalin, and copper sulfate; some of these are extremely toxic to aquatic organisms, including amphibians and the organisms on which they prey. Many more agricultural chemicals may have lethal or sublethal effects on California tiger salamanders; those discussed here provide only a sample of the actual and potential threats.

Nearly one million pounds of petroleum oil was applied as a pesticide over 46,000 acres of fruit orchards in Sonoma County in 1999. (CDPR 2001). The potential effect of oil on salamanders is discussed above in the section on contaminants.

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). 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 464,000 pounds of methyl bromide were used in Sonoma County in 1999. (CDPR 2001).

Chloropyrifos is a highly toxic organophosphate insecticide applied as granules, wettable powder, dustable powder, or emulsifiable concentrate. (EXTOXNET 2001). The compound is absorbed through the skin. Amphibians, with their highly permeable skins, absorb the chemical even more readily than mammals. (Id.) General agricultural use of chloropyrifos is considered to pose a serious threat to wildlife. (Id.) More than 51,000 pounds of chloropyrifos was used in Sonoma County in 1999. (CDPR 2001).

More than 19,000 pounds of Metam-sodium, a broad spectrum carbamate used for soil sterilization, were applied to right of ways in Sonoma County in 1999. (CDPR 2001). Metam-sodium is extremely toxic to fish. (Meister 1997). 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 2001). Mancozeb is available as dusts, liquids, water dispersible granules, as wettable powders, and as ready-to-use formulations. More than 31,000 pounds of Mancozeb were applied to over 23,000 acres of vineyards in Sonoma County in 1999. (CDPR 2001). Mancozeb is moderately to highly toxic to fish and aquatic organisms. (USNLM 1995a; EXTOXNET 2001). 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 2001). More than 7,000 pounds of phosmet were applied to apple orchards in Sonoma County in 1999. (CDPR 2001). 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 2001).

Oryzalin is a selective pre-emergence surface-applied herbicide used for control of annual grasses and broadleaf weeds. (EXTOXNET 2001). It is available in aqueous suspension, dry flowable, and wettable powder formulations. More than 3,000 pounds of oryzalin were applied to right of ways in Sonoma County in 1999. (CDPR 2001). 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 2001). Although no test data are available for amphibians, the effects are likely to be similar.

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 2001). It is available as a dust, wettable powder, or liquid concentrate. More than 2,500 pounds of copper sulfate were used in landscape maintenance in Sonoma County in 1999. (CDPR 2001). Copper sulfate is highly toxic to fish. (Pimentel 1971). Even at recommended rates of application, this material may be poisonous to trout 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). Although no test data are available for amphibians, the effects are likely to be similar.

Based on the above data, the use of these chemical agents must be considered a major threat to the continued survival of the California tiger salamander. The threat posed by these agents is particularly severe since the remaining populations in Sonoma County are extremely small and heavily impacted by other factors such as habitat fragmentation and road mortality.

c. Rodenticides

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

One such chemical compound 1080 (sodium fluoroacetate) which extremely toxic to nontarget fish, birds, and mammals (USFWS 2000) and may have contributed to reductions in salamander populations in the areas where it was used. Poisoned grains are the most common method used to control ground squirrels on rangelands, and there is little risk of ingestion by California tiger salamanders. However the use of these grains may impact the California tiger salamanders indirectly if washed into burrows or ponds used by the species.

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. (USFWS 2000; EXTOXNET 2001). Zinc phosphide is an acute rodenticide and a restricted material that turns into a toxic gas once ingested. Although the effects of these poisons on California tiger salamanders have not been assessed, use along roadways or railways may result in contamination of salamander breeding ponds, with undetermined effects. Gases, including aluminum phosphide, carbon monoxide, and methyl bromide, 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 California tiger salamanders spend most of their lives estivating in ground squirrel burrows, this can be a significant source of mortality.

Rodent control activities must be considered a significant threat to the Sonoma County population of the California tiger salamander, especially since remaining populations are small, isolated , and already heavily impacted by other factors such as habitat fragmentation and road mortality.

d. Chemicals used for Mosquito Abatement

Besides the introduction of mosquito fish, 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 California tiger salamander. 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 California tiger salamander 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 the 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 (MSMVCD 2001), 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. Lawrenz (1984-85) 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. 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 1984-85). The use of methoprene thus could have an indirect adverse effect on the California tiger salamander by reducing the availability of prey.

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 (*Rana pipiens*) (Ankley et al. 1998) and increased malformations in southern leopard frogs (*R. utricularia*). (Sparling 1998). Blumberg et al. (1998) also correlated exposure to methoprene with delayed metamorphosis and high mortality rates in northern leopard and mink (*R. septentrionalis*) frogs. 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 in Sonoma County for mosquito control (MSMVCD 2001). When the bacteria Bti encysts, it produces a protein crystal toxic to mosquito and midge larvae. Once the bacteria has been ingested, the toxin disrupts the lining of the larvae's intestine. It has no effect on a vast array of other aquatic organisms except midges in the same habitat. Bti strains are sold under the names Bactimos®, Teknar® and Vectobac®. Its effects on the salamander prey base have not been quantified.

Mosquito abatement agents should be considered a significant threat to the Sonoma County population of the California tiger salamander, especially since remaining populations are small, isolated, and already heavily impacted by other factors such as habitat fragmentation and road mortality.

e. Urban and Suburban Landscaping Contamination

Fertilizers and pesticides used for urban and suburban landscaping can also harm California tiger salamander populations. These chemicals run off into streams and ponds and can affect whatever California tiger salamander habitat may remain in such areas. Golf courses are often suggested by development interests as an ideal solution to open-space mitigation for animals, since they are open space, often have ponds, and are free from automobile traffic. (Shaffer et al. 1993). However, golf courses have enormous loads of fertilizers and pesticides, and burrowing rodent populations are normally completely removed, eliminating California tiger salamander upland habitat in the process. Shaffer et al. (1993) reported that they had never found a living California tiger salamander on a golf course, but rather regard golf courses as potentially damaging to surrounding California tiger salamander habitat.

4. 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 1998a). Because California tiger salamanders have poor burrowing abilities, burrowing rodent populations are an essential component of California tiger salamander 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 California tiger salamanders 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 currently 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. Rodent control programs are also conducted by individual landowners and managers on grazing, vineyard, and crop production lands. (USFWS 2000).

In addition to possible direct effects of rodent control chemicals, discussed *supra*, control programs probably have an adverse indirect effect on California tiger salamander populations. Control of ground squirrels could significantly reduce the number of burrows available for use by the species. (USFWS 2000). Because the burrow density required to support California tiger salamanders 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 California tiger salamanders in some areas, such as Altamont Pass.

Rodent control activities must be considered a significant threat to the Sonoma County population of the California tiger salamander, especially since remaining populations are small, isolated , and already heavily impacted by other factors such as loss of habitat, habitat fragmentation, and road mortality.

5. Livestock Grazing

Livestock grazing by domestic cattle, sheep, and horses has occurred within the range of the California tiger salamander since Europeans first arrived. Because lands used for grazing constitute some of the largest remaining areas of habitat for the California tiger salamander, the impression that livestock grazing in some cases may have positive, or at least neutral, effects on the California tiger salamander is understandable. On the one hand, light grazing does appear to be compatible with the persistence of California tiger salamander populations. It may even be true that in the absence of native ungulates, which have been eliminated in nearly all areas of the state by domestic livestock, light grazing does crop vegetation, improving habitat for ground squirrels. Relatively healthy populations of California tiger salamanders appear able to withstand mortality sustained due to trampling of individuals and burrows by livestock. However, it is important to recognize that livestock grazing alters the natural habitat and that intensive grazing does pose a significant threat to California tiger salamander populations.

The natural vernal pool habitat of the California tiger salamander can be destroyed by intensive grazing. Intensive livestock grazing alters natural hydrological patterns by extensively terracing hillsides, compacting the soil and stripping the vegetative cover. Soil disturbance in naturally occurring vernal pools could increase percolation rates and shorten the duration of pool life enough so that California tiger salamanders could no longer metamorphose successfully in those pools. (Jennings and Hayes 1994). Cattle can drink large quantities of water, sometimes causing temporary pools to dry faster than they otherwise would and possibly causing breeding pools to dry too quickly for salamanders to be able to metamorphose. (USFWS 2000).

California tiger salamanders have been found to be either absent or found in low numbers in portions of pools that were heavily trampled by cattle. (Id.) Continued trampling of a pond's edge by cattle can increase the surface area of a pond and may increase water temperature, accelerate the rate of evaporation, and thus reduce the amount of time the pond contains water. (Id.)

The reduction in water quality caused by cattle excrement may negatively affect salamanders, mainly by increasing potentially detrimental nitrogen levels. High nitrogen levels have been associated with blooms of deadly bacteria, and silt has been associated with fatal fungal infections. (Id.) Worthylake and Hovingh (1989) reported on repeated die-offs of tiger salamanders (*Ambystoma 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).

6. Water Draw Downs

Many ponds which are used or could be used by California tiger salamanders are subject to draw downs for various uses including irrigation, frost control, and flood control. Draining of these water bodies can have a two-fold effect to California tiger salamander 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 2000). This two-fold problem was documented for the Lagunitas population by Barry and Shaffer (1994) but it undoubtedly affects other populations as well.

8. Vandalism

The Sonoma County population of the California tiger salamander exists in an area that is heavily populated and becoming more so every day. Vandalism and other human impacts must be considered a serious threat to the species, given the fact that virtually every remaining population is surrounded by or adjacent to residential development. For example, an adult California tiger salamander was killed by an elementary school student at Southwest Community Park. (Dave Cook, pers. comm.).

As a practical matter, the habitat of the California tiger salamander 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 USFWS has faced this issue before with other species such as the San Bernardino kangaroo-rat (*Dipodomys merriami parvus*). (63 Fed. Reg. 3835). The only sensible solution to the threat is a prompt emergency listing of the California tiger salamander, coupled with a concerted public education campaign.

Because potential vandalism must be considered a serious threat to the Sonoma county population of the California tiger salamander, this petition has not presented known localities of the species, but rather has shown the general areas where the species still persists.

D. The Inadequacy of Current Regulatory Mechanisms

1. Federal Designation as a Candidate Species under the Endangered Species Act

On April 18, 1994 the USFWS published a 12-month finding on a citizen petition to list the species submitted by Dr. H. Bradley Shaffer. The finding concluded that listing of the California tiger salamander was warranted but precluded by higher priority listing actions. (USFWS 1994). At the same time, the species was designated a Candidate 1 species, indicating that sufficient information was currently on file with the USFWS to warrant listing.

The Candidate listing provides no formal protection to the species. Neither the protections of Section 9 of the ESA (prohibiting “take” of the species) nor the protections of Section 7 (requiring all federal agencies to insure that their activities do not jeopardize the continued existence of the species) apply to Candidate species. Candidate species will not have critical habitat designated, nor do they receive recovery plans.

The stated purpose of the Candidate designation is to allow landowners and other project proponents to plan early for the protection of species that are not yet listed but are likely to become listed in the future. 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, do contain some mitigation for Candidate Species. In addition, the USFWS does encourage federal agencies to consider Candidate Species during Section 7 consultation. However, these informal protections are implemented only at the discretion of the landowner and do not provide sufficient protection for the California tiger salamander.

2. Federal Endangered Listing of the Santa Barbara Population

On January 19, 2000, the Santa Barbara County population of the California tiger salamander was listed as an endangered species on an emergency basis. Emergency listing is effective for only 240 days, and so, on September 21, 2000, the USFWS published a final rule listing the Santa Barbara population as endangered. (USFWS 2000). The protections of the federal ESA apply only to the Santa Barbara population, however, and provide no protection for the Sonoma County population.

3. Federal Listing of Other Species Within the Range of the California Tiger Salamander

Cook and Northen (2001) provide a succinct summary of why federal protection for other species is inadequate to protect the Sonoma County Population of the California tiger salamander:

> State and federal regulations that protect wetlands and endangered vernal pool plant species (e.g., *Lasthenia burkei*¸ *Blennosperma bakeri*, and *Limnanthes vinculans*) have been inadequate to protect CTS and may negatively affect this species. These plants occur in vernal pools with shallow waters or along the margins of deeper pools. A common practice is to mitigate for the loss of wetlands with endangered plants by constructing artificial pools that maximize habitat for these species. This design approach often results in the construction of densely clustered artificial pools with shallow depths. Shallow artificial pools dry quickly and are not suitable breeding sites for CTS. In addition, artificial pools constructed in grasslands have the negative effect of eliminating terrestrial CTS habitat. (Cook and Northen 2001).

In addition to these reasons, protection of vernal pool species is inadequate to protect the California tiger salamander because protection of this species requires the preservation of both terrestrial and breeding habitat.

4. 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., any individual or entity that wishes to fill waters of the U.S. must obtain a permit from the U.S. Army Corps of Engineers ("ACOE"). "Waters of the U.S." includes vernal pools.[1] (33 CFR 328.3). The individual permitting process requires an analysis of the cumulative impact to wetlands, and sometimes results in the specification of conditions or mitigation measures in order to obtain the permit. However, the Section 404 program has not been successful in protecting California's verna pools. This is due in part because the ACOE's implementation of the individual permitting process has simply permitted too much development. The ACOE's Nationwide Permitting Program is designed such that it routinely allows the destruction of small pools that support or could support California tiger salamanders.

Under 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 considered automatically permitted. Most vernal pools in Sonoma County are far less than one acre in size, and all known California tiger salamander breeding pools are less than one acre. (Dave Cook, pers. comm.). 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. (Id.)

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, but due to various grandfather clauses it may take up to a year for all projects to be permitted under the new scheme. (65 Fed. Reg. 12818).

The new and modified NWPs[2] authorize many of the same activities that NWP 26 authorized, but are activity-specific. The maximum acreage limits of most of the new and

[1] The effect of the recent US Supreme Court decision of *Solid Waste Association of Northern Cook Counties v. United States Corps of Engineers*, issued on January 9th, 2001 may not be fully known for some time. It is possible that in the future the ACOE will no longer assert jurisdiction over all or some vernal pools in California. If the ACOE does not assert jurisdiction over vernal pools occupied by the California tiger salamander, the species will receive no protection under the Clean Water Act.

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

modified NWPs is 0.2 ha (0.5 ac). Most of the new and modified NWPs require notification to the District Engineer for activities 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 California tiger salamanders, 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.

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, projects, 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 salamanders at the sites. (DeWeese 1994).

The creation of artificial wetlands and ponds as breeding habitat for California 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. (Id.) Twenty-two projects ranged in age from three to five years old, and eight projects were greater than five 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 than natural systems or more frequently. 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 California tiger salamanders. In addition, Cook and Northen (2001), as discussed above, have pointed out that mitigation for other vernal pool species can actually have an adverse affect on the California tiger salamander.

Another obstacle to protecting the California tiger salamander is that the ACOE usually 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. California tiger salamanders spend as much as 95% of their life in uplands. (Dave Cook, pers. comm.). 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 and Brodie 1998). Therefore, impacts to uplands and mitigation for upland habitat losses usually are not addressed by the Corps.

In addition to the problems discussed above, many agricultural and farming practices such as overgrazing and discing destroy vernal pools within the range of the California tiger salamander. These activities, however, are exempt from the provisions of Section 404 of the Clean Water Act[3]. (The conversion of grazing land to intensive agricultural uses that may adversely affect the California tiger salamander generally is unregulated at any level of government.) 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 are also 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 California tiger salamander.

[3] 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 Corps (R. H. Wayland III, EPA, and D. R. Burns, Corps, 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 Corps does not assert jurisdiction over actual wetlands, either. For example, repeated deep-ripping of a pond known to be breeding habitat for California tiger salamanders occurred up until 2000 on the Lin/North Livermore property in Livermore, California. The damaged wetland had been federally delineated by the Corps, but the Corps (and the California Department of Fish and Game) failed to assert jurisdiction or take any action (Carl Wilcox, pers. com., 2000.)

5. Listing as a Species of Special Concern Under the California Endangered Species Act Does Not Provide Adequate Protection

The State of California recognizes the California tiger salamander as a Species of Special Concern ("CSC") under the California Endangered Species Act (CESA). The practical benefit of this designation to the species has been minimal. The designation may call attention to the species and cause more information to be collected about the loss of its habitat in Environmental Impact Reports and other documents, but it has not halted the habitat loss or other factors causing the decline of the species. The CDFG typically requires as mitigation for the destruction of California tiger salamander habitat that habitat be preserved at a ration of 1:1. (Carl Wilcox, personal communication). This requirement is inadequate to protect the species on its face, and as implemented is even more so. The CDFG does not require that mitigation lands actually be acquired prior to project approval or construction. Because occupied habitat in Sonoma County is so minimal, it may already be impossible to acquire suitable mitigation sites, despite that project approval and construction continues at a fast pace. As occupied habitat continues to vanish in Sonoma County, it may quickly become impossible to find suitable mitigation habitat. Despite the fact that this issue has been pointed out to the CDFG on several occasions, the CDFG has no plans to change the current policy. The mitigation requirements must be increased if there is to be any hope of the long term survival of this species in Sonoma County.

Cook and Northen (2001) addressed the protection afforded the California tiger salamander 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 California tiger salamander 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.

6. The California Environmental Quality Act Does Not Provide Sufficient Protection

The environmental review process under the California Environmental Quality Act, California Public Resources Code §21000 et. seq. ("CEQA") should theoretically provide some protection to the California tiger salamander. CEQA declares that it is the policy of the State to "(p)revent the elimination of fish or wildlife species due to man's activities, ensure that fish and wildlife populations do not drop below self-perpetuating levels, and preserve for future generations representations of all plant and animal communities." (California Public Resources Code, section 21001(c)). The CEQA process is triggered when discretionary activities of state agencies may have a significant affect on the environment. When the CEQA process is triggered, it requires full disclosure of the potential environmental impacts of proposed projects. The operative document for major projects is usually the Environmental Impact Report ("EIR").

Theoretically, besides ensuring environmental protection through procedural and informational means, CEQA also has substantive mandates for environmental protection. The most important of these is the provision requiring public agencies to deny approval of a project with significant adverse effects when feasible alternatives or feasible mitigation measures can substantially lessen such effects. *Citizens for Quality Growth v. City of Mt. Shasta*, 198 Cal.App.3d 433, 440_441 (1988); CA. Pub. Res. Code § 21002; 14 Cal. Code Regs. §§ 15002(a)(3), 15021(a)(2) and (c), 15041(c), 15364, 15370. In practice, however, this substantive mandate has not been implemented, especially with regards to protection of the California tiger salamander. In practice, alternatives that would protect the California tiger salamanders and other wildlife are almost universally dismissed as "infeasible." Mitigation, when required, is often ineffective or only marginally effective.

E. Overutilization for Commercial, Recreational, Scientific, or Educational Purposes

Overexploitation is not a major threat to the California tiger salamander. (Shaffer et al. 1993; USFWS 2000). Although tiger salamanders have been used for bait and imported larvae ("waterdogs") are still sold in California, there is no information indicating that California tiger salamanders are used for this purpose.

F. Disease and Predation

1. Disease

The direct effect of disease on California tiger salamanders is not known and the risks to the species have not been determined. Because California tiger salamanders remain in relatively few localities, disease must be considered a potential threat, in particular to the Sonoma County and Santa Barbara populations.

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 California tiger salamander populations.

Worthylake and Hovingh (1989) reported on repeated die-offs of tiger salamanders (*Ambystoma 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 (*Bufo boreas*), Cascades frogs (*Rana cascadae*), and Pacific treefrogs (*Hyla regilla*) 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 legally sold in certain counties (California Code of Regulations (CCR) Title 14, Division 1, Subdivision 1, Chapter 2, Article 3, Sec. 4, 1999), or where they are illegally sold in other areas. The virus may be carried by birds, such as herons and egrets, that feed on the salamanders. Such a virus could be devastating to remaining populations of California tiger salamanders.

2. Predation

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*. 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 spadefoot toad *(Scaphiopus hammondii*) larvae, and California red-legged frogs. (USFWS 2000). In healthy salamander populations such predation is probably not a significant threat, but when combined with other impacts, such as predation by nonnative species, contaminants, or habitat alteration, it may cause a significant decrease in population viability. (Id.)

IV. CRITICAL HABITAT

Petitioners request the designation of critical habitat for the Sonoma County population of the California tiger salamander concurrent with its final listing. Critical habitat should include all suitable breeding, migration, and uplands estivation habitat for the California tiger salamander within Sonoma County.

Critical habitat is defined by Section 3 of the ESA as:

(i) the specific areas within the geographical area occupied by the species, at the time it is listed in accordance with the provisions of section 1533 of this title, on which are found those physical or biological features (I) essential to the conservation of the species and (II) which may require special management considerations or protection; and

(ii) specific areas outside the geographical area occupied by the species at the time it is listed in accordance with the provisions of section 1533 of this title, upon a determination by the Secretary that such areas are essential for the conservation of the species. 16 U.S.C. §1532(5).

The designation and protection of critical habitat is one of the primary ways in which the fundamental purpose of the ESA, "to provide a means whereby the ecosystems upon which endangered species and threatened species depend may be conserved," (16 U.S.C. §1531(b) (emphasis added)) is achieved.

Critical habitat receives additional protection through Section 7 of the ESA. The Section 7 consultation requirements provide that no action authorized, funded, or carried out by any federal agency will "jeopardize the continued existence of any endangered species or threatened species or result in the destruction or adverse modification of [critical habitat]." 16 U.S.C. §1536(a)(2) (emphasis added). "Destruction or adverse modification" is further defined in the implementing regulations as an "alteration [of habitat] that appreciably diminishes the value of critical habitat for both the survival and recovery of a listed species." (50 C.F.R. §402.02). This prohibition is separate and distinct from, and in addition to the prohibition against actions which "jeopardize the continued existence of" a species. "Jeopardize the continued existence of" is defined as "to reduce appreciably the likelihood of both the survival and recovery of a species by reducing the reproduction, numbers, or distribution of that species." (Id.)

Critical habitat designation offers an added layer of protection to ensure that a listed species' habitat - the loss of which is widely recognized to be the primary reason for most species' decline - will not be harmed. Without critical habitat designation, a listed species' protection under Section 7 of the ESA is effectively limited to avoiding "jeopardy" to the species in its occupied habitat, without separate consideration of the potential for "destruction or adverse modification" of habitat or suitable unoccupied habitat which may be essential to the species' recovery. This distinction was nicely summarized by the U.S. Fish and Wildlife Service in the Final Rule designating critical habitat for the northern spotted owl:

> The Act's definition of critical habitat indicates that the purpose of critical habitat is to contribute to a species' conservation, which definition equates to recovery. Section 7 prohibitions against the destruction or adverse modification of critical habitat apply to actions that would impair survival and recovery of the listed species, thus providing a regulatory means of ensuring that Federal actions within critical habitat are considered in relation to the goals and recommendations of a recovery plan. As a result of the link between critical habitat and recovery, the prohibition against destruction or adverse modification of the critical habitat would provide for the protection of the critical habitat's ability to contribute fully to a species' recovery. ***Thus, the adverse modification standard may be reached closer to the recovery end of the survival continuum, whereas, the jeopardy standard traditionally has been applied nearer to the extinction end of the continuum.*** (57 Fed. Reg. 1796 at 1822) (emphasis added)).

This added protection will be implemented through the issuance of a biological opinion under 16 U.S.C. §1536(b)(3)(A), which must suggest reasonable and prudent alternatives by which a finding of jeopardy or adverse modification may be avoided.

Critical habitat designation also protects species by helping to define the meaning of "harm" under Section 9 of the ESA, which prohibits unlawful "take" of listed species, including harming the species through habitat degradation. Although "take" through habitat degradation is not expressly limited to harm to "critical habitat," it is practically much easier to demonstrate that the significance of the impact to a species' habitat where that habitat has already been deemed "essential," or "critical," to the species' continued survival. (*See* Palila v. Hawaii Department of Land and Natural Resources, 852 F. 2d 1106 (9th Circ. 1988)).

Critical habitat also helps species by providing for agency accountability through the citizen suit provision of the ESA. The citizen suit provision permits members of the public to seek judicial review of the agency's compliance with its mandatory statutory duty to consider the habitat needs of imperiled species. Also, the designation of critical habitat provides valuable information for the development of recovery plans that identify actions, including habitat protection, necessary for the recovery of the species.

The Sonoma County population of the California tiger salamander will benefit from the designation of critical habitat in all of the ways described above. To give this type of protection to a species through the protection of its habitat was the clearly articulated intent of Congress in the 1978 and 1982 amendments to the ESA.

Due to the small number of remaining populations, the Sonoma County California tiger salamander is potentially vulnerable to unrestricted collection, vandalism, or other disturbance. However, it is not expected that the identification of critical habitat will increase the degree of threat to this species of taking or other human activity. In the absence of a finding that critical habitat would increase threats to a species, if there are any benefits to critical habitat designation, then a prudent finding is warranted. The biological needs of the Sonoma County California tiger salamander are sufficiently well understood to identify an area appropriate to designate as critical habitat. Therefore, critical habitat is both prudent and determinable for the Sonoma County population of the California tiger salamander.

V. SIGNATURE PAGE

Submitted this 11th day of June 2001

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VI. LITERATURE CITED

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

Anderson, P. R. 1968b. 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 bng-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.

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. 1897. List of reptiles collected in California by Mr. E. Samulas. 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. and R. A. Lukenbach. 1976. Introduced amphibians and reptiles in California. Biological Conservation 10(1):1-14.

California Department of Fish and Game (CDFG). 2000. Letter from Robert W. Foerke, CDFG to Richard Rodgers, Sonoma County, Project Review Section, RE: Sonoma County Golf Learning Center (UPE-00-0064), dated November 7, 2000.

California Department of Food and Agriculture (CDFA). 2001. California Department of Food and Agriculture web site data.

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). 2001. CDPR web site data.

California Natural Diversity Database (CNDDB). 2001. Rarefind. California Department of Fish and Game.

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 Cotati. 2000. Design Review Committee Staff Report. Planning Application No. 09/00. Unsigned and Undated. (Comfort Inn Project).

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

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 tirginum*. Copeia 1940(3):154-162.

EIP Associates. 2000a. Draft Subsequent Environmental Impact Report, Southwest Santa Rosa Redevelopment Plan. State Clearinghouse No. 99102091. May.

EIP Associates. 2000b. Final Subsequent Environmental Impact Report, Southwest Santa Rosa Redevelopment Plan.

EIP Associates. 1994. Southwest Santa Rosa Area Plan Final Environmental Impact Report.

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.

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

Fisher, R. N., and Shaffer, H. B. 1996. The decline of amphibians in California's Great Central Valley. Conservation Biology 10(5), 1387-1397.

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.

Gallo Corporation Website. 2001. http://jobs.gallo.com/q_sonoma.htm

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.

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.

Goodsell, J. A., and L. B. Kats. 1999. Effect of introduced mosquitofish on Pacific treefrogs and the role of alternative prey. Conservation Biology 14:921-924.

Graf, M. 1993. Evaluation of mosquito abatement district's use of mosquitofish as biological mosquito control: case study - Sindicich Lagoon in Briones Regional Park. Unpublished manuscript. 22 pp.

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.

Heaton, E. and A.M. Merenlender. 2000. Modeling vineyard expansion, potential habitat fragmentation. California Agriculture 54, 3.

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, photrevised 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.

Holomuzki, J. R. 1986. Intraspecific predation and habitat use by tiger salamanders (*Ambystoma tigrinum nebulosum*). Journal of Herpetology 20:439-441.

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

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., 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.

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.

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

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.

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. 1984-85. 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.E. and S.P. Lawler. 2001. Survival and growth of California tiger salamander larvae in experimental ponds: a comparison of the effects of mosquito fish presence at low and high initial densities. Presentation at the 2001 Annual Meeting of the Western Section of the Wildlife Society. Politics and Realities of Wildlife Conservation at the Start of the 21st Century. Sacramento. February 22-24, 2001.

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.

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

Marin/Sonoma Mosquito and Vector Control District (MSMVCD). 2001. Marin/Sonoma Mosquito and Vector Control District web page http://www.msmosquito.com/

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.

Marsh, D.M. and P.C. Trenham. 2001. Metapopulation dynamics and amphibian conservation. Conservation Biology 15: 40-49.

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.

McNight, M.L. and H.B. Shaffer. 1997. Large, rapidly evolving intergenetic spacers int eh mitochondrial DNA of the salamander family Ambystomatidae (Amphibia: Caudata). Mol. Biol. Evol. 14(11):1167-1176.

Merenlender, A.M. 2000. Mapping vineyard expansion provides information on agriculture and the environment. California Agriculture 54, 3.

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.

Northern, Dr. P. T. 2001. Comments on the Draft Environmental Impact Report for the South Sonoma Business Park. Submitted to City of Cotati Director of Planning by Dr. Phillip T. Northern, Professor of Biology, Sonoma State University, February 5, 2001.

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.

Mike Peters, U. S. Fish and Wildlife Service, *in litt* 1993.

Petranka, J.W. 1998. Salamanders of the United States and Canada. Smithsonian Institution Press, Washington, D.C.

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.

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 Valley Drainage Program. 1990. Unpublished 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. 2001. The Santa Barbara tiger salamander emergency listing: the interplay of systematics, genetics, and land use practices. Presentation at the 2001 Annual Meeting of the Western Section of the Wildlife Society. Politics and Realities of Wildlife Conservation at the Start of the 21st Century. Sacramento. February 22-24, 2001.

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. Bradley, Robert N. Fisher, and Scott 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.

H. Bradley Shaffer, University of California, Davis, *in litt*. 1998, 1999, 2000a,b.

Sonoma County. 1999. County of Sonoma Traffic Volumes January 1994 through December 1998. Available from the County of Sonoma Permit and Resource Management Department.

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).

Stebbins, R. C. 1962. Amphibians of the western United States. Ambystomids. Pp. 29-49 and plates.

Stebbins, R. C. 1985. A field guide to western reptiles and amphibians. Second edition, revised. Houghton Mifflin Company, Boston, Massachusetts.

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

Rosemary Thompson, Senior Biologist, Science Applications International Corporation, in litt. 1998

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

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

U.S. Army Corps of Engineers. 2000. Questions and Answers, Nationwide permits, March 6, 2000. http://www.usace.army.mil/inet/functions/cw/cecwo/reg/press/.

USFWS. 2000. 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. 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. Fish and Wildlife Service (USFWS). 1991. Animal Candidate Review for Listing as Endangered or Threatened Species. Federal Register, Vol. 56, Page 58804, November 21, 1991

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.

Waaland, M. E., M. Fawcett, J. Nielsen, and D. W. Smith. 1990. Current Condition and Ecology of the Laguna Ecosystem. In D. W. Smith Consulting, ed. History, Land Uses, and Natural Resources of the Laguna de Santa Rosa. Prepared for the Santa Rosa Subregional Water Reclamation System, California.

R.H. Wayland 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.

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.

VIII. PERSONAL COMMUNICATION SOURCES

Cook, David. Wildlife Biologist.

Davis, Liam. California Department of Fish and Game.

Kranz, Lisa. City of Santa Rosa Planning Department. 2001.

Mayer, Tim. Sonoma County Planning and Development Department.

Morgan, Cree. Sonoma County Planning and Development Department. 2001.

Wilcox, Carl. California Department of Fish and Game