Cavett

United States Department of the Interior

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In Reply Refer To:
84120-2009-F-0782-1

NOV 02 2009

Ms. Jane M. Hicks
Chief, Regulatory Division
San Francisco District
U. S. Army Corps of Engineers
1455 Market Street
San Francisco, California 94103-1398

Subject: Biological Opinion for the Pacific Gas and Electric Company Gas Line 303ILI Repair Project, Alameda and Contra Costa Counties, California (Corps File # 2009-00143S)

Dear Ms. Hicks:

This letter is in response to the U.S. Army Corps of Engineer's (Corps) May 19, 2009, request for the initiation of consultation with the U.S. Fish and Wildlife Service (Service) for the Pacific Gas and Electric Company (PG&E) Gas Line 303ILI Repair Project in Livermore, Alameda County and Brentwood, Contra Costa County, California. Your letter requested consultation on the threatened California red-legged frog (*Rana aurora draytonii*) and its proposed critical habitat, threatened California tiger salamander (*Ambytoma californienses*), endangered longhorn fairy shrimp (*Branchinecta longiantenna*), endangered vernal pool tadpole shrimp (*Lepidurus packardi*), endangered Conservancy fairy shrimp (*Branchinecta conservatio*) and threatened vernal pool fairy shrimp (*Branchinecta lynchi*) and its critical habitat. Your letter was received in our office on May 21, 2009. This response is issued under the authority of the Endangered Species Act of 1973, as amended (16 U.S.C. 1531 *et seq.*) (Act).

While suitable habitat is present, the Service has determined that the project is not likely to adversely affect the Conservancy fairy shrimp due to the lack of occurrences in Contra Costa and Alameda Counties. The Conservancy fairy shrimp is not known to occur in the Livermore Vernal Pool Region. The closest occurrences to the project site are approximately 30 miles to the north in Solano County and approximately 30 miles to the southeast in Stanislaus County. However, we have determined that the project is likely to adversely affect the endangered San Joaquin kit fox (*Vulpes macrotis mutica*). This document represents the Service's biological opinion on the effects of the action on these species.

The following sources of information were used to develop this biological opinion: (1) the May 19, 2009, consultation request and associated biological assessment; (2) a revised biological assessment and wetland delineation received June 19, 2009; (3) emails providing additional project information; and (4) other information available to the Service.

Consultation History

May 21, 2009:	The Service received the formal consultation request from the Corps.
June 4, 2009:	The Service received a revised biological assessment and wetland delineation from PG&E via email.
July 23-24, 2009:	The Service and Corps exchanged emails regarding project details.
July 27, 2009:	The Service and PG&E exchanged emails regarding project details.
July 29, 2009:	The Service received additional information from PG&E via email.
August 4, 2009:	The Service received additional information from the Corps via email.

BIOLOGICAL OPINION

Description of the Action

During inspection of the natural gas pipeline in 2008, PG&E identified anomalies at three locations requiring external direct examination and possible repair. PG&E proposes to excavate these three locations to visually inspect the pipeline and if necessary make repairs. Sites 1 and 2 are located north and south of Camino Diablo Road, respectively, in Contra Costa County. Site 3 is located in Alameda County approximately two miles north of Interstate 580 and 0.45 miles west of Vasco Road near Livermore, California. Sites 1 and 2 are separated from Site 3 by a distance of approximately 9.8 miles. Sites 1 and 2 are accessed by Camino Diablo Road and Site 3 is accessed via a gated unpaved road located at the intersection of Ames Road and Raymond Road, which is located underneath the Contra Costa-Los Positas 230 kilovolt (kV) overhead electrical transmission line.

The repair will require a 50-foot x 50-foot work area which will be delineated by Environmentally Sensitive Area (ESA) fencing. Each pipeline anomaly will require excavation of a 10-foot x 20-foot hole in order to expose the anomaly and facilitate inspection and potential repair work. Soil from the excavation will be stockpiled alongside the pipe, within the work area and outside of any wetland areas. In areas where wetlands cannot be avoided PG&E will excavate soil from the area in layers and will stockpile each distinct layer in a separate pile. After the pipe has been exposed, examined and repaired, a protective epoxy coat will be applied and the pipe trench will be backfilled. Layered soil from wetland areas will be replaced as they were found. The temporarily impacted areas will then be restored to pre-construction conditions using a native seed mix appropriate for the area. The crew size will vary from 2 to 5 workers depending on the given task for the day. Equipment for the project will consist of a tracked excavator and front end loader. Work will be preformed Monday through Friday from 7:30 am to 5:00 pm and will take approximately 2-3 weeks to complete. Construction will take place in the dry season and is tentatively scheduled for late summer 2009.

Site 1 is immediately adjacent to Camino Diablo Road and does not have an access road. Access to Site 2 will be via a 20-foot wide travel route approximately 400 feet from Camino Diablo Road. Site 3 is located north of an existing Line 303 valve lot off of Raymond Road. The 20-foot wide access route will be approximately 800 feet long with approximately 1,200 square feet in a season wetland. Approximately 10-15 steel plates (8-feet x 12-feet each) will be placed across the route to minimize affects to the wetland.

Conservation Measures

1. PG&E will implement all minimization measures described in the Service's January 26, 1999, *Programmatic Formal Endangered Species Act Consultation on the Issuance of Permits under Section 404 of the Clean Water Act or Authorizations under the Nationwide Permit Program for Projects that May Affect the California Red-legged Frog (Rana aurora draytonii)* (Programmatic Consultation).

2. PG&E will submit the names and credentials of biologists proposed to perform preconstruction surveys and monitoring to the Service for written approval at least 15 days prior to commencement of any activities.

   A Service-approved biologist will survey the sites two weeks before the onset of activities. If California red-legged frogs, tadpoles, eggs or any life stage of California tiger salamander are found, the approved biologist will contact the Service to determine if moving any of these life-stages is appropriate. In making this determination the Service shall consider if an appropriate relocation site exists. If the Service approves moving animals, the approved biologist shall be allowed sufficient time to move California red-legged frogs and/or California tiger salamanders from the sites before work activities begin. Only Service-approvedbiologists will participate in activities associated with the capture, handling, and monitoring of these species. If a California red-legged frog and/or California tiger salamander is found nearby, but outside a proposed site, it will not be disturbed and Service will be notified. The biologist will also report any observations of vernal pool fairy shrimp, longhorn fairy shrimp, vernal pool tadpole shrimp, and San Joaquin kit fox.

3. Before any construction activities begin on the project, a Service-approved biologist will conduct a training session for all construction personnel. The training will include a description of the listed species with potential to occur, their habitat, and the general

measures that are being implemented to conserve the species as they relate to the project and the boundaries within which the project may accomplished (i.e. sites).

4. A Service-approved biologist will be present at the sites until all minimization and avoidance measures have been completed. After this time, a biological monitor, who has been trained per *Conservation Measure* 3 will remain on site during all construction activities, and will have the authority to halt any work activity that might result in impacts that exceed the levels anticipated by the Corps, Service, and the California Department of Fish and Game (CDFG) during review of the proposed action. If work is stopped, the Corps, Service, and CDFG will be notified immediately by the Service-approved biologist or on-site monitor.

5. During project activities, all trash that may attract predators will be properly contained, removed from the sites and disposed of regularly. Following construction, all trash and construction debris from sites will be removed.

6. All fueling and maintenance of vehicles and other equipment and staging areas will occur at least 66 feet from any riparian habitat or water body. PG&E will ensure contamination of habitat does not occur during such operations. Prior to the start of construction, PG&E will prepare a plan to ensure a prompt and effective response to any accidental spills. All workers will be informed of the importance of preventing spills and of the appropriate measures to take should a spill occur.

7. A Service-approved biologist will ensure that the spread or introduction of invasive plant species will be avoided to the maximum extent possible. When practical, invasive exotic plants in the project area will be removed.

8. Project areas that are disturbed will be revegetated with an appropriate assemblage of native riparian, wetland and upland vegetation.

9. Stream contours will be returned to their original condition at the end of project activities, unless consultation with the Service has determined that it is not beneficial to the species or feasible.

10. The number of access routes, number and size of staging areas, and the total area of the activity will be limited to the minimum necessary to achieve the project goal. Routes and boundaries will be clearly demarcated, and these areas will be outside of riparian and wetland areas to the extent feasible. For the work at Site 1, were a seasonal wetland cannot be avoided, the 50 x 50 foot work area will be delineated by fencing to limit impacts to adjacent wetland habitat. Where impacts occur in staging areas and access routes, restoration will be performed.

11. Work activities will be completed between April 1 and November 1. Should the proponent or applicant demonstrate a need to conduct activities outside this period, the Corps may authorize such activities after obtaining the Service's approval.

12. To control erosion during and after project implementation, PG&E will implement best management practices.

13. A Service-approved biologist will permanently remove, from within the project area, any individuals of exotic species, such as bullfrogs, crayfish, and centrarchid fishes to the maximum extent possible.

14. A preconstruction nesting bird survey will be conducted for burrowing owl, and other special-status birds. If active nests are found, buffers will be established to avoid impact to these species. If adequate buffers cannot be established, construction work will be delayed until after the breeding season is fully completed or CDFG will be contacted to determine further action.

15. A preconstruction survey for San Joaquin kit fox will be performed 14 to 30 days prior to the beginning of ground disturbance. Surveys will follow guidance described in the Service's 1999 *Standardized Recommendations for Protection of the San Joaquin kit fox Prior to or During Ground Disturbance.*

16. Project-related vehicles should observe a 20-mph speed limit in all project areas, except on county roads and State and Federal highways; this is particularly important at night when San Joaquin kit foxes are most active. To the extent possible, nighttime construction should be minimized. Off-road traffic outside of designated project areas should be prohibited.

17. To prevent inadvertent entrapment of San Joaquin kit foxes, California red-legged frogs, or California tiger salamanders during the construction phase of a project, all excavated, steep-walled holes or trenches more than 2 feet deep should be covered at the close of each working day by plywood or similar materials, or provided with one or more escape ramps constructed of earth fill or wooden planks. Before such holes or trenches are filled, they should be thoroughly inspected for trapped animals. If at any time a trapped or injured kit fox is discovered, the Service, and CDFG will be notified immediately.

18. San Joaquin kit foxes, California red-legged frogs, or California tiger salamanders are attracted to den-like structures such as pipes and may enter stored pipe becoming trapped or injured. All construction pipes, culverts, or similar structures with a diameter of 4-inches or greater that are stored at a construction site for one or more overnight periods should be thoroughly inspected for these species before the pipe is subsequently buried, capped, or otherwise used or moved in any way. If a San Joaquin kit fox is discovered inside a pipe, that section of pipe should not be moved until the Service has been

consulted. If necessary, and under the direct supervision of the biologist, the pipe may be moved once to remove it from the path of construction activity, until the fox has escaped.

19. To prevent harassment, mortality of San Joaquin kit foxes, California red-legged frogs, and/or California tiger salamanders or destruction of dens by dogs or cats, no pets should be permitted on project sites.

20. Steel plates will be installed across the access route to Site 3 to reduce disturbance to the seasonal wetland.

Action Area

The action area is defined in 50 CFR § 402.02, as "all areas to be affected directly or indirectly by the Federal action and not merely the immediate area involved in the action." For the purposes of the effects assessment, the action area contains the footprints for Sites 1, 2, and 3.

<u>Analytical Framework for the Jeopardy and Adverse Modification Analyses</u>

Jeopardy Determination

In accordance with policy and regulation, the jeopardy analysis in this biological opinion relies on four components: (1) the *Status of the Species*, which evaluates the California red-legged frog, California tiger salamander, San Joaquin kit fox, longhorn fairy shrimp, vernal pool fairy shrimp, and vernal pool tadpole shrimp's range-wide condition, the factors responsible for that condition, and their survival and recovery needs; (2) the *Environmental Baseline*, which evaluates the condition of the six species in the action area, the factors responsible for that condition, and the relationship of the action area to the survival and recovery of the these listed animals; (3) the *Effects of the Action*, which determines the direct and indirect impacts of the proposed federal action and the effects of any interrelated or interdependent activities on the California red-legged frog, California tiger salamander, San Joaquin kit fox, longhorn fairy shrimp, vernal pool fairy shrimp, and vernal pool tadpole shrimp; and (4) the *Cumulative Effects*, which evaluates the effects of future, non-Federal activities in the action area on them.

In accordance with policy and regulation, the jeopardy determination is made by evaluating the effects of the proposed federal action in the context of the California red-legged frog, California tiger salamander, San Joaquin kit fox, longhorn fairy shrimp, vernal pool fairy shrimp, and vernal pool tadpole shrimp's current status, taking into account any cumulative effects, to determine if implementation of the proposed action is likely to cause an appreciable reduction in the likelihood of both the survival and recovery of these six species in the wild.

The jeopardy analysis in this biological opinion places an emphasis on consideration of the range-wide survival and recovery needs of the California red-legged frog, California tiger salamander, San Joaquin kit fox, longhorn fairy shrimp, vernal pool fairy shrimp, and vernal pool tadpole shrimp and the role of the action area in their survival and recovery as the context for evaluating the significance of the effects of the proposed Federal action, taken together with cumulative effects, for purposes of making the jeopardy determination.

Adverse Modification Determination

This Biological Opinion does not rely on the regulatory definition of "destruction or adverse modification" of critical habitat at 50 CFR 402.02. Instead, we have relied upon the statutory provisions of the ESA to complete the following analysis with respect to critical habitat.

In accordance with policy and regulation, the adverse modification analysis in this Biological Opinion relies on four components: (1) the *Status of Critical Habitat*, which evaluates the rangewide condition of proposed critical habitat for the California red-legged frog and designated critical habitat for the vernal pool fairy shrimp in terms of primary constituent elements (PCEs), the factors responsible for that condition, and the intended recovery function of the critical habitat at the provincial and range-wide scale; (2) the *Environmental Baseline*, which evaluates the condition of the critical habitat in the action area, the factors responsible for that condition, and the recovery role of the critical habitat in the action area; (3) the *Effects of the Action*, which determines the direct and indirect impacts of the proposed Federal action and the effects of any interrelated or interdependent activities on the PCEs and how that will influence the recovery role of affected critical habitat units; and (4) *Cumulative Effects* which evaluates the effects of future, non-Federal activities in the action area on the PCEs and how that will influence the recovery role of affected critical habitat units.

For purposes of the adverse modification determination, the effects of the proposed Federal action on the California red-legged frog and vernal pool fairy shrimp critical habitat are evaluated in the context of the range-wide condition of the critical habitat at the provincial and range-wide scales, taking into account any cumulative effects, to determine if the critical habitat range-wide would remain functional(or would retain the current ability for the PCEs to be functionally established in areas of currently unsuitable but capable habitat) to serve its intended recovery role for the California red-legged frog and vernal pool fairy shrimp.

The analysis in this Biological Opinion places an emphasis on using the intended range-wide recovery function of California red-legged frog and vernal pool fairy shrimp critical habitat and the role of the action area relative to that intended function as the context for evaluating the significance of the effects of the proposed Federal action, taken together with cumulative effects, for purposes of making the adverse modification determination.

Status of the Species

<u>California Red-legged Frog</u>

The California red-legged frog was listed as a threatened species on May 23, 1996 (Service 1996). Please refer to the final rule and the *Recovery Plan for the California Red-legged Frog* (*<u>Rana</u> <u>aurora</u> <u>draytonii</u>*) (Service 2002) for additional information on this species.

The red-legged frog is the largest native frog in the western United States (Wright and Wright 1949), ranging from 1.5 to 5.1 inches in length (Stebbins 2003). The abdomen and hind legs of adults are largely red; the back is characterized by small black flecks and larger irregular dark blotches with indistinct outlines on a brown, gray, olive, or reddish background color. Dorsal spots usually have light centers (Stebbins 2003), and dorsolateral folds are prominent on the back. Larvae (tadpoles) range from 0.6 to 3.1 inches in length, and the background color of the body is dark brown and yellow with darker spots (Storer 1925).

California red-legged frogs have paired vocal sacs and vocalize in air (Hayes and Krempels 1986). They breed from November through March with earlier breeding records occurring in southern localities (Storer 1925). Female frogs deposit egg masses on emergent vegetation so that the egg mass floats on the surface of the water (Hayes and Miyamoto 1984). Individuals occurring in coastal drainages are active year-round (Jennings *et al.* 1992), whereas those found in interior sites are normally less active during the cold season.

Adult California red-legged frogs typically use dense, shrubby, or emergent riparian vegetation closely associated with deep (2.3 feet), still, or slow-moving water (Hayes and Jennings 1988). However, frogs also have been found in ephemeral creeks and drainages and in ponds that may or may not have riparian vegetation. The largest densities of red-legged frogs currently are associated with deep pools with dense stands of overhanging willows and an intermixed fringe of cattails (*Typha latifolia*) (Jennings 1988). California red-legged frogs disperse upstream and downstream of their breeding habitat to forage and seek sheltering habitat. During other parts of the year, habitat includes nearly any area within 1-2 miles of a breeding site that stays moist and cool through the summer (Fellers 2005). According to Fellers (2005), this can include vegetated areas with coyote bush (*Baccharis pilularis*), California blackberry (*Rubus ursinus*) thickets, and root masses associated with willow and California bay trees (*Umbellularia californica*). Sometimes the non-breeding habitat used by California red-legged frogs is extremely limited in size. For example, non-breeding California red-legged frogs have been found in a 6-foot wide coyote bush thicket growing along a tiny intermittent creek surrounded by heavily grazed grassland (Fellers 2005). Sheltering habitat for California red-legged frogs is potentially all aquatic, riparian, and upland areas within the range of the species and includes any landscape features that provide cover, such as existing animal burrows, boulders or rocks, organic debris such as downed trees or logs, and industrial debris. Agricultural features such as drains, watering troughs, spring boxes, abandoned sheds, or hay stacks may also be used. Incised stream channels with portions narrower and depths greater than 18 inches also may provide important summer sheltering habitat. Accessibility to sheltering habitat is essential for the survival of California red-legged frogs within a watershed, and can be a factor limiting frog population numbers and survival.

Adult California red-legged frogs are often associated with permanent bodies of water. However, while many frogs remain at permanent breeding ponds year-round, Fellers and Kleeman (2007) found that nearly half of all females in certain populations disperse away from these areas into other suitable non-breeding locations. Once at these areas, individuals may remain here for the majority of the year, retuning to breeding ponds for only several weeks at a time. While California red-legged frogs do not have a distinct breeding migration back to these breeding areas, the number of dispersing individuals appears to increase with rainfall (Fellers 2005; Fellers and Kleeman 2007). Dispersal distances to and from breeding habitat are typically less than 0.5 mile, with a few individuals moving up to 1-2 miles (Fellers 2005). Movements are typically along riparian corridors, however dispersal from breeding habitats to riparian areas often requires the species to traverse across less desirable habitats such as open fields where grazing, farming or other high intensity management activities may occur (Fellers and Kleeman 2007). Dispersing frogs in northern Santa Cruz County traveled distances from 0.25 miles to more than 2 miles without apparent regard to topography, vegetation type, or riparian corridors (Bulger *et al.* 2003). Because of the ability of California red-legged frogs to move through a range of different habitats as well as the life history needs required by this species, equal protection of suitable breeding and non-breeding areas as well as the migration corridors that connect them is vital to the recovery and survival of the species (Fellers and Kleeman 2007).

Egg masses contain about 2,000 to 5,000 moderate sized (0.08 to 0.11 inches in diameter), dark reddish brown eggs and are typically attached to vertical emergent vegetation, such as bulrushes (*Scirpus* spp.) or cattails (Jennings *et al.* 1992). California red-legged frogs are often prolific breeders, laying their eggs during or shortly after large rainfall events in late winter and early spring (Hayes and Miyamoto 1984). Eggs hatch in 6 to 14 days (Jennings 1988). Increased siltation during the breeding season can cause asphyxiation of eggs and small larvae. Larvae undergo metamorphosis 3.5 to 7 months after hatching (Storer 1925; Wright and Wright 1949; Jennings and Hayes 1990).

Of the various life stages, larvae probably experience the highest mortality rates, with less than 1% of eggs laid reaching metamorphosis (Jennings *et al.* 1992). Sexual maturity normally is reached at 3 to 4 years of age (Storer 1925; Jennings and Hayes 1985). California red-legged frogs may live 8 to 10 years (Jennings *et al.* 1992). Populations of California red-legged frogs fluctuate from year to year. When conditions are favorable red-legged frogs can experience extremely high rates of reproduction and thus produce large numbers of dispersing young and a concomitant increase in the number of occupied sites. In contrast, California red-legged frogs may temporarily disappear from an area when conditions are stressful (e.g., drought). At these locations, the rare individuals that disperse over long distances via riparian and overland corridors become necessary to repopulate temporarily abandoned but still suitable regions (Fellers and Kleeman 2007).

The diet of the California red-legged frog is highly variable. Hayes and Tennant (1985) found invertebrates to be the most common food items. According to their data, vertebrates, such as Pacific tree frogs (*Pseudacris regilla*) and California mice (*Peromyscus californicus*), represent over half the prey mass eaten by larger frogs, although invertebrates were the most numerous food items (Service 2002). Adult California red-legged frogs have been known to eat threatened California tiger salamanders larvae (Shaffer *et al.* 2004). Hayes and Tennant (1985) found juvenile frogs to be active diurnally and nocturnally, whereas adult frogs were largely nocturnal. Adult California red-legged frogs have often been observed spending daylight hours taking shelter in still pools and associated vegetation or thermoregulating in full sunlight on rocks or other highly exposed surfaces (Fellers and Kleeman 2007). Feeding activity probably occurs along the shoreline and on the surface of the water (Hayes and Tennant 1985). The diet of California red-legged frog tadpoles is not well studied, but their diet is probably similar to other Ranid tadpoles that feed on algae, diatoms, and detritus by grazing on the surface of rocks and vegetation (Jennings *et al.* 1992; Kupferberg 1996; Fellers 2005).

The historic range of the California red-legged frog extended coastally from the vicinity of Point Reyes National Seashore, Marin County, California, and inland from the vicinity of Redding in Shasta County, California, southward to northwestern Baja California, Mexico (Jennings and Hayes 1985; Hayes and Krempels 1986). The California red-legged frog was historically known from 46 counties but is currently only found in 22 of them (Service 2002). California Red-legged frogs are still locally abundant within portions of the San Francisco Bay area and the central coast. Within the remaining distribution of the species, only isolated populations have been documented in the Sierra Nevada, northern Coast, and northern Transverse Ranges. The species is believed to be extirpated from the southern Transverse and Peninsular ranges, but is still present in Baja California, Mexico. The most secure aggregations of red-legged frogs are found in aquatic sites that support substantial riparian and aquatic vegetation and lack non-native predators.

Habitat loss and alteration, over-exploitation, and introduction of exotic predators were significant factors in the species' decline in the early to mid-1900s. Agriculture, urbanization, mining, overgrazing, recreation, timber harvest, nonnative plants, impoundments, water diversions, degraded water quality, and introduced predators have resulted in substantial degradation and loss of California red-legged frog breeding ponds, upland habitat, and dispersal corridors. These factors have resulted in the isolation and fragmentation of habitats within many watersheds, often precluding dispersal between sub-populations and jeopardizing the viability of metapopulations (broadly defined as multiple subpopulations that occasionally exchange individuals through dispersal, and are able to "rescue" small populations and colonize available empty habitat patches). The fragmentation of existing habitat and the continued colonization of existing habitats by nonnative species may represent the most significant current threats to red-legged frogs. However, California red-legged frog populations are usually threatened by more than one factor. Pounds *et al.* (2006) discussed dramatic increases in fatalities of Ranid populations worldwide due to outbreaks associated with a chytrid fungus, *Batrachochytrium dendrobatidis* (Bd). These outbreaks are thought to be associated with rapid global climate change, which creates climatic conditions that are more favorable to the fungus (Pounds *et al.* 2006). Bd has been identified in the San Francisco Bay area and further research is currently underway to determine the extent and impact of these outbreaks. The increasing discrepancies in seasonal temperature and precipitation variations will produce deeper rivers with higher velocities in the spring and reduced aquatic habitat with higher eutrophication rates during the summer. The consequence of these changes will likely be a decline in California red-legged frog breeding habitat throughout California.

Some current habitat loss has been compensated in developed areas through artificially created habitat such as golf course or restoration ponds, and juvenile and adult red-legged frogs have been found in these human-created habitats. However, habitat created near urban areas where predators such as bullfrogs (*Lithobates catesbeianus*) and raccoons (*Procyon lotor*) are able to increase in population size may not be suitable for the long-term survival or successful reproduction of local frog populations (H.T. Harvey and Associates 1997). Other factors such as contaminants and lack of dispersal corridors connecting habitat patches may also prevent long-term survival of populations in created habitat patches (H.T. Harvey and Associates 1997).

Predation by introduced species is also a significant threat to the red-legged frog. Several researchers in central California have noted the decline and eventual local disappearance of California and northern red-legged frogs (*Rana aurora aurora*) once bullfrogs became established at the same sites (Jennings and Hayes 1990; Twedt 1993). This has been attributed to both predation and competition. Twedt (1993) documented bullfrog predation of juvenile northern red-legged frogs, and suggested that bullfrogs could prey on subadult Northern red-legged frogs as well. In addition to predation, bullfrogs may have a competitive advantage over red-legged frogs, since bullfrogs are larger, possess more generalized food habits (Bury and Whelan 1984), have an extended breeding season (Storer 1933) during which an individual female can produce as many as 20,000 eggs (Emlen 1977), and larvae are unpalatable to predatory fish (Kruse and Francis 1977). In addition to competition, bullfrogs interfere with red-legged frog reproduction. Both California and northern red-legged frogs have been observed in amplexus with (mounted on) both male and female bullfrogs (Jennings and Hayes 1990; Twedt 1993). Thus bullfrogs are able to prey upon and out-compete red-legged frogs, especially in sub-optimal habitat. Upon establishment within a given area, bullfrogs become difficult to eradicate. Historically, gigging methods or pellet guns were utilized by land managers to reduce populations. However, research suggests that these methods are only effective when applied in concert with biannual draining of perennial habitats and/or the flooding of riparian areas every five years (Doubledee *et al.* 2003). Red swamp crayfish (*Procambarus clarkii*), signal crayfish (*Pacifastacus leniusculus*), and several species of warm water fish including sunfish (*Lepomis* spp.), goldfish (*Carassius auratus*), common carp (*Cyprinus carpio*), and mosquitofish (*Gambusia affinis*) may similarly affect red-legged frogs through predation and competition (Lawler *et al.* 1999).

The urbanization of land within and adjacent to red-legged frog habitat has also impacted this species. Declines are attributed to channelization of riparian areas, enclosure of the channels by urban development that blocks red-legged frog dispersal, and the introduction of predatory fishes and bullfrogs. The conversion and isolation of perennial pool habitats resulting from urbanization is also an ongoing impact to red-legged frogs. Mao *et al.* (1999 cited in Fellers 2005) reported northern red-legged frogs infected with an iridovirus, a pathogen that was also detected in sympatric three-spined sticklebacks (*Gasterosteus aculeatus*) in northwestern California. Ingles (1932a, 1932b, and 1933 cited in Fellers 2005) reported four species of trematodes from red-legged frogs, but he later synonymized two of them (found them to be the same as the other two).

The recovery plan for the California red-legged frog identifies eight Recovery Units (Service 2002). The establishment of these Recovery Units is based on the Recovery Team's determination that various regional areas of the species' range are essential to its survival and recovery. The status of the California red-legged frog for the purposes of this Biological Opinion will be considered within the smaller scale of Recovery Units as opposed to the overall range. These Recovery Units are delineated by major watershed boundaries as defined by U.S. Geological Survey hydrologic units and the limits of the range of the red-legged frog. The goal of the recovery plan is to protect the long-term viability of all extant populations within each Recovery Unit. Within each Recovery Unit, core areas have been delineated and represent contiguous areas of moderate to high California red-legged frog densities that are relatively free of exotic species such as bullfrogs. The goal of designating core areas is to protect metapopulations that, combined with suitable dispersal habitat, will allow for the long term viability within existing populations; this management strategy will allow for the recolonization of habitat within and adjacent to core areas that are naturally subjected to periodic localized extinctions, thus assuring the long-term survival and recovery of the California red-legged frog. The proposed project is located within the South/East San Francisco Bay Recovery Unit, which extends from the northernmost portion of Contra Costa County, includes a portion of San Joaquin County south to Santa Clara County, includes the eastern portion of San Mateo County, and all of San Francisco County. Contra Costa and Alameda Counties contain the majority of known California red-legged frog localities within the eastern San Francisco Bay area. Within this Recovery Unit, California red-legged frogs seem to have been nearly eliminated from the western lowland areas near urbanization. The species still occurs in isolated populations in the East Bay Foothills (between Interstate 580 and Interstate 680) and is abundant in several areas in eastern Alameda and Contra Costa counties, such as the area around Los Vaqueros Reservoir; this Unit is essential to the survival and recovery of California red-legged frog, as it contains the largest number of occupied drainages in the northern portion of its range.

California Red-legged Frog Proposed Revised Critical Habitat

Critical habitat for the California red-legged frog was designated on April 13, 2006 (Service 2006a). On September 16, 2008, the Service published a proposed rule revising critical habitat for the amphibian (Service 2008). When designating critical habitat, the Service is required to list the known primary constituent elements essential to the conservation of the species, and that may require special management considerations and protection (50 CFR § 424.14). Such physical and biological features include, but are not limited to, space for individual and population growth and for normal behavior; food, water, air, light, minerals, or other nutritional or physiological requirements; cover or shelter; sites for breeding, reproduction, rearing or development of offspring; and habitats that are protected from disturbance or are representative of the historic geographical and ecological distributions of a species (Service 2006a).

Within areas essential for the conservation and recovery of the California red-legged frog, the Service has determined the following primary constituent elements (PCEs):

PCE 1: aquatic breeding habitat defined as standing bodies of fresh water (with salinities less than 7.0 parts per thousand), including natural and manmade ponds, slow moving streams or pools within streams, and other ephemeral or permanent water bodies that typically become inundated during winter rains and hold water for a minimum of 20 weeks in all but the driest of years;

PCE 2: non-breeding aquatic habitat defined as freshwater habitats, as described in PCE 1, that may or may not hold water long enough for the subspecies to hatch and complete its aquatic life cycle but that do provide for shelter, foraging, predator avoidance, and aquatic dispersal for juvenile and adult California red-legged frogs;

PCE 3: upland habitat defined as adjacent to or surrounding breeding and non-breeding aquatic and riparian habitat up to a distance of 1 mile in most cases and comprised of various vegetational series such as grasslands, woodlands, and/or wetland/riparian plant species that provides the frog shelter, forage, and predator avoidance;

PCE 4: dispersal habitat defined as accessible upland or riparian dispersal habitat within designated units and between occupied locations within 1 mile of each other that allows for movement between such sites and can include various natural habitats and altered habitats such as agricultural fields, which do not contain barriers to dispersal.

California Tiger Salamander

On May 23, 2003, we proposed to list the Central California Distinct Population Segment (DPS) of the California tiger salamander as threatened. At this time we also proposed reclassification of the Santa Barbara County DPS and Sonoma County DPS from endangered to threatened (Service 2003a). In the same notice we also proposed a special rule under section 4(d) of the Act to exempt take for routine ranching operations for the Central California DPS and, if reclassified to threatened, for the Santa Barbara and Sonoma County DPSs (Service 2003a). On August 4, 2004, after determining that the listed the Central California population of the California DPS of the California tiger salamander was threatened (Service 2004b), we determined that the Santa Barbara and Sonoma County populations were threatened as well, and reclassified the California tiger salamander as threatened throughout its range, removing the Santa Barbara and Sonoma County populations as separately listed DPSs (Service 2004b). In this notice we also finalized the special rule to exempt take for routine ranching operations for the California tiger salamander throughout its range (Service 2004b).

On August 18, 2005, as a result of litigation of the August 4, 2004, final rule on the reclassification of the California tiger salamander DPSs (*Center for Biological Diversity et al.* v. *United States Fish and Wildlife Service et al.*, C 04-04324 WHA (N.D. Cal. 2005), the District

Court of Northern California sustained the portion of the 2004 rule pertaining to listing the Central California tiger salamander as threatened with a special rule, vacated the 2004 rule with regard to the Santa Barbara and Sonoma DPSs, and reinstated their prior listing as endangered. The List of Endangered and Threatened Wildlife in part 17, subchapter B of Chapter I, title 50 of the Code of Federal Regulations (CFR) has not been amended to reflect the vacatures contained in this order, and continues to show the rangewide reclassification of the California tiger salamander as a threatened species with a special rule. We are currently in the process of correcting the CFR to reflect the current status of the species throughout its range.

The California tiger salamander is a large, stocky, terrestrial salamander with a broad, rounded snout. Adults may reach a total length of 8.2 inches (Petranka 1998). California tiger salamanders exhibit sexual dimorphism with males typically larger than females. The coloration of the California tiger salamander is white or yellowish markings against black. As adults, California tiger salamanders tend to have creamy yellow to white spotting on the sides with much less on the dorsal surface of the animal, whereas other tiger salamander species have brighter yellow spotting that is heaviest on the top of the animals. California tiger salamander larvae have yellowish gray bodies, broad fat heads, large feathery external gills, and broad dorsal fins extending well up their back and range in length from approximately 0.45 to 0.56 inches (Petranka 1998).

The California tiger salamander has an obligate biphasic life cycle (Shaffer *et al.* 2004). Although larval salamanders develop in vernal pools and ponds in which they were born, they are otherwise terrestrial salamanders that spend most of their postmetamorphic lives in widely dispersed underground retreats (Trenham *et al.* 2001; Shaffer *et al.* 2004). Subadult and adult California tiger salamanders spend the dry summer and fall months of the year in the burrows of small mammals, such as California ground squirrels (*Spermophilus beecheyi*) and Botta's pocket gopher (*Thomomys bottae*) (Storer 1925; Loredo and Van Vuren 1996; Petranka 1998; Trenham 1998a). The burrows provide protection from the sun and wind that can cause desiccation (drying out) of amphibian skin. Camel crickets (*Ceuthophilas* spp. and *Pristoceuthophilus* spp.) and other invertebrates within these burrows are likely prey for tiger salamander.

California tiger salamanders are members of the Family Ambystomatidae (mole salamanders); although members of this family are known as "burrowing salamanders," California tiger salamanders are not known to create their own burrows in the wild, perhaps due to the hardness of soils in the California ecosystems in which they are found. Because they live underground in the burrows of mammals, they are rarely encountered in the uplands by humans even where they are abundant. Recent surveys performed within the East Bay Regional Parks District (EBRPD) have demonstrated that California tiger salamanders may utilize less than 50% of suitable breeding habitat during any given year. This data indicates that even in ponds where the species appears to have been extirpated, regular breeding activities may still occur (Bobzien and DiDonato 2007). Burrows may be active (in use by small mammals) or inactive (small mammals are absent), but because burrows tend to be short lived without continued small mammal activity, they typically collapse within approximately 18 months if not maintained (Loredo *et al.* 1996).

An active population of burrowing mammals is necessary to sustain sufficient underground refugia for the species. California tiger salamanders also may utilize leaf litter or desiccation cracks in the soil.

The upland burrows inhabited by California tiger salamanders have often been referred to as "aestivation" sites, which implies a state of inactivity, however, recent studies show that the animals move, feed, and remain active in their burrows (Trenham 2001; Van Hattem 2004). Researchers have long inferred that they are feeding while underground because the animals arrive at breeding ponds in good condition and are heavier when entering a pond than when leaving. Thus, upland habitat is a more accurate description of the terrestrial areas used by tiger salamanders.

Once fall or winter rains begin, the salamanders emerge from the upland sites on rainy nights to feed and to migrate to the breeding ponds (Stebbins 1985, 1989; Shaffer *et al.* 1993). Adult salamanders mate in the breeding ponds, after which the females lay their eggs in the water (Twitty 1941; Shaffer *et al.* 1993; Petranka 1998). Historically, California tiger salamanders utilized vernal pools, but the animals also currently breed in livestock ponds. Females attach their eggs singly, or in rare circumstances, in groups of two to four, to twigs, grass stems, vegetation, or debris (Storer 1925; Twitty 1941). In ponds with no or limited vegetation, they may be attached to objects, such as rocks and boards on the bottom (Jennings and Hayes 1994). California tiger salamander populations at eastern San Francisco Bay locations may have higher reproductive success in ponds with limited to no emergent vegetation, potentially due to a reduced number of aquatic predators that rely on more highly shaded areas (Bobzien and DiDonato 2007). After breeding, adults leave the pool and return to the small mammal burrows (Loredo *et al.* 1996; Trenham 1998a), although they may continue to emerge nightly for approximately the next two weeks to feed (Shaffer *et al.* 1993). In drought years, the seasonal pools may not fill and the adults can not breed (Barry and Shaffer 1994).

California tiger salamander eggs hatch in 2 to 4 weeks (Storer 1925). The larvae are aquatic with yellowish gray coloration and have broad fat heads, possess large, feathery external gills, and broad dorsal fins that extend well onto their back. The larvae feed on zooplankton, small crustaceans, and aquatic insects for about six weeks post hatching, after which they switch to larger prey (J. Anderson 1968). Larger larvae are known to consume tadpoles of Pacific tree frogs and California red-legged frogs (J. Anderson 1968; P. Anderson 1968). The larvae are among the top aquatic predators in the seasonal pool ecosystems. Larval California tiger salamanders often rest on the bottom in shallow water; they may also be found at varying depths in locations where deep water is available. The young salamanders are wary and when approached by potential predators, will dart into vegetation on the bottom of the pool (Storer 1925).

The larval stage of the California tiger salamander usually last three to six months, as most seasonal ponds and pools dry up during the summer (Petranka 1998). The peak emergence of these metamorphs is typically between mid-June to mid-July (Loredo and Van Vuren 1996; Trenham *et al.* 2000) but in some areas as early as late February or early March. Amphibian larvae must grow to a critical minimum body size before they can metamorphose (change into a different physical form) to the terrestrial stage (Wilbur and Collins 1973). Individuals collected near Stockton in the Central Valley during April varied from 1.88 to 2.32 inches in length (Storer 1925). Feaver (1971) found that larvae metamorphosed and left the breeding pools 60 to 94 days after the eggs had been laid, with larvae developing faster in smaller, more rapidly drying pools. The longer the ponding duration, the larger the larvae and metamorphosed juveniles are able to grow, and the more likely they are to survive and reproduce (Pechmann *et al.* 1989; Semlitsch *et al.* 1988; Morey 1998; Trenham 1998b). The larvae will perish if a site dries before metamorphosis is complete (P. Anderson 1968; Feaver 1971). Pechmann *et al.* (1989) found a strong positive correlation with ponding duration and total number of metamorphosing juveniles in five salamander species. In Madera County, Feaver (1971) found that only 11 of 30 pools sampled supported larval tiger salamanders, and five of these dried before metamorphosis could occur. Therefore, out of the original 30 pools, only six (20 percent) provided suitable conditions for successful reproduction that year. Size at metamorphosis is positively correlated with stored body fat and survival of juvenile amphibians, and negatively correlated with age at first reproduction (Semlitsch *et al.* 1988; Scott 1994; Morey 1998). In the late spring or early summer, before the ponds dry completely, metamorphosed juveniles leave ponds and enter upland habitat. This emigration occurs in both wet and dry conditions (Loredo and Van Vuren 1996; Loredo *et al.* 1996). Unlike during their winter migration, the wet conditions when adult California tiger salamanders typically move do not generally occur during the months when their breeding ponds begin to dry. As a result, juveniles may be forced to leave their ponds on rainless nights. Under these conditions, they may move only short distances to find temporary upland sites for the dry summer months, waiting until the next winter's rains to move further into suitable upland refugia. Once juvenile tiger salamanders leave their birth ponds for upland refugia, they typically do not return to ponds to breed for an average of 4 to 5 years (Trenham *et al.* 2000). However, the minimum age at sexual maturity has been observed to be 2 years for males and 2 to 3 years for females (Loredo and Van Vuren 1996; Trenham et al. 2000), Individuals remain active in the uplands, coming to the surface during rainfall events to disperse or forage (Trenham *et al.* 2000).

Lifetime reproductive success for California tiger salamanders is low. Trenham *et al.* (2000) found the average female bred 1.4 times and produced 8.5 young that survived to metamorphosis per reproductive effort. This resulted in roughly 11 metamorphic offspring over the lifetime of a female. Data suggests that two reasons for the low reproductive success is that most individuals require two years to become sexually mature, but some individuals may be slower to mature (Shaffer *et al.* 1993); and some animals do not breed until they are four to six years old. While individuals may survive for more than ten years, many breed only once, and in some populations, less than five percent of marked juveniles survive to become breeding adults (Trenham 1998b). With such low recruitment, isolated populations are susceptible to unusual, randomly occurring natural events as well as from anthropogenic factors that reduce breeding success and individual survival. Factors that repeatedly lower breeding success in isolated pools can quickly extirpate a population.

Movements made by California tiger salamanders can be grouped into two main categories: (1) breeding migration; and (2) interpond dispersal. Breeding migration is the movement of salamanders to and from a pond and the surrounding upland habitat. After metamorphosis, juveniles move away from breeding ponds into the surrounding uplands, where they live continuously for several years. At a study in Monterey County, it was found that upon reaching sexual maturity, most individuals returned to their natal/ birth pond to breed, while 20 percent dispersed to other ponds (Trenham *et al.* 2001). Following breeding, adult California tiger salamanders return to upland habitats, where they may live for one or more years before breeding again (Trenham *et al.* 2000).

California tiger salamanders are known to travel large distances from breeding sites into upland habitats. Maximum distances moved are generally difficult to establish for any species, but California tiger salamanders in Santa Barbara County have been recorded to disperse 1.3 miles from breeding ponds (Sweet 1998). California tiger salamanders are known to travel between breeding ponds; one study found that 20 to 25 percent of the individuals captured at one pond were recaptured later at ponds approximately 1,900 and 2,200 feet away (Trenham *et al.* 2001). In addition to traveling long distances during migration to or from ponds, tiger salamanders may reside in burrows that are far from ponds. At one site in Contra Costa County, hundreds of California tiger salamanders have been captured three years in a row in upland habitat approximately 0.75 miles from the nearest breeding pond (Orloff 2003).

Although the observations above show that California tiger salamanders can travel far, typically they stay closer to breeding ponds. Evidence suggests that subadult California tiger salamanders disperse further into upland habitats than adults. A trapping study conducted in Solano County during winter of 2002/2003 found that subadults used upland habitats further from breeding ponds than adults (Trenham and Shaffer 2005). More subadults were captured at distances of 328, 656, and 1,312 feet from a breeding pond than at 164 feet. Large numbers, approximately 20 percent of total captures, were found 1,312 feet from a breeding pond. Fitting a distribution curve to the data revealed that 95 percent of subadult could be found within 2,067 feet of the pond, with the remaining 5 percent being found at even greater distances. Results from the 2003-04 trapping efforts detected subadult California tiger salamanders at even further distances, with a large proportion of the total salamanders caught at 2,297 feet from the breeding pond (Service 2004a). Most subadults captured, even those at 2,100 feet, were still moving away from ponds (Service 2004a). These data show that many tiger salamanders travel large distances while still in the juvenile/subadult stage. Post-breeding movements away from breeding ponds by adults appear to be much smaller. During post-breeding emigration, radio-tracked adult tiger salamanders were located in burrows 62 to 813 feet from their breeding ponds (Trenham 2001). These reduced movements may be due to adult California tiger salamanders having depleted physical reserves post-breeding, or also due to the drier weather conditions that can occur during the period when adults leave the ponds.

California tiger salamanders are also known to use several successive burrows at increasing distances from an associated breeding pond. Although previously sited studies provide information regarding linear movement from breeding ponds, upland habitat features appear to have some influence on movement. Trenham (2001) found that radio-tracked adults favored grasslands with scattered large oaks, over more densely wooded areas. The same study showed no indication that certain habitats type are favored as terrestrial travel corridors over others (Trenham 2001). In addition, at two ponds completely encircled by drift fences and pitfall traps, captures of arriving adults and dispersing new metamorphs were distributed roughly evenly around the ponds. Thus, it appears that dispersal into the terrestrial habitat occurs randomly with respect to direction and habitat types.

Historically, California tiger salamanders inhabited low elevation grassland and oak savanna plant communities of the Central Valley, and adjacent foothills, and the inner Coast Ranges in California (Storer 1925; Shaffer *et al.* 1993; Jennings and Hayes 1994). The species has been recorded from near sea level to approximately 3,900 feet in the Coast Ranges and up to about 1,600 feet in the Sierra Nevada foothills (Shaffer *et al.* 2004). Along the Coast Ranges, the species occurred from the Santa Rosa area of Sonoma County south to the vicinity of Buellton in Santa Barbara County. In the Central Valley and surrounding foothills, the species occurred from northern Yolo County southward to northwestern Kern County and northern Tulare County. Three distinct California tiger salamander populations are recognized and correspond to the Santa Maria area within Santa Barbara County, the Santa Rosa Plain in Sonoma County, and vernal pool/grassland habitats throughout the Central Valley.

Documented and/or potential predators on California tiger salamanders include coyotes (*Canis latrans*), raccoons, striped skunks (*Mephitis mephitis*), opossums (*Didelphis virginiana*), egrets (*Egretta* spp.), great blue herons (*Ardea herodias*), crows (*Corvus brachyrhynchos*), ravens (*Corvus corax*), garter snakes (*Thamnophis* spp.), bullfrogs, California red-legged frogs, mosquito fish, and crayfish (*Procrambus* spp.). In addition, predacious aquatic hexapods (arthropods) have also been shown to have a significant negative association with California tiger salamanders (Bobzien and DiDonato 2007). Domestic dogs (*Canis familiaris*) have been observed eating California tiger salamanders at Lake Lagunitas at Stanford University (Sean Barry, ENTRIX, pers. comm. July 2004).

Diseases may pose a significant threat though the specific effects of disease on the California tiger salamander are not known. Pathogens, fungi, water mold, bacteria, and viruses have been known to adversely affect other tiger salamander species and/or other amphibians. Pathogens are suspected of causing global amphibian declines (Davidson *et al.* 2003). Pathogen outbreaks have not been documented in the California tiger salamander, but chytrid fungus infections (chytridiomycosis) have been detected in California tiger salamander (Padgett-Flohr and Longcore 2005). Chytridiomycosis and ranaviruses are a potential threat to the California tiger salamander because these diseases have been found to adversely affect other amphibians, including tiger salamanders (Davidson *et al.* 2003; Lips *et al.* 2003). A deformity-causing infection, possibly caused by a parasite in the presence of other factors, has affected pond-breeding amphibians at known tiger salamander breeding sites. This same infection has become widespread among amphibian populations in Minnesota and poses the threat of becoming widespread in California. Nonnative species, such as bullfrogs and nonnative tiger salamanders, are located within the range of the California tiger salamander and have been identified as potential carriers of these diseases. Human activities can facilitate the spread of disease by encouraging the further introduction of non-native carriers and by acting as carriers themselves (i.e. contaminated boots or fishing equipment). Human activities can also introduce stress by other means, such as habitat fragmentation, that results in tiger salamanders being more susceptible to the effects of disease. Disease will likely become a growing threat because of the relatively small and fragmented remaining California tiger salamander breeding sites, the many stresses on these sites due to habitat losses and alterations, and the many other potential disease-enhancing anthropogenic changes that have occurred both inside and outside the species' range.

The California tiger salamander is imperiled throughout its range by a variety of human activities (Service 2004b). Current factors associated with declining populations of the salamander include continued degradation and loss of habitat due to agriculture and urbanization, hybridization with non-native eastern tiger salamanders (*Ambystoma tigrinum*) (Riley *et al.* 2003; Fitzpatrick and Shaffer 2004), and introduced predators. Fragmentation of existing habitat and the continued colonization of existing habitat by non-native tiger salamanders (and other species) may represent the most significant current threats to tiger salamanders, although populations are likely threatened by more than one factor. Isolation and fragmentation of habitats within many watersheds have precluded dispersal between sub-populations and jeopardized the viability of metapopulations (broadly defined as multiple subpopulations that occasionally exchange individuals through dispersal, and are capable of colonizing or "rescuing" extinct habitat patches). Other threats are predation and competition from introduced exotic species, possible commercial over utilization, various chemical contaminants, road-crossing mortality, and certain unrestrictive mosquito and rodent control operations. The various primary and secondary threats are not currently being offset by existing Federal, State, or local regulatory mechanisms. The tiger salamander is also vulnerable to chance environmental or demographic events, to which small populations are particularly vulnerable.

The Bay Area region occurs within the Central Coast and Livermore vernal pool regions (Keeler-Wolf *et al.* 1998). Vernal pools within the Coast Range are more sporadically distributed than vernal pools in the Central Valley (Holland 2003). In San Benito and Santa Clara counties, Central Coast vernal pools have been destroyed and degraded due to agriculture. The vernal pools at Stanford in Santa Clara County have been destroyed and degraded due to recreation and development (Keeler-Wolf *et al.* 1998). The annual loss of vernal pools from 1994 to 2000 in Monterey, San Benito, San Luis Obispo, Santa Barbara, and Ventura counties was 2 to 3 percent. This rate of loss suggests that vernal pools in these counties are disappearing faster than previously reported (Holland 2003). Most of the vernal pools in the Livermore Region in Alameda County have been destroyed or degraded by urban development, agriculture, water diversions, poor water quality, and long-term overgrazing (Keeler-Wolf *et al.* 1998). However, properly managed grazing is believed to be beneficial to the species in upland habitats as these activities promote the presence of burrowing fossorial mammals (Cook *et al.* 2006). Additionally, the limited and carefully managed introduction of cattle into wetlands can reduce dense emergent vegetation that may attract predators as well as compress soils at the bottom of pools, deepening these areas and thus increasing their hydrologic inundation period (Bobzien and DiDonato 2007).

Of the 140 California tiger salamander localities where wetland habitat has been identified, only seven percent were located in vernal pools. Due to the extensive losses of vernal pool complexes and their limited distribution in the Bay Area region, many tiger salamander breeding sites consist of artificial water bodies. In surveys performed in Alameda and Contra Costa counties, California tiger salamanders were found to breed almost exclusively in man-made stock ponds (Bobzien and DiDonato 2007). Use of these areas may place the tiger salamander at great risk of hybridization with non-native tiger salamanders. Without long-term maintenance, the longevity of artificial breeding habitats is uncertain relative to naturally occurring vernal pools that are dependent on the continuation of seasonal weather patterns. During the 1980s and 1990s, vernal pools were lost at a 1.1 percent annual rate in Alameda County (Holland 1998).

San Joaquin Kit Fox

The San Joaquin kit fox was listed as an endangered species on March 11, 1967 (Service 1967) and it was listed by the State of California as a threatened species on June 27, 1971. Please refer to the final listing and the *Recovery Plan for Upland Species of the San Joaquin Valley, California* (Service 1998) for additional information on this species.

In the San Joaquin Valley before 1930, the range of the San Joaquin kit fox extended from southern Kern County north to Tracy in San Joaquin County, on the west side, and near La Grange in Stanislaus County, on the east side (Grinnell *et al.* 1937; Service 1998). Historically, this species occurred in several San Joaquin Valley native plant communities. In the southernmost portion of the range, these communities included Valley Sink Scrub, Valley Saltbush Scrub, Upper Sonoran Subshrub Scrub, and Annual Grassland. San Joaquin kit foxes also exhibit a capacity to utilize habitats that have been altered by man. The animals are present in many oil fields, grazed pasturelands, and "wind farms" (Cypher 2000). San Joaquin kit foxes can inhabit the margins and fallow lands near irrigated row crops, orchards, and vineyards, and may forage occasionally in these agricultural areas (Service 1998). There are a limited number of observations of San Joaquin kit foxes foraging in trees in urban areas (Murdoch *et al.* 2005). The San Joaquin kit fox seems to prefer more gentle terrain and decreases in abundance as terrain ruggedness increases (Grinnell *et al.* 1937; Morrell 1972; Warrick and Cypher 1999).

Adult San Joaquin kit foxes are usually solitary during late summer and fall. In September and October, adult females begin to excavate and enlarge natal dens (Morrell 1972), and adult males join the females in October or November (Morrell 1972). Typically, pups are born between February and late March following a gestation period of 49 to 55 days (Egoscue 1962; Morrell 1972; Spiegel and Tom 1996; Service 1998). Mean litter sizes reported for San Joaquin kit foxes include 2.0 on the Carrizo Plain (White and Ralls 1993), 3.0 at Camp Roberts (Spencer *et al.* 1992), 3.7 in the Lokern area (Spiegel and Tom 1996), and 3.8 at the Naval Petroleum Reserve (Cypher *et al.* 2000). Pups appear above ground when they are approximately 3-4 weeks old, and are weaned at 6-8 weeks. Reproductive rates, the proportion of females bearing young, of adult San Joaquin kit foxes vary annually with environmental conditions, particularly food availability. Annual rates range from 0-100 percent, and reported mean rates include 61 percent at the Naval Petroleum Reserve (Cypher *et al.* 2000), 64 percent in the Lokern area (Spiegel and Tom 1996), and 32 percent at Camp Roberts (Spencer *et al.* 1992). Although some yearling female kit foxes will produce young, most do not reproduce until 2 years of age (Spencer et al. 1992; Spiegel and Tom 1996; Cypher *et al.* 2000). Some young of both sexes, but particularly females may delay dispersal, and may assist their parents in raising the following year's litter of pups (Spiegel and Tom 1996). The young San Joaquin kit foxes begin to forage for themselves at about four to five months of age (Koopman *et al.* 2000; Morell 1972).

Although most young kit foxes disperse less than 5 miles (Scrivner *et al.* 1987), dispersal distances of up to 76.3 miles have been documented for the San Joaquin kit fox (Service 1998). Dispersal can be through disturbed habitats, including agricultural fields, and across highways and aqueducts. The age at dispersal ranges from 4-32 months (Cypher 2000). Among juvenile kit foxes surviving to July 1 at the Naval Petroleum Reserve, 49 percent of the males dispersed from natal home ranges while only 24 percent of the females dispersed (Koopman *et al.* 2000). Among dispersing kit foxes, 87 percent did so during their first year of age. Most, 65.2 percent, of the dispersing juveniles at the Naval Petroleum Reserve died within 10 days of leaving their natal home den (Koopman *et al.* 2000). Some kit foxes delay dispersal and may inherit their natal home range.

San Joaquin kit foxes are reputed to be poor diggers, and their dens are usually located in areas with loose-textured, friable soils (Morrell 1972; O'Farrell 1983). However, the depth and complexity of their dens suggest that they possess good digging abilities, and kit fox dens have been observed on a variety of soil types (Service 1998). Some studies have suggested that where hardpan layers predominate, kit foxes create their dens by enlarging the burrows of California ground squirrels or badgers (*Taxidea taxus*) (Jensen 1972; Morrell 1972; Orloff *et al.* 1986). In parts of their range, particularly in the foothills, kit foxes often use ground squirrel burrows for dens (Orloff *et al.* 1986). San Joaquin kit fox dens are commonly located on flat terrain or on the lower slopes of hills. About 77 percent of all kit fox dens are at or below midslope (O'Farrell 1983), with the average slope at den sites ranging from 0 to 22 degrees (CDFG 1980; O'Farrell 1983; Orloff *et al.* 1986). Natal and pupping dens are generally found in flatter terrain. Common locations for dens include washes, drainages, and roadside berms. Kit foxes also commonly den in human-made structures such as culverts and pipes (O'Farrell 1983; Spiegel *et al.* 1996).

Natal and pupping dens of the San Joaquin kit fox may include from two to 18 entrances and are usually larger than dens that are not used for reproduction (O'Farrell *et al.* 1980; O'Farrell and McCue 1981). Natal dens may be reused in subsequent years (Egoscue 1962). It has been speculated that natal dens are located in the same location as ancestral breeding sites (O'Farrell 1983). Active natal dens are generally 1.2 to 2 miles from the dens of other mated kit fox pairs (Egoscue 1962; O'Farrell and Gilbertson 1979). Natal and pupping dens usually can be identified by the presence of scat, prey remains, matted vegetation, and mounds of excavated soil (i.e. ramps) outside the dens (O'Farrell 1983). However, some active dens in areas outside the valley floor often do not show evidence of use (Orloff *et al.* 1986). During telemetry studies of San Joaquin kit foxes in the northern portion of their range, 70 percent of the dens that were known to be active showed no sign of use (e.g., tracks, scats, ramps, or prey remains) (Orloff *et al.* 1986). In another more recent study in the Coast Range, 79 percent of active San Joaquin kit fox dens lacked evidence of recent use other than signs of recent excavation (Jones and Stokes Associates 1997).

A San Joaquin kit fox can use more than 100 dens throughout its home range, although on average, an animal will use approximately 12 dens a year for shelter and escape cover (Cypher *et al.* 2001). Hall (1983) reported individual animals using up to 70 different dens. San Joaquin kit foxes typically use individual dens for only brief periods, often for only one day before moving to another den (Ralls *et al.* 1990). At the Naval Petroleum Reserve, individual San Joaquin kit foxes used an average of 11.8 dens per year (Koopman *et al.* 1998). Den switching by the San Joaquin kit fox may be a function of predator avoidance, local food availability, or external parasite infestations (e.g., fleas) in dens (Egoscue 1956). Reasons for changing dens include infestation by ectoparasites, local depletion of prey, or avoidance of coyotes. Kit foxes tend to use dens that are located in the same general area, and clusters of dens can be surrounded by hundreds of hectares of similar habitat devoid of other dens (Egoscue 1962). In the southern San Joaquin Valley, kit foxes were found to use up to 39 dens within a denning range of 320 to 482 acres (Morrell 1972). An average den density of one den per 69 to 92 acres was reported by O'Farrell (1984) in the southern San Joaquin Valley.

The diet of the San Joaquin kit fox varies geographically, seasonally, and annually, based on temporal and spatial variation in abundance of potential prey. Known prey species of the kit fox include white-footed mice (*Peromyscus* spp.), insects, California ground squirrels, kangaroo rats (*Dipodomys* spp.), San Joaquin antelope squirrels (*Ammospermophilus nelsoni*), black-tailed hares (*Lepus californicus*), and chukar (*Alectoris chukar*) (Jensen 1972; Archon 1992). Kit foxes also prey on desert cottontails (*Sylvilagus audubonii)*, ground-nesting birds, and pocket mice (*Perognathus* spp.).

The diets and habitats selected by coyotes and San Joaquin kit foxes living in the same areas are often quite similar. Hence, the potential for resource competition between these species may be quite high when prey resources are scarce such as during droughts, which are quite common in semi-arid, central California. Competition for resources between coyotes and kit foxes may result in kit fox mortalities. Coyote-related injuries accounted for 50-87 percent of the mortalities of radio collared kit foxes at Camp Roberts, the Carrizo Plain Natural Area, the Lokern Natural Area, and the Naval Petroleum Reserve (Cypher and Scrivner 1992; Standley *et al.* 1992).

San Joaquin kit foxes are primarily nocturnal, although individuals are occasionally observed resting or playing (mostly pups) near their dens during the day (Grinnell *et al.* 1937). Kit foxes occupy home ranges that vary in size. White and Ralls (1993) reported average home ranges of 4.47 square miles, while others have reported home ranges of up to 12 square miles (Service 1998). A mated pair of kit foxes and their current litter of pups usually occupy each home range (White and Ralls 1993, Spiegel 1996; White and Garrott 1997). Other adults, usually offspring from previous litters, also may be present (Koopman *et al.* 2000), but individuals often move independently within their home range (Cypher 2000). Ralls *et al.* (2001) found that foxes sometimes share dens with foxes from other groups; many of these cases involved unpaired individuals and appeared to be unsuccessful attempts at pair formation. Average distances traveled each night range from 5.8 to 9.1 miles and are greatest during the breeding season (Cypher 2000).

San Joaquin kit foxes maintain core home range areas that are exclusive to mated pairs and their offspring; this territorial spacing behavior eventually limits the number of foxes that can inhabit an area owing to shortages of available space and per capita prey. Hence, as habitat is fragmented or destroyed, the carrying capacity of an area is reduced and a larger proportion of the population is forced to disperse. Increased dispersal generally leads to lower survival rates and, in turn, decreased abundance because greater than 65 percent of dispersing juvenile foxes die within 10 days of leaving their natal range (Koopman *et al.* 2000).

Estimates of San Joaquin kit fox density vary greatly throughout its range, and have been reported as high as 3.11 per square mile in optimal habitats in good years (Service 1998). At the Elk Hills in Kern County, density estimates varied from 1.86 animals per square mile in the early 1980s to 0.03 animals per square mile in 1991 (Service 1998). San Joaquin kit fox home ranges vary in size from approximately 1 to 12 square miles (Spiegel *et al.* 1996; Service 1998). Knapp (1978) estimated that a home range in agricultural areas is approximately 1 square mile. Individual home ranges overlap considerably, at least outside the core activity areas (Morrell 1972; Spiegel *et al.* 1996).

Mean annual survival rates reported for adult San Joaquin kit foxes include 0.44 at the Naval Petroleum Reserve (Cypher *et al.* 2000), 0.53 at Camp Roberts (Standley *et al.* 1992), 0.56 at the Lokern area (Spiegel and Disney 1996), and 0.60 on the Carrizo Plain (Ralls and White 1995). However, survival rates widely vary among years (Spiegel and Disney 1996; Cypher *et al.* 2000). Mean survival rates for juvenile San Joaquin kit foxes (<1 year old) are lower than rates for adults. Survival to age 1 year was 0.14 at the Naval Petroleum Reserve (Cypher *et al.* 2000), 0.20 at Camp Roberts (Standley *et al.* 1992), and 0.21 on the Carrizo Plain (Ralls and White 1995). For both adults and juveniles, survival rates of males and females are similar. San Joaquin kit foxes may live to ten years in captivity (McGrew 1979) and 8 years in the wild (Berry *et al.* 1987), but most kit foxes do not live past 2-3 years of age.

The status (i.e., distribution, abundance) of the kit fox has decreased since its listing in 1967. This trend is reasonably certain to continue into the foreseeable future unless measures to protect, sustain, and restore suitable habitats, and alleviate other threats to their survival and recovery, are implemented. Threats that are seriously affecting kit foxes are described in further detail in the following sections.

Less than 20 percent of the habitat within the historical range of the kit fox remained when the animal was listed as federally-endangered in 1967, and there has been a substantial net loss of habitat since that time. Historically, San Joaquin kit foxes occurred throughout California's Central Valley and adjacent foothills. Extensive land conversions in the Central Valley began as early as the mid-1800s with the Arkansas Reclamation Act. By the 1930's, the range of the kit fox had been reduced to the southern and western parts of the San Joaquin Valley (Grinnell *et al.* 1937). The primary factor contributing to this restricted distribution was the conversion of native habitat to irrigated cropland, industrial uses (e.g., hydrocarbon extraction), and urbanization (Laughrin 1970; Jensen 1972; Morrell 1972, 1975). Approximately one-half of the natural communities in the San Joaquin Valley were tilled or developed by 1958 (Service 1983). This rate of loss accelerated following the completion of the Central Valley Project and the State Water Project, which diverted and imported new water supplies for irrigated agriculture (Service 1995a). Approximately 1.97 million acres of habitat, or about 66,000 acres per year, were converted in the San Joaquin region between 1950 and 1980 (Service 1998). The counties specifically noted as having the highest wildland conversion rates included Kern, Tulare, Kings, and Fresno, all of which are occupied by kit foxes. From 1959 to 1969 alone, an estimated 34 percent of natural lands were lost within the then-known kit fox range (Laughrin 1970).

By 1979, only approximately 370,000 acres out of a total of approximately 8.5 million acres on the San Joaquin Valley floor remained as non-developed land (Service 1983; Williams 1985). Data from the CDFG (1985) and Service file information indicate that between 1977 and 1988, essential habitat for the blunt-nosed leopard lizard, a species that occupies habitat that is also suitable for kit foxes, declined by about 80 percent – from 311,680 acres to 63,060 acres, an average of about 22,000 acres per year (Biological Opinion for the Interim Water Contract Renewal, Service file 1-1-00-F-0056, February 29, 2000). Virtually all of the documented loss of essential habitat was the result of conversion to irrigated agriculture.

During 1990 to 1996, a gross total of approximately 71,500 acres of habitat were converted to farmland in 30 counties (total area 23.1 million acres) within the Conservation Program Focus area of the Central Valley Project. This figure includes 42,520 acres of grazing land and 28,854 acres of "other" land, which is predominantly comprised of native habitat. During this same time period, approximately 101,700 acres were converted to urban land use within the Conservation Program Focus area (California Department of Conservation 1998). This figure includes 49,705 acres of farmland, 20,476 acres of grazing land, and 31,366 acres of "other" land, which is predominantly comprised of native habitat. Because these assessments included a substantial portion of the Central Valley and adjacent foothills, they provide the best scientific and commercial information currently available regarding the patterns and trends of land conversion within the kit fox's geographic range. More than one million acres of suitable habitat for kit foxes have been converted to agricultural, municipal, or industrial uses since the listing of the kit fox. In contrast, less than 500,000 acres have been preserved or are subject to community-level conservation efforts designed, at least in part, to further the conservation of the kit fox (Service 1998).

Land conversions contribute to declines in San Joaquin kit fox abundance through direct and indirect mortalities, displacement, reduction of prey populations and denning sites, changes in the distribution and abundance of larger canids that compete with kit foxes for resources, and reductions in carrying capacity. Kit foxes may be buried in their dens during land conversion activities (C. Van Horn, Endangered Species Recovery Program, Bakersfield, personal communication to S. Jones, Fish and Wildlife Service, Sacramento, 2000), or permanently displaced from areas where structures are erected or the land is intensively irrigated (Jensen 1972; Morrell 1975). Furthermore, even moderate fragmentation or loss of habitat may significantly impact the abundance and distribution of kit foxes. Capture rates of kit foxes at the Naval Petroleum Reserve in Elk Hills were negatively associated with the extent of oil-field development after 1987 (Warrick and Cypher 1999). Likewise, the California Energy Commission found that the relative abundance of kit foxes was lower in oil-developed habitat than in nearby undeveloped habitat on the Lokern (Spiegel 1996). Researchers from both studies inferred that the most significant effect of oil development was the lowered carrying capacity for populations of both foxes and their prey species owing to the changes in habitat characteristics or the loss and fragmentation of habitat (Spiegel 1996; Warrick and Cypher 1999).

Dens are essential for the survival and reproduction of kit foxes that use them year-round for shelter and escape and in the spring for rearing young. Hence, kit foxes generally have dozens of dens scattered throughout their territories. However, land conversion reduces the number of typical earthen dens available to kit foxes. For example, the average density of typical, earthen kit fox dens at the Naval Hills Petroleum Reserve was negatively correlated with the intensity of petroleum development (Zoellick *et al.* 1987), and almost 20% of the dens in developed areas were found to be in well casings, culverts, abandoned pipelines, oil well cellars, or in the banks of sumps or roads (Service 1983). These results are important because the California Energy Commission found that, even though kit foxes frequently used pipes and culverts as dens in oil-developed areas of western Kern County, only earthen dens were used to birth and wean pups (Spiegel 1996). Similarly, San Joaquin kit foxes in Bakersfield use atypical dens, but have only been found to rear pups in earthen dens (Paul Kelly, Endangered Species Recovery Program, Fresno, California, personal communication to P. White, Service, Sacramento, California April 6, 2000). Hence, the fragmentation of habitat and destruction of earthen dens could adversely affect the reproductive success of kit foxes. Furthermore, the destruction of earthen dens may also affect kit fox survival by reducing the number and distribution of escape refuges from predators.

Land conversions and associated human activities can lead to widespread changes in the availability and composition of mammalian prey for kit foxes. For example, oil field disturbances in western Kern County have resulted in shifts in the small mammal community from the primarily granivorous species that are the staple prey of kit foxes (Spiegel 1996), to species adapted to early successional stages and disturbed areas (e.g., California ground squirrels)(Spiegel 1996). Because more than 70 percent of the diets of kit foxes usually consist of abundant rabbits and rodents, and kit foxes often continue to feed on their staple prey during ephemeral periods of prey scarcity, such changes in the availability and selection of foraging sites by kit foxes could influence their reproductive rates, which are strongly influenced by food supply and decrease during periods of prey scarcity (White and Garrott 1997, 1999).

Extensive habitat destruction and fragmentation have contributed to smaller, more-isolated populations of San Joaquin kit foxes. Small populations have a higher probability of extinction than larger populations because their low abundance renders them susceptible to stochastic (i.e., random) events such as high variability in age and sex ratios, and catastrophes such as floods, droughts, or disease epidemics (Lande 1988; Frankham and Ralls 1998; Saccheri *et al.* 1998). Similarly, isolated populations are more susceptible to extirpation by accidental or natural catastrophes because their recolonization has been hampered. These chance events can adversely affect small, isolated populations with devastating results. Extirpation can even occur when the members of a small population are healthy, because whether the population increases or decreases in size is less dependent on the age-specific probabilities of survival and reproduction than on raw chance (sampling probabilities). Owing to the probabilistic nature of extinction, many small populations will eventually lose out and go extinct when faced with these stochastic risks (Caughley and Gunn 1995).

Oil fields in the southern half of the San Joaquin Valley also continue to be an area of expansion and development activity. This expansion is reasonably certain to increase in the near future owing to market-driven increases in the price of oil. The cumulative and long-term effects of oil extraction activities on kit fox populations are not fully known, but recent studies indicate that moderate- to high-density oil fields may contribute to a decrease in carrying capacity for kit foxes owing to habitat loss or changes in habitat characteristics (Spiegel 1996; Warrick and Cypher 1999). There are no limiting factors or regulations that are likely to retard the development of additional oil fields. Hence, it is reasonably certain that development will continue to destroy and fragment kit fox habitat into the foreseeable future.

Several species prey upon San Joaquin kit foxes. Predators (such as coyotes, bobcats, non-native red foxes, badgers, and golden eagles (*Aquila chrysaetos*) will kill kit foxes. Badgers, coyotes, and red foxes also may compete for den sites (Service 1998). The diets and habitats selected by coyotes and kit foxes living in the same areas are often quite similar (Cypher and Spencer 1998). Hence, the potential for resource competition between these species may be quite high when prey resources are scarce such as during droughts, which are quite common in semi-arid, central California. Land conversions and associated human activities have led to changes in the distribution and abundance of coyotes, which compete with kit foxes for resources.

Coyotes occur in most areas with abundant populations of kit foxes and, during the past few decades, coyote abundance has increased in many areas owing to a decrease in ranching operations, favorable landscape changes, and reduced control efforts (Orloff *et al.* 1986; Cypher and Scrivner 1992; White and Ralls 1993; White *et al.* 1995). Coyotes may attempt to lessen resource competition with kit foxes by killing them. Coyote-related injuries accounted for 50-87 percent of the mortalities of radio collared kit foxes at Camp Roberts, the Carrizo Plain Natural Area, the Lokern Natural Area, and the Naval Petroleum Reserves (Cypher and Scrivner 1992; Standley *et al.* 1992; Ralls and White 1995; Spiegel 1996). Coyote-related deaths of adult foxes appear to be largely additive (i.e., in addition to deaths caused by other mortality factors such as disease and starvation) rather than compensatory (i.e., tending to replace deaths due to other mortality factors; White and Garrott 1997). Hence, the survival rates of adult foxes decrease significantly as the proportion of mortalities caused by coyotes increase (Cypher and Spencer 1998; White and Garrott 1997), and increases in coyote abundance may contribute to significant declines in kit fox abundance (Cypher and Scrivner 1992; Ralls and White 1995; White *et al.*

1996). There is some evidence that the proportion of juvenile foxes killed by coyotes increases as fox density increases (White and Garrott 1999). This density-dependent relationship would provide a feedback mechanism that reduces the amplitude of kit fox population dynamics and keeps foxes at lower densities than they might otherwise attain. In other words, coyote-related mortalities may dampen or prevent fox population growth, and accentuate, hasten, or prolong population declines.

Land-use changes also contributed to the expansion of non-native red foxes into areas inhabited by the San Joaquin kit fox. Historically, the geographic range of the red fox did not overlap with that of the kit fox. By the 1970's, however, introduced and escaped red foxes had established breeding populations in many areas inhabited by San Joaquin kit foxes (Lewis *et al.* 1993). The larger and more aggressive red foxes are known to kill kit foxes (Ralls and White 1995), and could displace them, as has been observed in the arctic when red foxes expanded into the ranges of smaller arctic foxes (Hersteinsson and Macdonald 1982). The increased abundance and distribution of nonnative red foxes will also likely adversely affect the status of kit foxes because they are closer morphologically and taxonomically, and would likely have higher dietary overlap than coyotes; potentially resulting in more intense competition for resources. Two documented deaths of kit foxes due to red foxes have been reported (Ralls and White 1995), and red foxes appear to be displacing kit foxes in the northwestern part of their range (Lewis *et al.* 1993). At Camp Roberts, red foxes have usurped several dens that were used by kit foxes during previous years (California Army National Guard, Camp Roberts Environmental Office, unpublished data). In fact, opportunistic observations of red foxes in the cantonment area of Camp Roberts have increased 5-fold since 1993, and no kit foxes have been sighted or captured in this area since October 1997. Also, a telemetry study of sympatric red foxes and kit foxes in the Lost Hills area has detected spatial segregation between these species, suggesting that kit foxes may avoid or be excluded from red fox-inhabited areas (Paul Kelly, pers. comm. to P.J. White, April 6, 2000). Such avoidance would limit the resources available to local populations of kit foxes and possibly result in decreased fox abundance and distribution.

Wildlife diseases do not appear to be a primary mortality factor that consistently limits kit fox populations throughout their range (McCue and O'Farrell 1988; Standley and McCue 1992). However, central California has a high incidence of wildlife rabies cases (Schultz and Barrett 1991), and high seroprevalences of canine distemper virus and canine parvovirus indicate that kit fox populations have been exposed to these diseases (McCue and O'Farrell 1988; Standley and McCue 1992). Hence, disease outbreaks could potentially cause substantial mortality or contribute to reduced fertility in seropositive females, as was noted in the closely-related swift fox (*Vulpes velox*).

For example, there are some indications that rabies virus may have contributed to a catastrophic decrease in San Joaquin kit fox abundance at Camp Roberts, San Luis Obispo County, California, during the early 1990's. San Luis Obispo County had the highest incidence of wildlife rabies cases in California during 1989 to 1991, and striped skunks were the primary vector (Barrett 1990; Schultz and Barrett 1991; Reilly and Mangiamele 1992). A rabid skunk was trapped at Camp Roberts during 1989 and two foxes were found dead due to rabies in 1990

(Standley *et al.* 1992). Captures of kit foxes during annual live trapping sessions at Camp Roberts decreased from 103 to 20 individuals during 1988 to 1991. Captures of kit foxes were positively correlated with captures of skunks during 1988 to 1997; suggesting that some factor(s) such as rabies virus was contributing to concurrent decreases in the abundances of these species. Also, captures of kit foxes at Camp Roberts were negatively correlated with the proportion of skunks that were rabid when trapped by County Public Health Department personnel two years previously. These data suggest that a rabies outbreak may have occurred in the skunk population and spread into the fox population. A similar time lag in disease transmission and subsequent population reductions was observed in Ontario, Canada, although in this instance the transmission was from red foxes to striped skunks (MacDonald and Voigt 1985).

Pesticides and rodenticides pose a threat to kit foxes through direct or secondary poisoning. Kit foxes may be killed if they ingest rodenticide in a bait application, or if they eat a rodent that has consumed the bait. Even sublethal doses of rodenticides may lead to the death of these animals by impairing their ability to escape predators or find food. Pesticides and rodenticides may also indirectly affect the survival of kit foxes by reducing the abundances of their staple prey species. For example, the California ground squirrel, which is the staple prey of kit foxes in the northern portion of their range, was thought to have been eliminated from Contra Costa County in 1975, after extensive rodent eradication programs. Field observations indicated that the long-term use of ground squirrel poisons in this county severely reduced kit fox abundance through secondary poisoning and the suppression of populations of its staple prey (Orloff *et al.* 1986).

Kit foxes occupying habitats adjacent to agricultural lands are also likely to come into contact with insecticides applied to crops owing to runoff or aerial drift. Kit foxes could be affected through direct contact with sprays and treated soils, or through consumption of contaminated prey. Data from the California Department of Pesticide Regulation indicate that acephate, aldicarb, azinphos methyl, bendiocarb, carbofuran, chlorpyrifos, endosulfan, s-fenvalerate, naled, parathion, permethrin, phorate, and trifluralin are used within one mile of kit fox habitat. A wide variety of crops, buildings, Christmas tree plantations, commercial/industrial areas, greenhouses, nurseries, landscape maintenance, ornamental turf, rangeland, rights of way, and uncultivated agricultural and non-agricultural land, occur in close proximity to San Joaquin kit fox habitat.

Efforts have been underway to reduce the risk of rodenticides to kit foxes (Service 1993). The Federal government began controlling the use of rodenticides in 1972 with a ban of Compound 1080 on Federal lands pursuant to Executive Order. Above-ground application of strychnine within the geographic ranges of listed species was prohibited in 1988. A July 28, 1992, biological opinion regarding the Animal Damage Control (now known as Wildlife Services) Program by the U.S. Department of Agriculture found that this program was likely to jeopardize the continued existence of the kit fox owing to the potential for rodent control activities to take the fox. As a result, several reasonable and prudent measures were implemented, including a ban on the use of M-44 devices, toxicants, and fumigants within the recognized occupied range of the kit fox. Also, the only chemical authorized for use by Wildlife Services within the occupied range of the kit fox was zinc phosphide, a compound known to be minimally toxic to kit foxes (Service 1993).

Despite these efforts, the use of other pesticides and rodenticides still pose a significant threat to the kit fox, as evidenced by the death of two kit foxes at Camp Roberts in 1992 owing to secondary poisoning from chlorophacinone applied as a rodenticide, (Berry *et al.* 1992; Standley *et al.* 1992). Also, the livers of three kit foxes that were recovered in the City of Bakersfield during 1999 were found to contain detectable residues of the anticoagulant rodenticides chlorophacinone, brodifacoum, and bromadiolone (CDFG 1999). To date, no specific research has been conducted on the effects of different pesticide or rodent control programs on the kit fox (Service 1998). This lack of information is problematic because Williams (*in litt.* 1989) documented widespread pesticide use in known kit fox and Fresno kangaroo rat habitat adjoining agricultural lands in Madera County. In a separate report, Williams (*in litt.* 1989) documented another case of pesticide use near Raisin City in Fresno County, where treated grain was placed within an active Fresno kangaroo rat precinct. Also, farmers have been allowed to place bait on Bureau of Reclamation property to maximize the potential for killing rodents before they entered adjoining fields (Biological Opinion for the Interim Water Contract Renewal, Service file 1-1-00-F-0056, February 29, 2000).

A September 22, 1993, biological opinion issued by the Service to the Environmental Protection Agency (EPA) regarding the regulation of pesticide use (31 registered chemicals) through administration of the Federal Insecticide, Fungicide, and Rodenticide Act found that use of the following chemicals would likely jeopardize the continued existence of the kit fox: (1) aluminum and magnesium phosphide fumigants; (2) chlorophacinone anticoagulants; (3) diphacinone anticoagulants; (4) pival anticoagulants; (5) potassium nitrate and sodium nitrate gas cartridges; and (6) sodium cyanide capsules (Service 1993). Reasonable and prudent alternatives to avoid jeopardy included restricting the use of aluminum/magnesium phosphide, potassium/sodium nitrate within the geographic range of the kit fox to qualified individuals, and prohibiting the use of chlorophacinone, diphacinone, pival, and sodium cyanide within the geographic range of the kit fox, with certain exceptions (e.g., agricultural areas that are greater than 1 mile from any kit fox habitat) (Service 1993).

The intentional or unintentional destruction of habitat occupied by the San Joaquin kit fox is an issue of serious concern. Section 9 of the Act prohibits the "take" (e.g., harm, harass, pursue, injure, kill) of federally-listed wildlife species. If no authorization is obtained for the incidental take of listed species, the individuals or entities responsible for these actions could be liable under section 9 of the Act if any unauthorized take occurs. There are numerous examples of potential section 9 violations and possible noncompliance with the terms and conditions of existing biological opinions.

Historically, kit foxes may have existed in a metapopulation structure of core and satellite populations, some of which periodically experienced local extinctions and recolonization (Service 1998). Today's populations exist in an environment drastically different from the historic one, however, and extensive habitat fragmentation will result in geographic isolation, smaller population sizes, and reduced genetic exchange among populations; all of which increase the vulnerability of kit fox populations to extirpation. Populations of kit foxes are extremely susceptible to the risks associated with small population size and isolation because they are characterized by marked instability in population density. For example, the relative abundance of kit foxes at the Naval Petroleum Reserves, California, decreased 10-fold during 1981 to 1983, increased 7-fold during 1991 to 1994, and then decreased 2-fold during 1995 (Cypher and Scrivner 1992; Cypher and Spencer 1998).

Many populations of kit fox are at risk of chance extinction owing to small population size and isolation. This risk has been prominently illustrated during recent, drastic declines in the populations of kit foxes at Camp Roberts and Fort Hunter Liggett. Captures of kit foxes during annual live trapping sessions at Camp Roberts decreased from 103 to 20 individuals during 1988 to 1991. This decrease continued through 1997 when only three kit foxes were captured (White *et al.* 2000). A similar decrease in kit fox abundance occurred at nearby Fort Hunter Liggett, and only 2 kit foxes have been observed on this installation since 1995 (L. Clark, Wildlife Biologist, Fort Hunter Liggett, pers. comm. to P. J. White, February 15, 2000). It is unlikely that the current low abundances of kit foxes at Camp Roberts and Fort Hunter Liggett will increase substantially in the near future owing to the limited potential for recruitment. The chance of substantial immigration is low because the nearest core population on the Carrizo Plain is distant (greater than 16 miles) and separated from these installations by barriers to kit fox movement such as roads, developments, and irrigated agricultural areas. Also, there is a relatively high abundance of sympatric predators and competitors on these installations that contribute to low survival rates for kit foxes and, as a result, may limit population growth (White *et al.* 2000). Hence, these populations may be on the verge of extinction.

The destruction and fragmentation of habitat could also eventually lead to reduced genetic variation in populations of kit foxes that are small and geographically isolated. Historically, kit foxes likely existed in a metapopulation structure of core and satellite populations, some of which periodically experienced local extinctions and recolonization (Service 1998). Preliminary genetic assessments indicate that historic gene flow among populations was quite high, with effective dispersal rates of at least one to 4 dispersers per generation (M. Schwartz, pers. comm. to P. J. White, March 23, 2000). This level of genetic dispersal should allow for local adaptation while preventing the loss of any rare alleles. Based on these results, it is likely that northern populations of kit foxes were once panmictic (i.e., randomly mating in a genetic sense), or nearly so, with southern populations. In other words, there were no major barriers to dispersal among populations.

Current levels of gene flow also appear to be adequate, however, extensive habitat loss and fragmentation continues to form more or less geographically distinct populations of foxes, which could potentially reduce genetic exchange among them. An increase in inbreeding and the loss of genetic variation could increase the extinction risk for small, isolated populations of kit foxes by interacting with demography to reduce fecundity, juvenile survival, and lifespan (Lande 1988; Frankham and Ralls 1998; Saccheri *et al.* 1998).

An area of particular concern is Santa Nella in western Merced County where pending development plans threaten to eliminate the little suitable habitat that remains and provides a dispersal corridor for kit foxes between the northern and southern portions of their range.

Preliminary estimates of expected heterozygosity from foxes in this area indicate that this population already may have reduced genetic variation. Other populations that may be showing the initial signs of genetic isolation are the Lost Hills area and populations in the Salinas-Pajaro River watershed (i.e., Camp Roberts and Fort Hunter Liggett). Preliminary estimates of the mean number of alleles per locus from foxes in these populations indicate that allelic diversity is lower than expected. Although these results may, in part, be due to the small number of foxes sampled in these areas, they may also be indicative of an increase in the amount of inbreeding due to population subdivision (M. Schwartz, pers. Comm. to P. J. White, March 23, 2000). Further sampling and analyses are necessary to adequately assess the effects of these potential genetic bottlenecks.

Arid systems are characterized by unpredictable fluctuations in precipitation, which lead to high frequency, high amplitude fluctuations in the abundance of mammalian prey for kit foxes (Goldingay *et al.* 1997; White and Garrott 1999). Because the reproductive and neonatal survival rates of kit foxes are strongly depressed at low prey densities (White and Ralls 1993; White and Garrott 1997, 1999), periods of prey scarcity owing to drought or excessive rain events can contribute to population crashes and marked instability in the abundance and distribution of kit foxes (White and Garrott 1999). In other words, unpredictable, short-term fluctuations in precipitation and, in turn, prey abundance can generate frequent, rapid decreases in kit fox density that increase the extinction risk for small, isolated populations.

The primary goal of the recovery strategy for kit foxes identified in the *Recovery Plan for Upland Species of the San Joaquin Valley, California* (Service 1998) is to establish a complex of interconnected core and satellite populations throughout the species' range. The long-term viability of each of these core and satellite populations depends partly upon periodic dispersal and genetic flow between them. Therefore, kit fox movement corridors between these populations must be preserved and maintained. In the northern range, from the Ciervo Panoche in Fresno County northward, kit fox populations are small and isolated, and have exhibited significant decline. The core populations are the Ciervo Panoche area, the Carrizo Plain area, and the western Kern County population. Satellite populations are found in the urban Bakersfield area, Porterville/Lake Success area, Creighton Ranch/Pixley Wildlife Refuge, Allensworth Ecological Reserve, Semitropic/Kern National Wildlife Refuge (NWR), Antelope Plain, eastern Kern grasslands, Pleasant Valley, western Madera County, Santa Nella, Kesterson NWR, and Contra Costa County. Major corridors connecting these population areas are on the east and west side of the San Joaquin Valley including the Millerton Lake area of Fresno County, around the bottom of the Valley, and cross-valley corridors in Kern, Fresno, and Merced counties.

Although there have been sightings of kit fox in the northern range through the years by qualified biologists, population studies in this area have been limited. In 1982 and 1983, a family of kit foxes was radio collared and monitored near Bethany Reservoir (Hall 1983). From 1985 to 1989, kit fox surveys in the Kellogg Creek watershed found a total of 114 potential and possibly active dens, most of which were associated with ground squirrel colonies (Jones & Stokes Associates 1989).

The small size of the population and its isolation from other established populations make this northern most population vulnerable to extinction owing to predation and competition from coyotes and red foxes, inbreeding, catastrophic events, and disease epidemics (White *et al.* 2000). Genetic studies conducted by Schwartz *et al.* (2000) found that individuals in the Los Banos population near San Luis Reservoir only breed with animals in the northern population in Alameda and Contra Costa counties. Thus, projects in Alameda and Contra Costa County that significantly reduce travel corridors and population size could potentially impact the Los Banos kit fox population. The long term viability of both populations depends, at least in part, on periodic immigration and gene flow from between the populations.

Habitat in the northern range is highly fragmented by highways, canals, and development. Interstate 580 runs southeast to northwest as it splits from Interstate 5, and turns west through the Altamont Pass area; thus it impedes both north-south and west-east movement of San Joaquin kit foxes. Although the canal system facilitates north-south migration along its length, it also impedes lateral east-west kit fox travel. Development proposals will further impede the movement of kit fox and isolate the northern population from more southern populations. These and other developments are slowly diminishing the last remaining kit fox habitat, and development pressures are expected to increase in the future. The protection of the remaining travel corridor, including grasslands west of Interstate 580, and lands between the California aqueduct and the Delta Mendota Canal, is vital to the survival of this population.

<u>Longhorn Fairy Shrimp</u>

A final rule was published on September 19, 1994, to list longhorn fairy shrimp as endangered under the Act (Service 1994). The final rule to designate critical habitat for 15 vernal pool species, including the vernal pool tadpole shrimp and the vernal pool fairy shrimp, was published on August 6, 2003 (Service 2003b). A final rule was published again on August 11, 2005 (Service 2005). Further information on the life history and ecology of the longhorn fairy shrimp may be found in the final listing rule, the final rule to designate critical habitat, the *Recovery Plan for Vernal Pool Ecosystems of California and Southern Oregon* (Service 2005b), and Eng *et al.* (1990).

Longhorn fairy shrimp are tiny freshwater crustaceans with delicate elongate bodies, large stalked compound eyes, and 11 pairs of phyllopods (swimming legs that also function as gills). Fairy shrimp do not have a hard shell, a characteristic of the order Anostraca to which they belong. This species is easily distinguished from other fairy shrimp by the male's extremely long second antennae. Longhorn fairy shrimp are dependent on seasonally inundated wetlands, such as vernal pools, and are endemic to California vernal pool habitat.

The longhorn fairy shrimp is highly adapted to the unpredictable conditions of vernal pool ecosystems. It requires a minimum of 23 days, but averaged 43 days, to reach maturity in artificial pools. Although this species is only known from a few locations, these sites contain very different types of vernal pool habitats. Longhorn fairy shrimp in the Livermore Vernal Pool Region in Contra Costa and Alameda Counties live in small, clear, sandstone outcrop vernal pools. These sandstone pools are sometimes no larger than 3.3 feet in diameter, have a pH near neutral, and very low alkalinity and conductivity. Water temperatures in these vernal pools have been measured between 50 and 64 degrees Fahrenheit (Helm 1988). In both the San Joaquin and Carrizo Vernal Pool Regions, the longhorn fairy shrimp is found in clear to turbid, grassland pools. These grassland pools may be as large as 203.4 feet in diameter. Water temperatures in the grassland vernal pools are also warmer, between 50 to 82 degrees Fahrenheit. The species was most recently observed in a disturbed roadside ditch 2 miles north of Los Banos. Longhorn fairy shrimp have been found at elevations ranging from 75.5 feet in the San Joaquin Vernal Pool Region to 2,887 feet in the Carrizo Vernal Pool Region (Service 2005b, CDFG 2007).

The longhorn fairy shrimp has been found in the same general area as the Conservancy fairy shrimp (*Branchinecta conservatio*), vernal pool fairy shrimp, California fairy shrimp (*Linderiella occidentalis*), versatile fairy shrimp (*Branchinecta lindahli*) and spadefoot toad (*Spea hammondii*) tadpoles at different locations. Active adults have been observed from the same vernal pool as versatile fairy shrimp and spadefoot toad tadpoles on the Carrizo Plain (Service 2005b).

Longhorn fairy shrimp are rare, and at the time of listing four widely separated populations of this species were known (Service 1994). Since the time of listing, extensive surveys for fairy shrimp species throughout its range have not located additional populations of this species, although additional occurrences within the four populations have been detected. Currently, the CDFG's California Natural Diversity Database (CNDDB) reports 11 occurrences of this species (CDFG 2009). One CNDDB occurrence record may represent a single vernal pool, a single puddle, multiple pools within a vernal pool complex, a substantial portion of a vernal pool complex, or an entire complex.

The four known populations of longhorn fairy shrimp include: (1) areas within and adjacent to the Carrizo Plain National Monument; (2) areas within the San Luis National Wildlife Refuge (NWR) Complex, Merced County; (3) areas within the Brushy Peak Preserve, Alameda County; and, (4) areas within the Vasco Caves Preserve, near the town of Byron (Service 2005). The Brushy Peak and Vasco Caves Preserves are within three miles of each other. This species was also detected in a roadside ditch two miles north of Los Banos, in Merced County. Only one individual was detected in the ditch and this occurrence is considered to be an anomaly and not a sustainable population (CDFG 2007). Three of the four confirmed populations are found entirely on public lands that are currently protected and managed for vernal pool species. A portion of the Carrizo Plain population is found on public lands, with the remaining portion occurring on private lands.

Informal monitoring of known populations of longhorn fairy shrimp has occurred within the Brushy Peak Preserve. For all sites with known occurrences, biologists have noted observations when out in the field, but no standardized site assessments exist for any of the sites (S. Bobzien, personal communication, 2007). There are several vernal pools that have longhorn fairy shrimp within the 507-acre Brushy Peak Preserve, which is owned by the Livermore Area Recreation and Park District and managed by the East Bay Regional Parks District (Steve Bobzien, personal communication, 2007). The exact number of vernal pools within this preserve containing this species has not been quantified. The Brushy Peak Preserve contains rock outcrops with multiple indentations that seasonally pool water and support longhorn fairy shrimp. The number of pools supporting longhorn fairy shrimp varies from year to year (Steve Bobzien, personal communication, 2007). All of the known locations of this species in this population are within the preserve and are currently protected.

Vernal Pool Fairy Shrimp

A final rule was published on September 19, 1994, to list the vernal pool fairy shrimp as threatened under the Act (Service 1994). The final rule to designate critical habitat for 15 vernal pool species, including the vernal pool fairy shrimp, was published on August 6,2003 (Service 2003b). A final rule was published again on August 11, 2005 (Service 2005). Further information on the life history and ecology of the vernal pool fairy shrimp may be found in the final listing rule, the final rule to designate critical habitat, Eng *et al.* (1990), Helm (1998), Simovich *et al.* (1992), and Volmar (2002).

Vernal pool fairy shrimp inhabit alkaline pools, ephemeral drainages, rock outcrop pools, vernal pools, and vernal swales (Eriksen and Belk 1999; Helm 1998). Occupied habitats range in size from rock outcrop pools as small as one square meter to large vernal pools up to 12 acres; the potential ponding depth of occupied habitat ranges from 1.2 inches to 48 inches. The adults of the vernal pool fairy shrimp have been collected from early December to early May.

Vernal pool fairy shrimp have delicate elongate bodies; large, stalked, compound eyes; no hard shell (i.e., no carapace); and 11 pairs of swimming legs. Typically less than 1 inch long, they swim or glide gracefully upside-down by means of complex, wavelike beating movements while feeding on algae, bacteria, protozoa, rotifers, and detritus. Female vernal pool fairy shrimp carry eggs in a pear-shaped, ventral brood sac until the eggs are either dropped or sink to the pool bottom with the female when she dies. Eggs which remain after pools dry are known as cysts and are able to withstand heat, cold, and prolonged desiccation. When pools refill in the same or subsequent seasons, some, but not all, of the cysts hatch, resulting in a cyst bank in the soil that may include cysts from several breeding seasons (Donald 1983). Vernal pool fairy shrimp develop rapidly and may become sexually mature within two weeks after hatching (Gallagher 1996; Helm 1998). Such quick maturation permits fairy shrimp populations to persist in short-lived, shallow bodies of water (Simovich *et al.* 1992).

All known occurrences of vernal pool fairy shrimp occur in California or southern Oregon. The geographic range of this species encompasses most of the Central Valley from Shasta County to Tulare County and the central coast range from northern Solano County to Santa Barbara County, California; additional disjunct occurrences have been identified in western Riverside County, California, and in Jackson County, Oregon near the city of Medford (CDFG 2006; Helm 1998; Eriksen and Belk 1999; Volmar 2002; Service 1994, 2003).

The primary historic dispersal method for the vernal pool fairy shrimp was likely large scale flooding resulting from winter and spring rains which allowed colonization of different individual vernal pools and other vernal pool complexes. This dispersal is prohibited by the construction of dams, levees, and other flood control measures, and widespread urbanization within significant portions of the range of this species. Waterfowl and shorebirds likely are now the primary dispersal agents for vernal pool fairy shrimp (Simovich *et al.* 1992). The eggs of these crustaceans are either ingested (Krapu 1974; Swanson *et al.* 1974; Driver 1981; Ahl 1991) and/or adhere to the legs and feathers upon which they are transported to new habitats. Cysts may also be dispersed by a number of other species, such as salamanders, toads, cattle, and humans (Eriksen and Belk 1999).

Vernal Pool Fairy Shrimp Critical Habitat

A final rule designated approximately 858,846 acres of critical habitat collectively for 4 vernal pool crustaceans and 11vernal pool plants in 34 counties in California and 1 county in southern Oregon in a final rule of August 11, 2005 (Service 2005). On February 10, 2006, a final rule describing species-specific unit descriptions and maps identifying the critical habitat for each individual species was published (Service 2006b). The rule identifies approximately 597,821 acres within 32 critical habitat units in Jackson County, Oregon, and Alameda, Amador, Butte, Contra Costa, Fresno, Kings, Madera, Mariposa, Merced, Monterey, Napa, Placer, Sacramento, San Benito, San Joaquin, San Luis Obispo, Santa Barbara, Shasta, Solano, Stanislaus, Tehama, Tulare, Ventura, and Yuba counties, California.

Within areas essential for the conservation and recovery of the vernal pool species, the Service has determined the following PCEs:

PCE 1: topographic features characterized by mounds and swales and depressions within a matrix of surrounding uplands that result in complexes of continuously, or intermittently, flowing surface water in the swales connecting the pools described in PCE (2), providing for dispersal and promoting hydroperiods of adequate length in the pools;

PCE 2: depressional features including isolated vernal pools with underlying restrictive soil layers that become inundated during winter rains and that continuously hold water for a minimum of 18 days, in all but the driest years; thereby providing adequate water for incubation, maturation, and reproduction. As these features are inundated on a seasonal basis, they do not promote the development of obligate wetland vegetation habitats typical of permanently flooded emergent
wetlands;

PCE 3: sources of food, expected to be detritus occurring in the pools, contributed by overland flow from the pools' watershed, or the results of biological processes within the pools themselves, such as single-celled bacteria, algae, and dead organic matter, to provide for feeding; and

PCE 4: structure within the pools described in PCE (3), consisting of organic and inorganic materials, such as living and dead plants from plant species adapted to seasonally inundated environments, rocks, and other inorganic debris that may be washed, blown, or otherwise transported into the pools, that provide shelter.

Vernal Pool Tadpole Shrimp

A final rule was published on September 19, 1994, to list the vernal pool tadpole shrimp as endangered under the Act (Service 1994). The final rule to designate critical habitat for 15 vernal pool species, including the vernal pool tadpole shrimp, was published on August 6, 2003 (Service 2003b). A final rule was published again on August 11, 2005 (Service 2005). Further information on the life history and ecology of the this species may be found in the final listing rule, the final rule to designate critical habitat, Eng *et al.* (1990), Helm (1998), Simovich *et al.* (1992), and Volmar (2002).

Vernal pool tadpole shrimp inhabit alkaline pools, clay flats, vernal lakes, vernal pools, vernal swales, and other seasonal wetlands (Helm 1998). Occupied habitats range in size from vernal pools as small as two square meters to large vernal lakes up to 89 acres; the potential ponding depth of occupied habitat ranges from 1.5 inches to 59 inches.

Vernal pool tadpole shrimp have large, shield-like carapaces approximately one inch long that covers most of their body; dorsal, compound eyes; and a pair of long cercopods, one on each side of a flat caudal plate, at the end of their last abdominal segment. They are primarily bottom-dwelling animals that move with legs down while feeding on detritus and living organisms, including fairy shrimp and other invertebrates (Pennak 1989). Females deposit cysts (partially developed embryos encased in an egg-like structure) which settle on the pool bottom. Although some cysts may hatch quickly, others remain dormant to hatch during later rainy seasons (Ahl 1991). When winter rains refill inhabited wetlands, tadpole shrimp hatch from dormant cysts and may become sexually mature within three to four weeks after hatching (Ahl 1991; Helm 1998). Reproductively mature adults may be present in pools until the habitats dry up in the spring (Ahl 1991; Simovich *et al.* 1992; Gallagher 1996).

The vernal pool tadpole shrimp is known from 19 populations in the Central Valley, ranging from east of Redding in Shasta County south to Fresno County, and from a single vernal pool complex located on the San Francisco Bay National Wildlife Refuge in Alameda County. The species inhabits vernal pools containing clear to highly turbid water, ranging in size from 54 square feet in the Mather Air Force Base area of Sacramento County, to the 89-acre Olcott Lake at Jepson Prairie in Solano County. Vernal pools at Jepson Prairie and Vina Plains (Tehama County) have a neutral pH, and very low conductivity, total dissolved solids, and alkalinity (Barclay and Knight 1984; Eng *et al.* 1990). These pools are located most commonly in grass-bottomed swales of grasslands in old alluvial soils underlain by hardpan or in mud-bottomed claypan pools containing highly turbid water.

The primary historic dispersal method for the vernal pool tadpole shrimp was likely large scale flooding resulting from winter and spring rains which allowed colonization of different individual vernal pools and other vernal pool complexes. This dispersal is prohibited by the construction of dams, levees, and other flood control measures, and widespread urbanization within significant portions of the range of this species. Waterfowl and shorebirds likely are now the primary dispersal agents for vernal pool tadpole shrimp (Simovich *et al.* 1992). The eggs of these crustaceans are either ingested (Krapu 1974; Swanson *et al.* 1974; Driver 1981; Ahl 1991) and/or adhere to the legs and feathers upon which they are transported to new habitats.

Environmental Baseline

California Red-legged Frog

There are several California red-legged frog occurrences in the action area. Occurrences within one mile of Sites 1 and 2 were recorded along Kellogg Creek to the southeast. These sites contain suitable dispersal habitat. The nearest occurrences to Site 3 are two adult California red-legged frogs that were observed in a stock pond located approximately 262 feet southeast of the pipeline anomaly. Site 3 and associated work area contain dispersal habitat. This species has been documented to move 2.2 miles. The project area provides aquatic, foraging, and refugial habitat for this species. Therefore, the Service has determined it is reasonable to conclude the California red-legged breeds near the area, migrates through and inhabits the area, based on the biology and ecology of this listed species, the presence of suitable habitat in the action area and recent records.

California Red-legged Frog Proposed Revised Critical Habitat

Sites 1, 2 and 3 are within the CCS-2, Mt. Diablo, California red-legged frog proposed critical habitat unit. This unit contains the features that are essential for the conservation of the subspecies. This unit also contains aquatic habitat for breeding and non-breeding activities (PCE 1 and PCE 2) and upland habitat for foraging and dispersal activities (PCE 3 and PCE 4). CCS-2 was known to be occupied at time of listing and is currently occupied. This unit is mapped from occurrences recorded at time of listing and subsequent to the time of listing. CCS-2 is located in eastern Contra Costa County and northeastern Alameda County, north of Highway 580 and consists of 9,869 acres of State land, 4,186 acres of local government land, and 124,803 of private land. The unit contains permanent and ephemeral aquatic habitats suitable for breeding, upland areas for dispersal, shelter and food, and provides for connectivity between populations farther south in the interior Coast Range. Threats that may require special management in CCS-2 include removal and alteration of habitat due to urbanization, overgrazing of aquatic and riparian habitats, erosion and siltation due to flooding, and predation by nonnative species.

Aquatic non-breeding habitat (PCE 2) and upland habitat for foraging and dispersal activities (PCE 3 and PCE 4) are present within the action area. This area contains seasonal wetlands and swales upland areas for dispersal, shelter, and food. These features of the critical habitat which are present at the site are essential to the recovery of the species.

California Tiger Salamander

According to the CNDDB (2009) there are several California tiger salamander occurrences in the area. Within one mile of Sites 1, 2 and 3, there are several occurrence records and several breeding ponds within 0.5 miles of Site 1. The nearest occurrence to Site 3 is located approximately 1600 feet northeast of the project area. The next closest recorded occurrence is located approximately 0.8 miles southwest of the project Area within the Springtown Wetland Reserve. This species has been documented to move 1.3 miles. The project area provides aquatic, foraging, and refugial habitat for this species. Therefore, the Service has determined it is reasonable to conclude the California tiger salamander breeds near the area, migrates through and inhabits the area, based on the biology and ecology of this listed species, the presence of suitable habitat in the action area and recent records.

San Joaquin Kit Fox

San Joaquin kit fox habitat in the form of grasslands is abundant in the action area. Surveys in Contra Costa and Alameda counties have shown that although suitable habitat exists, kit foxes in this area are rare and difficult to detect, as they are in other portions of the current range. The nearest CNDDB record of San Joaquin kit fox to Sites 1 and 2 is located approximately 0.5 miles west, at the intersection of Marsh Creek Road and Camino Diablo Road. For Site 3, the nearest CNDDB record is 3.1 miles northeast of the pipeline anomaly. No suitable burrows for dens at were observed by the applicant's consultants in the three work areas or access roads, but San Joaquin kit fox may forage or disperse through the project area. Kit foxes residing in the vicinity of Livermore and Los Vaqueros likely forage and disperse throughout the continuous band of suitable habitat. The proposed project is located within grasslands that currently support foraging and dispersal habitat for the kit fox. In addition, individuals of this species have been recorded to move as far as 9 miles or more in a single night (Service 1998). Therefore, the Service believes that the San Joaquin kit fox is reasonably certain to occur within the action area because of the biology and ecology of the animal, the presence of suitable habitat in and adjacent to the action area, as well as the nearby observations of this listed species

Longhorn Fairy Shrimp

Vernal pool habitat occurs in Sites 1 and 3. The nearest longhorn fairy shrimp CNDDB occurrence to Site 1 is located approximately 3 miles south of the project area. The nearest occurrence to Site 3 is located approximately 3 miles northeast of the project area. Although longhorn fairy shrimp in the Livermore Vernal Pool Region are known from sandstone outcrop vernal pools, they do occur in different types of vernal pool habitats. Therefore, the Service has determined it is reasonable to conclude the longhorn fairy shrimp inhabits the action area based on the biology and ecology of the species, and the presence of vernal pool habitat.

Vernal Pool Fairy Shrimp

Vernal pool fairy shrimp has been found in the Springtown area immediately south of Site 3 and in within 2 miles of Site 1. A vernal pool is located within 15 feet of the pipeline anomaly for Site 1. Sites 1 and 3 contain either swales or vernal pool features. Therefore, the Service has determined it is reasonable to conclude the vernal pool fairy shrimp inhabits the action area based on the biology and ecology of the species, the presence of suitable habitat, as well as the recent observations of this animal.

Vernal Pool Fairy Shrimp Critical Habitat

Site 3 is located within Unit 19C in Alameda County. The Altamont Hills Unit is comprised of three subunits (19A–19C), located in the general vicinity of Mount Diablo and Morgan Territory Regional Park, and comprises approximately 7,892 acres in Contra Costa and Alameda Counties. This unit was known to be occupied by vernal pool fairy shrimp at the time of listing, is currently occupied, and contains the following vernal pool and associated upland features that are essential for the conservation of the species: mound and inter-mound topography (PCE 1, PCE 2) within a matrix of surrounding upland habitat which provide for cyst dispersal and adequate pool hydroperiods, and vernal pool wetland features within a matrix of upland habitat which provide for food, shelter, hatching, growth, and reproduction (PCE 3, PCE 4). The unit represents the only known location that supports vernal pool fairy shrimp within sandstone outcrop pools (Eriksen and Belk 1999). Special management considerations within this unit include: habitat conversion to urban uses or intensive agriculture, hydrologic disruptions or modifications which may disturb vernal pool habitats and restrict or isolate vernal pool fairy shrimp distribution, management of grazing animals, management of off-road recreational vehicles, and control of invasive plant species.

Vernal Pool Tadpole Shrimp

Vernal pool habitat occurs in Sites 1 and 3. A vernal pool is located within 15 feet of the pipeline anomaly for Site 1. Sites 1 and 3 contain either swales or vernal pool features. The closest CNDDB records are near Fremont in Alameda County and near Antioch in Contra Costa County. However, a Jones and Stokes biologist observed a vernal pool tadpole shrimp in a ditch along Dyer Road within the Livermore Vernal Pool Regional during a April 19, 2004 visual survey (Jones and Stokes 2006). Therefore, the Service has determined it is reasonable to conclude this vernal pool tadpole shrimp inhabits the action areas based on the biology and ecology of the species, the presence of suitable habitat, as well as the recent observations of this animal.

Effects of the Proposed Action

The project will affect 0.5 acre of suitable habitat for the California red-legged frog, California tiger salamander, and San Joaquin kit fox. The project will affect 0.03 acre of suitable habitat for the longhorn fairy shrimp, vernal pool fairy shrimp, and vernal pool tadpole shrimp. The project will affect a total of 0.03 of seasonal wetlands and 0.47 acre of uplands. The project footprint for Site 1 is 0.06 acres where 0.06 acre of uplands and 0.0007 acre of wetlands will be affected. A vernal pool is located 15 feet from the pipeline anomaly in Site 1. The Service considers the habitat completely avoided if there is a buffer of 250 feet. The project footprint for Site 2 is 0.17 acre and is entirely in uplands. The project footprint for Site 3 is 0.28 acres where 0.25 acre of uplands and 0.03 of wetlands will be affected. The wetland in Site 3 is located south of the pipeline anomaly in the access road. The installation of a steel plate across the access road will reduce the effects to the wetland.

The project will likely result in a number of adverse effects to the San Joaquin kit fox, California tiger salamander, and the California red-legged frog. There is a likelihood the animals may be affected by being entombed in their burrows, trapped in pipes or trenches, buried or crushed, hit and injured or killed by vehicle strikes, harassed by noise and vibration, and be indirectly affected by invasive exotic plants whose numbers may be increased by habitat disturbance. The California tiger salamander, California red-legged frog, and the prey of the San Joaquin kit fox may become trapped if plastic mono-filament netting is used for erosion control or other purposes where they would be subject to death by predation, starvation, or dessication (Stuart *et al.* 2001; Barton and Kinkead 2005).

Preconstruction surveys and the relocation of individual California red-legged frogs or California tiger salamanders may reduce injury or mortality. However, the capturing and handling of California red-legged frogs and California tiger salamanders to remove them from a work area may result in the mortality or injury of individuals. Injury and mortality may occur as a result of stress and injury during improper handling, containment, and transport of individuals. Death and injury of individual red-legged frogs or tiger salamanders could occur at the time of relocation or later in time subsequent to their release. Although survivorship for translocated red-legged frogs and tiger salamanders has not been estimated, survivorship of translocated wildlife, in general, is lower because of intraspecific competition, lack of familiarity with the location of potential breeding, feeding, and sheltering habitats, and increased risk of predation. Improper handling, containment, or transport of individuals would be reduced or prevented by use of a Service-approved biologist, by limiting the duration of handling, and requiring the proper transport of these species.

Trenching in Site 1 may permanently affect the hydrology of the seasonal wetland and the adjacent vernal pool feature. Trenching can affect the amount and quality of water available to the perched water tables characteristic of vernal pool areas. Changes to the perched water table can lead to alterations in the rate, extent, and duration of inundation (water regime) of remaining habitat. The biota of vernal pools and swales can change when the hydrologic regime is altered (Bauder 1986, 1987). Survival of aquatic organisms like fairy shrimp is directly linked to the water regime of their habitat (Zedler 1987). Therefore, trenching near vernal pool areas may result in the failure of local sub-populations of vernal pool organisms, including the listed crustaceans. Additionally, vehicle use through wetland features may result in hydrologic changes and may crush cysts of vernal pool shrimp species. The actions described in the *Conservation Measures* of this biological opinion will reduce, but not eliminate, the potential for these effects.

Effects on Designated and Proposed Critical Habitat

This biological opinion on the critical habitat for the California red-legged frog and vernal pool fairy shrimp does not rely on the regulatory definition of "destruction or adverse modification" of critical habitat at 50 CFR § 402.02. Instead, we have relied upon the statute and the August 6, 2004, Ninth Circuit Court of Appeals decision in *Gifford Pinchot Task Force v. U.S. Fish and Wildlife Service* (No. 03-35279) to complete the following analysis with respect to the critical habitat.

California Red-Legged Frog

The proposed action is not expected to appreciably diminish the value of the proposed critical habitat for the California red-legged frog, or prevent the proposed critical habitat from sustaining its role in the conservation and recovery of this species. The entire project footprint will affect 0.18 acre of Unit CCS-2. PCEs 2-4 will be temporarily affected but will be restored and will continue to provide habitat essential for species recovery. Due to the temporary effects and proposed actions described in the *Conservation Measures*, the project will not significantly interfere with the current capability of the proposed critical habitat to satisfy essential requirements of the species.

Vernal Pool Fairy Shrimp

The proposed action is not expected to appreciably diminish the value of the critical habitat for the vernal pool fairy shrimp, or prevent the critical habitats from sustaining its role in the conservation and recovery of this species. The proposed project's access road for Site 3 will affect 0.18 acre of Unit 19C. PCEs for the vernal pool fairy shrimp will be temporarily affected but will be restored and will continue to provide habitat essential for species recovery. Due to the proposed actions described in the *Conservation Measures*, the project will not significantly interfere with the current capability of the critical habitat to satisfy essential requirements of the species.

Cumulative Effects

Cumulative effects include the effects of future State, Tribal, local, or private actions that are reasonably certain to occur in the action area considered in this biological opinion. Future Federal actions that are unrelated to the proposed action are not considered in this section because they require separate consultation pursuant to section 7 of the Act.

The global average temperature has risen by approximately 0.6 degrees Celsius during the 20th Century (Intergovernmental Panel on Climate Change 2001, 2007; Adger *et al* 2007). There is an international scientific consensus that most of the warming observed has been caused by human activities (Intergovernmental Panel on Climate Change 2001, 2007; Adger *et al.* 2007), and that it is "very likely" that it is largely due to manmade emissions of carbon dioxide and other greenhouse gases (Adger *et al.* 2007). Ongoing climate change (Inkley *et al.* 2004; Kerr 2007; Adger *et al.* 2007; Kanter 2007) likely imperils these listed species and the resources necessary for their survival. Since climate change threatens to disrupt annual weather patterns, it may result in a loss of their habitat and/or prey, and/or increased numbers of their predators, parasites, and diseases. Where populations are isolated, a changing climate may result in local extinction, with range shifts precluded by lack of habitat.

Conclusion

After reviewing the current status of the California red-legged frog, California tiger salamander, San Joaquin kit fox, longhorn fairy shrimp, vernal pool fairy shrimp, and vernal pool tadpole shrimp, environmental baseline for the species, the effects of the proposed action, and the cumulative effects on these species, it is the Service's biological opinion that the proposed Gas Line 303ILI Repair Project, as described herein, is not likely to jeopardize the continued existence of the California red-legged frog, California tiger salamander, San Joaquin kit fox, longhorn fairy shrimp, vernal pool fairy shrimp, and vernal pool tadpole shrimp current status. Although designated critical habitat for the vernal pool fairy shrimp and proposed critical habitat for the California red-legged frog will be affected, none will be destroyed or adversely modified by the project.

INCIDENTAL TAKE STATEMENT

Section 9 of the Act and Federal regulation pursuant to section 4(d) of the Act prohibit the take of endangered and threatened species, respectively, without special exemption. Take is defined as harass, harm, pursue, hunt, shoot, wound, kill, trap, capture or collect, or to attempt to engage in any such conduct. Harass is defined by the Service as an intentional or negligent act or omission which creates the likelihood of injury to a listed species by annoying it to such an extent as to significantly disrupt normal behavioral patterns which include, but are not limited to, breeding, feeding or sheltering. Harm is defined by the Service to include significant habitat modification or degradation that results in death or injury to listed species by impairing behavioral patterns including breeding, feeding, or sheltering. Incidental take is defined as take that is incidental to, and not the purpose of, the carrying out of an otherwise lawful activity. Under the terms of section 7(b)(4) and section 7(o)(2), taking incidental to and not intended as part of the agency action is not considered to be prohibited taking under the Act, provided that such taking is in compliance with this Incidental Take Statement.

The measures described below are nondiscretionary and must be implemented by the Corps so they become binding conditions of any grant or permit issued to the applicant, as appropriate, in order for the exemption in section 7(o)(2) to apply. The Corps has a continuing duty to regulate the activity that is covered by this incidental take statement. If the Corps (1) fails to require the applicant to adhere to the terms and conditions of the incidental take statement through enforceable terms that are added to the permit or grant document, and/or (2) fails to retain oversight to ensure compliance with these terms and conditions, the protective coverage of section 7(o)(2) may lapse.

Amount or Extent of Take

The Service expects that incidental take of the San Joaquin kit fox will be difficult to detect or quantify because this mammal inhabits dens or burrows when it is not foraging, mating, or conducting other surface activity; the animal may range over a large territory; it is primarily active at night, it is a highly intelligent animal that often is extremely shy around humans, and the finding of an injured or dead individual is unlikely because of their relatively small body size. Losses of this species also may be difficult to quantify due to seasonal fluctuations in their numbers. Therefore, the Service is estimating that all of the San Joaquin kit foxes inhabiting or utilizing areas within 0.5 acre will be subject to incidental take in the form of harm and harassment. Upon implementation of the Reasonable and Prudent Measures, incidental take associated with the Gas Line 303I in the form of harm and harassment of the San Joaquin kit fox caused by the project will become exempt from the prohibitions described under section 9 of the Act.

The Service anticipates that incidental take of the California tiger salamander will be difficult to detect because when this amphibian is not in their breeding ponds, or foraging, migrating, or conducting other surface activity, it inhabits the burrows of ground squirrels or other rodents; the burrows may be located a distance from the breeding ponds; the migrations occur on a limited period during rainy nights in the fall, winter, or spring; and the finding of an injured or dead individual is unlikely because of their relatively small body size. Losses of this species also may be difficult to quantify due to seasonal fluctuations in their numbers, random environmental events, changes in water regime at their breeding ponds, or additional environmental disturbances. Therefore, the Service is estimating that all California tiger salamanders inhabiting 0.5 acre, will be subject to incidental take in the form of harm, harassment, capture, injury, and death. Upon implementation of the Reasonable and Prudent Measures, incidental take associated with the Gas Line 303I in the form of harm, harassment, capture, injury, and death of the California tiger salamander caused by the project will become exempt from the prohibitions described under section 9 of the Act.

The Service anticipates that incidental take of the California red-legged frog will be difficult to detect because of their life history. Specifically, when California red-legged frogs are not in their breeding ponds, they may be difficult to locate due to their cryptic appearance and behavior; they may be located a distance from the breeding ponds; and the finding of an injured or dead individual is unlikely because of their relatively small body size. Losses of these species also may be difficult to quantify due to seasonal fluctuations in their numbers, random environmental events, changes in water regime at their breeding ponds, or additional environmental disturbances. Therefore, the Service anticipates that all California red-legged frogs inhabiting

0.5 acre of suitable habitat will be subject to incidental take in the form of harm, harassment, capture, injury, and death. Upon implementation of the Reasonable and Prudent Measures, incidental take associated with the Gas Line 303ILI Repair Project in the form of harm, harassment, capture, injury, and death of the California red-legged frog caused by the project will become exempt from the prohibitions described under section 9 of the Act.

The Service anticipates that incidental take of the longhorn fairly shrimp, vernal pool tadpole shrimp, and vernal pool fairy shrimp will be difficult to detect because when these crustaceans are not in its active adult stage, the cysts or naupuli are difficult to located in the vernal pools and seasonal wetlands; and the finding of an injured or dead individual is unlikely because of their relatively small body size. Losses of this species also may be difficult to quantify due to seasonal fluctuations in their numbers, random environmental events, changes in water regime at their breeding ponds, or additional environmental disturbances. Therefore, the Service is estimating that all longhorn fairy shrimp, vernal pool fairy shrimp, and vernal pool tadpole shrimp inhabiting 0.03 acre of seasonal wetlands as will be subject to incidental take. Upon implementation of the Reasonable and Prudent Measures, incidental take associated with the construction of the project in the form of harm, harassment, injury, and death of the listed vernal pool crustaceans caused by habitat loss and construction activities will become exempt from the prohibitions described under section 9 of the Act.

Effect of the Take

In the accompanying biological opinion, the Service determined that the level of anticipated take is not likely to result in jeopardy to the California red-legged frog, California tiger salamander, San Joaquin kit fox, longhorn fairy shrimp, vernal pool fairy shrimp, and vernal pool tadpole shrimp. Although designated critical habitat for the vernal pool fairy shrimp and proposed critical habitat for the California red-legged frog will be affected, none will be destroyed or adversely modified by the project.

Reasonable and Prudent Measures

The Service has determined that the following reasonable and prudent measures are necessary and appropriate to minimize the effects of the Gas Line 303ILI Repair Project on the California red-legged frog, California tiger salamander, San Joaquin kit fox, longhorn fairy shrimp, vernal pool fairy shrimp, and vernal pool tadpole shrimp:

1. PG&E will implement the conservation measures as described in this biological opinion.

2. PG&E will minimize adverse affects to the California red-legged frog, California tiger salamander, San Joaquin kit fox, longhorn fairy shrimp, vernal pool fairy shrimp, and vernal pool tadpole shrimp.

3. The Corps shall ensure that the PG&E is within compliance with this biological opinion.

Terms and Conditions

In order to be exempt from the prohibitions of section 9 of the Act, the Corps shall ensure the PG&E complies with the following terms and conditions, which implement the reasonable and prudent measures described above. These terms and conditions are nondiscretionary.

1. The following Term and Conditions will implement Reasonable and Prudent Measure number one (1):

    a. The PG&E shall make the terms and conditions in this biological opinion a required term in all contracts for the project that are issued by them to all contractors.

    b. The PG&E shall provide the Resident Engineer or their designee with a copy of this biological opinion, and the Resident Engineer or their designee shall be responsible for implementing the conservation measures and Terms and Conditions of this biological opinion and shall be the point of contact for the project. The Resident Engineer or their designee shall maintain a copy of this biological opinion onsite whenever construction is taking place. Their name and telephone number shall be provided to the Service at least thirty (30) calendar days prior to groundbreaking at the project. Prior to ground breaking, the Resident Engineer must submit a letter to the Service verifying that they posses a copy of this biological opinion and have read the Terms and Conditions.

    c. The PG&E on-site monitor shall have oversight over implementation of all the Terms and Conditions in this biological opinion, and shall have the authority to stop project activities, through communication with the Resident Engineer, if any of the requirements associated with these Terms and Conditions are not being fulfilled. If biologist/construction liaison has requested a stop work due to take of any of the listed species the Service and CDFG will be notified within one (1) working day via email or telephone

2. The following Term and Conditions will implement Reasonable and Prudent Measure number two (2):

    a. Consistent with previous consultations on PG&E Gas Line projects, PG&E will compensate for effects to listed amphibians and vernal pool crustaceans from disturbance of grassland and wetland habitat, with a minimum three to one compensation ratio. PG&E shall provide the Service with proof of compensation at least twenty (20) work days prior to ground breaking

    b. All excavated material shall be stored at a minimum of 150 feet from any culvert, wash, pond, vernal pool, or stream crossing.

c. Cross-country travel by vehicles shall be prohibited, unless authorized by the Service.

d. Plastic mono-filament netting (erosion control matting) or similar material containing netting shall not be used at the project site because California red-legged frog, California tiger salamanders, and the San Joaquin kit fox may become entangled or trapped in it. Acceptable substitutes include coconut coir matting or tackified hydroseeding compounds.

e. All construction activity shall be confined within the Gas Line 303ILI Repair Project site, which may include temporary access roads, haul roads, and staging areas specifically designated and marked for these purposes. At no time shall equipment or personnel be allowed to adversely affect areas outside the project site without authorization from the Service.

f. The Gas Line 303ILI Repair Project construction area shall be delineated with high visibility temporary fencing at least four (4) feet in height, flagging, or other barrier to prevent encroachment of construction personnel and equipment onto any sensitive areas during project work activities. Such fencing shall be inspected and maintained daily until completion of the project. The fencing will be removed only when all construction equipment is removed from the site. Actions within the project area shall be limited to vehicle and equipment operation on existing roads. No project activities will occur outside the delineated project construction area.

g. Silt fencing will be used in conjunction with the high visibility fencing to prevent soil and debris from entering sensitive areas. Such fencing shall be inspected and maintained daily until completion of the project. The fencing will be removed only when all construction equipment is removed from the site.

h. Twenty-four (24) hours prior to any ground disturbance, pre-construction surveys shall be conducted for San Joaquin kit foxes, California tiger salamanders, California red-legged frogs, vernal pool crustaceans, and sensitive plants. These surveys will consist of walking surveys of the project limits and adjacent areas accessible to the public to determine presence of the species.

i. The project area shall be re-inspected by the monitoring biologist whenever a lapse in construction activity of two weeks or greater has occurred.

j. Excavations shall be inspected in the morning before construction work starts to ensure that animals have not fallen in the trench or hole.

k. Only a Service-approved biologist will be allowed to trap or capture California tiger salamanders and/or California red-legged frogs.

l. Bare hands shall be used to capture California red-legged frogs and California tiger salamanders. Service-approved biologists will not use soaps, oils, creams, lotions, repellents, or solvents of any sort on their hands within two hours before and during periods when they are capturing and relocating individuals of either of these two listed species. To avoid transferring disease or pathogens of handling of the amphibians, Service-approved biologists will follow the *Declining Amphibian Populations Task Force's "Code of Practice."* If at any time a trapped California tiger salamander or California red-legged frog is discovered by the on-site biologist or anyone else, the Service-approved biologist shall move the animal to a safe nearby location (e.g. mouth of ground squirrel burrow within immediate walking distance at site where the landowner has approved in writing that the listed animals may be released) and monitored until it is determined that they are not imperiled by predators, or other dangers. California tiger salamanders and/or California red-legged frogs shall not be moved from within the immediate walking distance of the site where the animal was found without the specific written authorization of the CDFG and the Service.

3. The following Terms and Conditions implement Reasonable and Prudent Measure three (3):

   a. If requested, during or upon completion of construction activities, the on-site biologist, and/or a representative from PG&E shall accompany Service, CDFG, and/or Corps personnel on an on-site inspection of the site to review project effects to the San Joaquin kit fox, California red-legged frog, and California tiger salamander, vernal pool crustaceans, and their habitats.

   b. The Corps shall ensure PG&E complies with the Reporting Requirements of this biological opinion.

Reporting Requirements

The Service and the Department of Fish and Game must be notified within one (1) working day of the finding of any injured California red-legged frog, California red-legged frog, San Joaquin kit fox or any unanticipated damage to their habitats associated with the proposed project. Injured listed species must be cared for by a licensed veterinarian or other qualified person(s), such as the Service-approved biologist. Notification must include the date, time, and precise location of the individual/incident clearly indicated on a USGS 7.5 minute quadrangle and other maps at a finer scale, as requested by the Service, and any other pertinent information. Dead individuals must be sealed in a Zip-lock® plastic bag containing a paper with the date and time when the animal was found, the location where it was found, and the name of the person who found it, and the bag containing the specimen frozen in a freezer located in a secure site. The Service contact persons are Chris Nagano, Division Chief of the Endangered Species Program at the Sacramento Fish and Wildlife Office at (916) 414-6600; and Dan Crum, Resident Agent-in-Charge of the Service's Division of Law Enforcement, 2800 Cottage Way, Room W-2928, Sacramento, California 95825, at (916) 414-6660. The CDFG contact is Liam Davis at (707) 944-5529.

The Corps through PG&E shall submit a post-construction compliance report prepared by the Service-approved biologist to the Sacramento Fish and Wildlife Office within thirty (30) calendar days of the date of the completion of construction activity. This report shall detail (i) dates that construction occurred; (ii) pertinent information concerning the success of the project in meeting conservation measures; (iii) an explanation of failure to meet such measures, if any; (iv) known project effects on listed species, if any; (v) occurrences of incidental take of listed species, if any; (vi) documentation of employee environmental education; and (vii) other pertinent information.

CONSERVATION RECOMMENDATIONS

Conservation recommendations are suggestions of the Service regarding discretionary measures to minimize or avoid adverse effects of a proposed action on listed species or critical habitat or regarding the development of new information. These measures may serve to further minimize or avoid the adverse effects of a proposed action on listed, proposed, or candidate species, or on designated critical habitat. They may also serve as suggestions on how action agencies can assist species conservation in furtherance of their responsibilities under section 7(a)(1) of the Act, or recommend studies improving an understanding of a species' biology or ecology. Wherever possible, conservation recommendations should be tied to tasks identified in recovery plans. The Service is providing you with the following conservation recommendation:

1. The Corps through PG&E should assist the Service in implementing recovery actions identified in the *Recovery Plan for the California red-legged Frog* (Service 2002).

2. The Corps through PG&E should assist the Service in developing and implementing recovery actions identified in the *Recovery Plan for Upland Species of the San Joaquin Valley, California* (1998).

3. Sightings of any listed or sensitive animal species should be reported to the California Natural Diversity Database of the California Department of Fish and Game. A copy of the reporting form and a topographic map clearly marked with the location the animals were observed also should be provided to the Service.

To be kept informed of actions minimizing or avoiding adverse effects or benefiting listed and proposed species or their habitats, the Service requests notification of the implementation of any conservation recommendations.

REINITIATION - CLOSING STATEMENT

This concludes formal consultation on the proposed Gas Line 303ILI Repair Project. As provided in 50 CFR 402.16, reinitiating of formal consultation is required where discretionary Federal agency involvement or control over the action has been retained (or is authorized by law) and if: (1) the amount or extent of incidental take is exceeded; (2) new information reveals effects of the agency action that may affect listed species or critical habitat in a manner or to an extent not considered in this opinion; (3) the agency action is subsequently modified in a manner that causes an effect to the listed species or critical habitat that was not considered in this biological opinion; or (4) a new species is listed or critical habitat designated that may be affected by the action. In instances where the amount or extent of incidental take is exceeded, any operations causing such take must immediately cease, pending reinitiating.

If you have any questions regarding this biological opinion on the proposed Gas Line 303ILI Repair Project, please contact Kim Squires, Senior Endangered Species Biologist, or Arnold Roessler, Forest-Foothills Branch Chief, at the letterhead address, telephone (916) 414-6600, or electronic mail at Kim_Squires@fws.gov or Arnold_Roessler@fws.gov.

Sincerely,

Cliff Vargas

fn Susan K. Moore
Field Supervisor

cc:
Scott Wilson, Liam Davis, Marcia Grefsrud, California Department of Fish and Game, Yountville, California
Cliff Harvey, State Water Resources Control Board, Sacramento, California

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