LIVE OAK ASSOCIATES, INC.

an Ecological Consulting Firm

COUNTY CROSSINGS
SPECIAL STATUS ANIMAL SPECIES REPORT
ANTIOCH, CONTRA COSTA COUNTY, CALIFORNIA

Prepared by:
LIVE OAK ASSOCIATES, INC.

Rick Hopkins, Ph.D., Principal and Senior Conservation Biologist
Mark Jennings, Ph.D., Senior Herpetologist
Sue Townsend, Ph.D., Senior Conservation Biologist

Prepared for**:**

Brosamer & Wall
FKP Antioch, Inc.

Daniel R. Revay
1777 Oakland Road, Suite 300
Walnut Creek, CA 94596

September 10, 2008 PN 1117-01

TABLE OF CONTENTS

1 INTRODUCTION

Live Oak Associates, Inc. (LOA) has prepared the following report that evaluates the presence or absence of several special status wildlife species on the approximately 375-acre Hillcrest Station Area (referred herein as the study area) in the City of Antioch, California. The study area is located on the eastern edge of Antioch, California where Highway 4 (SR 4) and Highway 160 (SR 160) meet in the north central portion of Contra Costa County, California (Figure 1). The proposed project site is located in the Antioch North and Antioch South 7.5" U.S. Geological Survey (USGS) quadrangle in Sections 20, 21, 28 and 29, within Township 2N and Range 2E.

This report identifies findings of a series of species specific surveys that were conducted from August 2007 to July 2008 to identify the potential use of the study area by special status species that are either known to occur regionally or may occur in the study area. The choice of species that were investigated for this report were based on general surveys conducted on the site in 2005 (RCL 2005a), results of the East Contra Costa County Habitat Conservation plan and Natural Community Plan (ECCCHCP 2006) and state and federal data bases (CNDDB 2008).

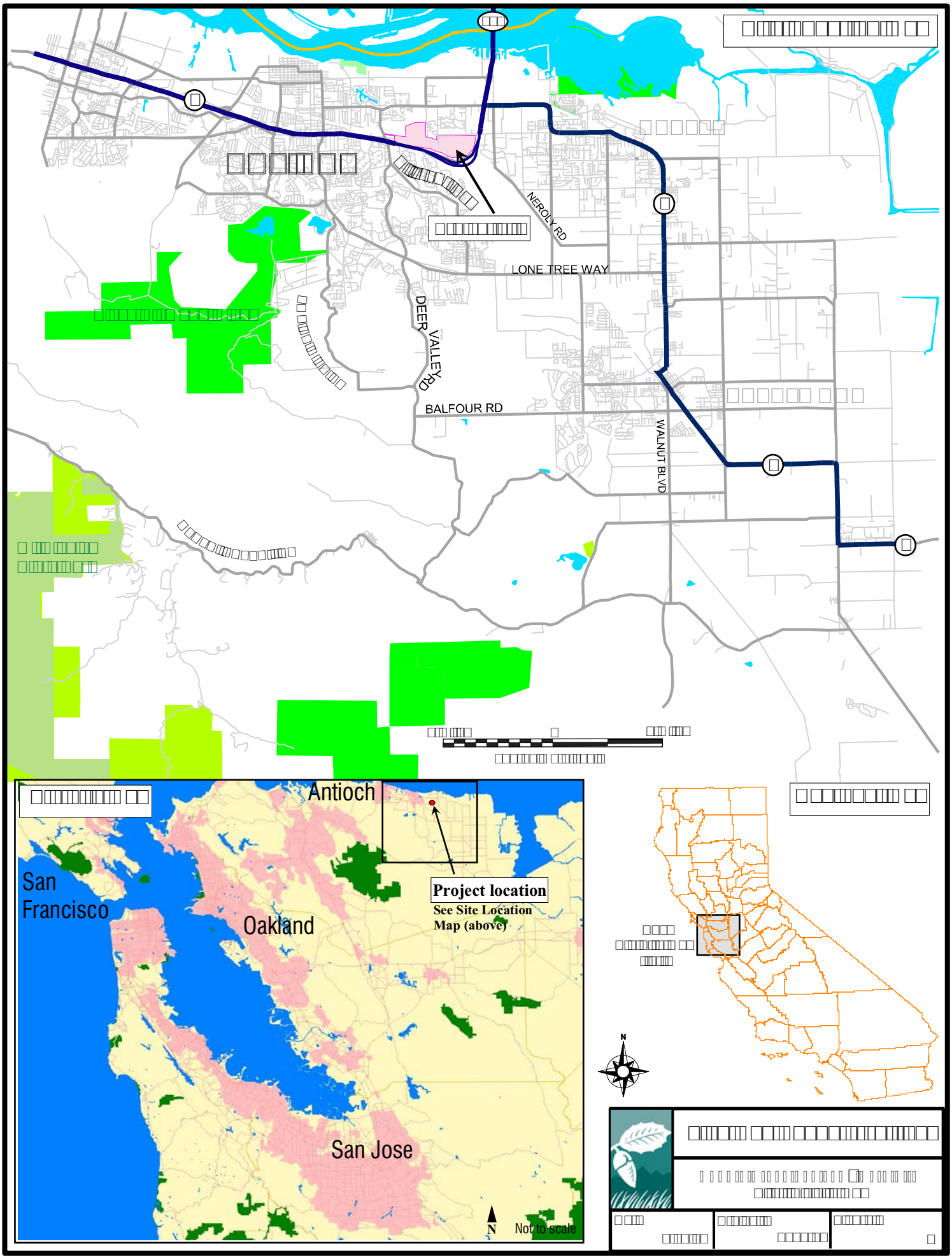
Species addressed by this report include the California tiger salamander (*Ambystoma californiense*), California red-legged frog (*Rana aurora draytonii*), western pond turtle (*Clemmys marmorata*), silvery legless lizard (*Anniella pulchra pulchra*), giant garter snake (*Thamnophis gigas*), tree nesting raptors (both special status and non-special status raptors), burrowing owl (*Athene cunicularia*), and the San Joaquin kit fox (*Vulpes macrotis mutica*).

While the Hillcrest Station Area Plan consists of 375 acres, this report will address our findings on approximately 280 acres of the Hillcrest Station Area Plan. Lands that were excluded from the analysis were the PG&E substation, Contra Costa County Flood Control Basins and the Bart Property as these could not be accessed. Nonetheless, it is believed that the findings of these surveys could be reasonably expanded to include these parcels.

Therefore, the primary objectives of this report were twofold:

- Summarize all site-specific information related to these special status species; and

Make reasonable inferences about the presence or absence of these species based on a series of species specific surveys.


NEROLY RD
LONE TREE WAY
DEER VALLEY RD
BALFOUR RD
WALNUT BLVD
Antioch
San Francisco
Oakland
San Jose
Project location
See Site Location Map (above)
N
Not to scale

2 EXISTING CONDITIONS

2.1 BIOTIC HABITATS AND LAND USES

Elevations of the study area range from a high of approximately 236 feet National Geodetic Vertical Datum (NGVD) on the southern site boundary to a low of approximately 31 feet NGVD along the northwestern site boundary. The study area is characterized by rolling to flat terrain dominated by disturbed non-native annual grassland and ruderal vegetation (see RCL 2005 for a more detailed description of the vegetation communities and land uses of the study area). The habitats and land uses of the study area consist of non-native annual grassland, ruderal vegetation, coastal and valley freshwater marsh, ruderal seasonal wetland and commercial development (Figure 2).

Therefore, the study area consists mostly of non-native upland habitat that has been largely disturbed by past activities including dryland farming, livestock grazing, almond orchards, off road vehicle use, dumping and mining.

The most natural occurring habitat feature of the site consists of a reach of East Antioch Creek that flows from the southeastern corner of the site and exits at the northwestern corner of the site. The habitat along the creek is best characterized as a narrow band of coastal/valley freshwater marsh with red and arroyo willows occurring in areas of ponded or slow moving water. The U.S. Army Corps of Engineers has claimed regulatory authority over 16.14 acres of wetlands and other Waters of the U.S. These include a total of 13.27 acres of coastal/valley freshwater marsh and in-channel pond associates with East Antioch Creek and 2.87 acres of ruderal seasonal wetlands and drainage swale in the northeastern portion of the study area (see RCL 2005b; Figure 2 provides a depiction of these features).

Some development is present on the site; a house and yard, roads, several old houses (some are abandoned), materials laydown area, horse barn, a warehouse, and disked areas. PG&E structures are at the west end of the property and are surrounded by a chainlink fence approximately 12 feet high. The creek is mostly disturbed supporting some patches of riparian vegetation and emergent freshwater vegetation. Sandy soils in the north lacked vegetative cover.

Annual grasslands occur in large patches throughout the site. These grasslands are dominated by non-native grass species such as wild oats *(Avena spp.)*, soft chess *(Bromus hordeaceous)*, foxtail barley *(Hordeum murinum ssp. leporinum)*, and Italian rye grass *(Lolium multiflorum)*, and weedy non-native herbaceous species such as black mustard *(Brassica nigra)*, Italian thistle *(Carduus pycnocephalus)*, summer mustard *(Hirschfeldia incana)* and milk thistle *(Silybum marianum)* are scattered in sometimes dense patches throughout the grassland habitat.

The study area is completely surrounded urban development that supports mostly residential development interspersed with a few small patches of undeveloped in-fill parcels (Figure 3 and 4). Highway 4 borders the study areas southern and eastern boundary with urban development occurring south and east this highway.

Table 1 provides a summary of the list of special status animal species considered for this report. Appendix A. provides a more detailed discussion of the target species' ecology and biology. Appendix B provides the predicted landscape surface of potentially suitable habitat in the ECCCHCP area for those target species in this report covered by the HCP. Figure 5 provides the distribution of the target species (sans the San Joaquin kit fox) within 5 km of the study area and Figure 6 provides the historical occurrences of the San Joaquin kit fox within 10 km of the study area.

While all of the above species listed in Table 1 were surveyed for, the species that had at least some potential to occur on site included the California red-legged frog (CRLF), western pond turtle (WPT), and western burrowing owl (WBO). All other species from Table 1 were either unlikely or not expected to occur within the study area boundaries.

Nonetheless surveys were designed to make reasonable inferences about the presence or absence of all species listed in Table 1.

TABLE 1. SPECIAL STATUS ANIMAL SPECIES SURVEYED FOR IN THE HILLCREST STATION PLAN AREA, AUGUST 2007 TO JULY 2008.

The "Potential for occurrence on site" column is intended to provide a measure of likelihood for the species to occur prior to surveys. See also Figure 6 and 7.

Species	Status	Habitat	Potential for Occurrence on Site
California Tiger Salamander (*Ambystoma californiense*)	FT, CSC	Breeds in vernal pools and stock ponds of central California; adults aestivate in grassland habitats adjacent to the breeding sites.	**Not expected to occur.** The site lacks areas that would likely support suitable breeding habitat for the tiger salamander (CTS). East Antioch Creek and the two in-channel ponds are not typical breeding habitat and these features support a significant population of mosquito fish and black bass have on occasion been stocked in the larger in-channel pond in the main reach of East Antioch Creek. Thus, the site lacks suitable breeding habitat on or within a few km of the site. The ECCCHCP developed species habitat suitability models using map attributes (e.g., ponds, upland habitats, connected to other suitable landscapes, etc.) specific to the tiger salamander. The suitability map for the CTS is consistent with the above conclusion and shows no potential breeding and subsequently no suitable upland habitat for the species. The closest extant population of CTS is nearly 5 km south of the site in the Sand Creek or FUA1 portion of the City of Antioch.
California Red-legged Frog (*Rana aurora draytonii*)	FT, CSC	Rivers, creeks and stock ponds of the Sierra foothills and coast range, preferring pools with overhanging vegetation.	**Potential to occur.** East Antioch Creek supports potentially suitable habitat, although the nearest known extant location for CRLF is more than 5 km south of the site. Although CRLF are known to occur in Sand Creek (approximately 2000 feet from the site), suitable habitat for CRLF is absent on-site (Jennings, pers.comm.).
Western Pond Turtle (*Clemmys marmorata*)	CSC	Open slow-moving water of rivers and creeks of central California with rocks and logs for basking.	**Potential to occur.** The site supports potentially suitable habitat along East Antioch Creek on the study area. The ECCCHCP species habitat suitability maps distinguish portions of East Antioch Creek as core and movement habitat for the western pond turtle. The closest occurrence is nearly 5 km west of the site near the City of Pittsburg.

Table 1. Continued

Species	Status	Habitat	Potential for Occurrence on Site
Silvery Legless Lizard (*Anniella pulchra pulchra*)	CSC	Sandy or loose loamy soils under sparse vegetation of beaches, chaparral, pine-oak woodlands or native riparian vegetation.	**Not likely to occur.** The northeast portion of the site supports sandy soils that could potentially support the species. However, this region of the site had been historically mined and if this species had occurred on the study area prior to mining, the mining activity is likely to have extirpated it from the site. This species is highly susceptible to activities that disturbed its preferred habitat such as urbanization, agricultural, mining, etc. Even though the sandy soils on site have been long been disturbed, the ECCCHCP species models considers these areas suitable for the species. The closest occurrence is approximately 3 km east of the site.
Giant garter snake (*Thamnophis gigas*)	FT, CT	Habitat requirements consist of (1) adequate water during the snake's active season (early-spring through mid-fall) to provide food and cover; (2) emergent, herbaceous wetland vegetation, such as cattails and bulrushes, for escape cover and foraging habitat during the active season; (3) grassy banks and openings in waterside vegetation for basking; and (4) higher elevation uplands for cover and refuge from flood waters during the snake's dormant season in the winter.	**Not expected to occur.** While potential suitable breeding and overwintering habitat may have once occurred on the study area along East Antioch Creek, this region is no longer thought to support an extant population of the snake. The ECCCHCP species model does not include any portion of the study area as core habitat or movement and foraging habitat. The closest area predicted by this map is more than 4 km to the east. The closest historical sighting within 5 km of the study area is on the north side of the Sacramento River.
Swainson's Hawk (*Buteo swainsoni*)	CT	Nests in oaks or cottonwoods in or near riparian habitats; forages in grasslands, irrigated pastures, and grain fields.	**Not expected to occur.** The study area is considered outside the breeding and foraging range of the species in the county. The ECCCHCP species habitat maps note suitable breeding and foraging habitat 3 to 4 km east of the site. However, as a volant species, they can and do at times occur in unexpected locales outside their range.

Table 1. Continued.

Species	Status	Habitat	Potential for Occurrence on Site
Burrowing Owl *(Athene cunicularia)*	CSC	Found in open, dry grasslands, deserts and ruderal areas. Requires suitable burrows. This species is often associated with California ground squirrels.	**Potential to occur.** Burrowing owls have become more prevalent in the region over the last decade. Extensive ground squirrel poisoning programs during the 1940's to 1970's effective eliminated ground squirrels from this region of the County. The suspension of these poisoning programs have allowed ground squirrel and subsequently burrowing owls, to recolonize the grassland habitats of the Antioch region. The upland habitats of the site provide potential breeding habitat for this species. The ECCCHCP habitat suitability maps confirm this conclusion.
San Joaquin Kit Fox (*Vulpes macrotis mutica*)	FE, CT	Saltbush scrub, grassland, oak woodlands, savanna, and freshwater marsh.	**Not expected to occur.** While potential habitat is present on the project site, no historical records occur for the kit fox north of Highway 4 and this area is highly fragmented and disturbed. The closest record is from the mid-1990s in Black Diamond Mines some 8 km south west of the site. The ECCCHCP habitat suitability models predicts suitable low use habitat. The most recent sighting in the Altamont Pass region is from 2002 in the Brushy Peak area some 30 plus km south west.

3 METHODS

Surveys were designed to provide the appropriate level of effort based on the suitability of the site to support the target species and were therefore, timed to maximize detection. Table 2 provides a summary of survey dates for all species.

TABLE 2. SURVEY DATES FOR EACH OF THE TARGET SPECIES LISTED IN TABLE 1.

Date	Species Surveyed *	Time and Weather
8/11/07	General habitat survey to assess potential suitability for all herp species, CRLF	1215-1600hrs 82F, clear and windy
1/5/08	CTS, CRLF, WPT, GGS	1730-2030hrs, 46F, light sprinkles
1/23/08	CTS, CRLF, WPT, GGS	1750-2050hrs, 42F, light to moderate rain
1/31/08	CTS, CRLF, WPT, GGS	1720-2010hrs, 49F, heavy rain before surveys light rain with wind gust during surveys
2/25/08	CTS, CRLF, WPT, GGS	1410-1710hrs, 59F, clear and sunny
3/15/08	CTS visual larval surveys, CRLF, WPT, GGS	1415-1715hrs, 60F, partly cloudy
3/15/08	CTS, CRLF, WPT, GGS	50F, Cool and overcast
4/13/08	CTS visual larval surveys, CRLF, WPT, SLL, GGS	1015-1450hrs, 85F, Sunny and clear
5/7/08	WBO, tree nesting raptors, SJKF	1000-1400hrs, 90F, clear no wind
5/26/08	CTS visual larval surveys, CRLF, WPT, SLL, GGS	1145-1645hrs, 90F, Partly cloudy
5/28/08	WBO, tree nesting raptors, SJKF	0900-1700hrs, 88F, clear no wind
5/29/08	WBO, tree nesting raptors, SJKF	0900-1600hrs 92F, clear no wind
6/27/08	Tree nesting raptors	1230-1330hrs, 84F, clear
7/2/08	CTS juvenile pond surveys, CRLF, WPT, SLL, GGS	86F clear and slight breeze
7/7/08	Tree nesting raptor	1055-1130hrs, 90F, clear
7/9/08	CRLF, WPT, GGS	2030-2335hrs, 91F, clear no wind, ½ moon

- California tiger salamander (CTS), California red-legged frog (CRLF), western pond turtle (WPT), silvery legless lizard (SLL), giant garter snake (GGS), western burrowing owl (WBO), San Joaquin kit fox (SJKF)

3.1 AMPHIBIAN AND REPTILES

Dr. Mark Jennings (see Appendix C for relevant resumes) conducted all of the surveys for special status amphibian and reptile species (herp species). These were all visual surveys that were designed to maximize the probability of detection by timing the surveys during a period of time when the species if present would be most active, thereby maximizing detection probabilities. Considerations were given to the time of day and weather patterns. Of the 5

special status herp species surveyed for only the California red-legged frog (CRLF) and western pond turtle (WPT) had the potential to occur. The California tiger salamander (CTS), giant garter snake (GGS) and silvery legless lizard (SLL) were either considered "Not likely to occur" or "Not expected to occur" (see Table 1). Survey methodologies were designed accordingly.

Non-invasive visual survey techniques were utilized for these surveys so as not to adversely affect any sensitive species; nonetheless, these visual survey techniques were considered affective for this site. The study area did not contain suitable breeding habitats for the California tiger salamander as the only water features on site was East Antioch Creek (and a tributary to it) and two in-channel ponds that support large populations of mosquito fish with one pond in the main reach of East Antioch Creek also supporting black. Even though the site lacked suitable breeding habitat for CTS, effort was put forth to visually inspect the two in-channel ponds (and the creek) during periods of time that either egg masses should occur (January to March), larvae (March to May) and/or juveniles (May to July). Four evening surveys were conducted along East Antioch Creek and adjacent upland habitats between January 5 and March 15, 2008 while 5 daytime surveys were conducted between February 25 and July 2, 2008, with the surveys on March 15, April 13, May 26, and July 2 focusing largely on the two in-channel ponds to detect any life cycle stages of CTS (egg masses, larvae, juvenile).

A total of 6 surveys were conducted for the CRLF during the breeding season 4 of these were nighttime surveys and two daytime survey between January 5 and March 15, 2008 (see Table 2). Five additional surveys outside the breeding season were conducted for the CRLF, one daytime survey occurred August 11, 2007 while the remaining 4 surveys (3 daytime 1 nighttime) occurred between April 13 and July 9, 2008 (see Table 2).

Surveys for WPT and GGS were also timed with surveys for CTS and CRLF and all aquatic features were surveyed for the explicit purpose of detecting individuals of these two species;

While these areas appear potentially suitable for the species, disturbance from mining to agricultural activities have likely rendered the site unsuitable. Nonetheless, the sandy areas of the site were inspected for SLL three times between April 13 and July 2, 2008 (Table 2).

3.2 BURROWING OWL AND TREE NESTING RAPTORS

The western burrowing owl (WBO) and all tree nesting raptors were surveyed for by walking transects of the entire site for WBO (see survey methods for the San Joaquin kit fox) and inspecting all trees on site for any tree nesting raptors. These efforts consisted of three surveys conducted in May, 2008 with two follow-up surveys in July, 2008 to monitor a Swainson's hawk nest (tree nesting raptor) detected during the May surveys.

3.3 SAN JOAQUIN KIT FOX

These efforts followed the early evaluation phase of the U.S. Fish and Wildlife Service's survey protocol for the species the *San Joaquin Kit Fox Survey Protocol for the Northern Range* (USFWS 1999). The *Early Evaluation* was developed by the USFWS (1999) as a tool to determine if focused surveys are warranted during informal consultation.

This *Early Evaluation* (USFWS 1999) includes the following information:

1. Brief description of the study area and map;
2. Compilation of occurrence records within a ten-mile radius of the boundaries of the study area;
3. Description of vegetative communities within the study area and a ten-mile radius of the study area;
4. Description of habitat suitability within the study area;
5. Analysis of impacts from land use changes on kit foxes (if any);
6. Preliminary recommendations for mitigation for impacts related to land use changes and an analysis of cumulative effects;
7. A walking survey of the entire site to assess the site for potential denning habitat and prey availability.

Regional kit fox occurrences were compiled primarily from the California Natural Diversity Database (CDFG 2007) and the *Recovery Plan for the San Joaquin Valley* (USFWS 1998).

Vegetative communities on site and within a ten-mile radius of the site are identified herein. We used aerial photographs (Google Earth 2006), USGS 7.5' quadrangles and drove the surrounding area.

A visual inspection of the suitable habitat within the site boundaries was completed by walking transects. These surveys were conducted on May 7, 2008 by Dr. Sue Townsend, May 28, by Dr. Townsend and Mr. Nathan Hale (see Appendix C for relevant resumes), and May 29 by Drs. Townsend and Colleen Lenihan and Mr. Nathan Hale (see Table 2). Areas supporting marginal (tall, thick, ruderal vegetation), unsuitable and developed areas were visually inspected from the margins. In addition, areas supporting unsuitable habitat (riparian creek and ruderal) were visually surveyed from the margins. In addition, surveys noted relative distribution and abundance of potential prey and suitable denning sites. Suitably-sized burrows (4" or greater in diameter for at least 3.5') were monitored for a minimum of three nights with tracking medium and, in some cases, camera stations.

Areas of low ruderal vegetation, grasslands, and moderately high grasslands were walked in transects. Some areas supporting ruderal vegetation were not walked as the ruderal vegetation was very high (4 to 5'). Portions of the site were developed (train tracks, houses, warehouse, abandoned houses, and stockpiled materials); these areas were inspected for burrows and sign. Creek and riparian areas were inspected as well. In general, the vegetation on the site was thick, weedy and overgrown. The PG&E site was fenced and was not walked. Portions of the PG&E lands supported mowed grasslands with ground squirrel activity visible through the fence. The remainder of the PG&E supports a power substation and other buildings and structures.

4 RESULTS

4.1 AMPHIBIAN AND REPTILE SPECIES

No life stages of any of the target special status herp species were observed and no evidence of their presence was detected during any of the surveys. However, common native or exotic aquatic species were observed during these surveys. Pacific treefrogs, western mosquito fish and Louisiana crayfish were commonly observed. Indicative of the human disturbance of the study area, Dr. Jennings collected an exotic juvenile western painted turtle (*Chrysemys picta bella*) in East Antioch Creek at the Willow Road crossing on March 15, 2008. This specimen now resides at the collections of California Academy. Surprisingly, no bullfrogs were observed or heard calling during any of the surveys.

4.2 WESTERN BURROWING OWL AND TREE NESTING RAPTORS

On May 28, 2008, LOA ecologists identified a pair of burrowing owls utilizing several burrows on the study area (Figure 7). These owls were also observed on May 29, 2008, the following day. The active owl burrows were located within a sandy bowl feature occurring approximately 100 m south of Oakley Road in the northeast portion of the site. It appeared that three burrows of approximately ten that occurred within the bowl feature experienced regular use by these owls. Owls were observed using two of these three burrows and a third burrow had evidence of use (whitewash, pellets, etc.). Evidence of burrowing owls was also observed in a horse pasture in the southeast portion of the site.

On May 29, 2008, a pair of adult Swainson's hawks was observed flying over the site. On May 30, 2008 LOA staff was able to identify the nest site on the north side of East Antioch Creek (Figure 7). The nest was in a mature pepper tree growing within a clump of trees along north side of East Antioch Creek within the northeast portion of the site. The nest tree location was approximately 150 m south of Oakley Road and 0.4 km east of Willow Road. During a site visit on June 27, 2008, a nestling that appeared to be nearly full grown was observed in the nest with two adult Swainson's hawks flying above the vicinity of the nest. It is assumed that the nestling may have fledged successfully as the nest was empty during a site visit on July 7, 2008. One adult Swainson's hawk was observed flying over that portion of the site during the July 7 visit.

SAN JOAQUIN KIT FOX

Kit Fox Occurrences in the Region

Eight San Joaquin kit fox occurrences are reported within approximately 16 km of the property (Figure 6). A cluster of occurrences in and around EBRP Black Diamond Mines to the southwest are 5 to 8 km away and are from the early and mid-90's. There is no habitat connectivity between these occurrences and the project area; development and Highway 4 are between the occurrences and the project area. Sightings to the south, 13 to 16 km away, are from mid-70's, late 80's and early 90's. Residential development associated with the City of Antioch and Highway 4 (immediately south of the development) is between the study area and these occurrences.

Vegetative Communities and Land Use

Elevations of the project site range from a high of approximately 236 feet National Geodetic Vertical Datum (NGVD) on the southern site boundary to a low of approximately 31 feet NGVD along the northwestern site boundary (Figures 2 and 3). The site is characterized by rolling to flat terrain and ruderal vegetation. The site supports non-native annual grassland, ruderal, riparian creek and developed landscape (Figures 2 and 3). Some development is present on the site; a house and yard, roads, several old houses (some are abandoned), materials lay-down area, horse barn, a warehouse, and disked areas. PG&E structures are at the west end of the property and are surrounded by a chain link fence approximately 12 feet high. The creek is mostly disturbed supporting some patches of riparian vegetation and emergent freshwater vegetation. Sandy soils in the north lacked vegetative cover.

Annual grasslands occur in large patches throughout the site. These grasslands are dominated by non-native grass species such as wild oats *(Avena spp.)*, soft chess *(Bromus hordeaceous)*, foxtail barley *(Hordeum murinum ssp. leporinum)*, and Italian rye grass *(Lolium multiflorum)*, and weedy non-native herbaceous species such as black mustard *(Brassica nigra)*, Italian thistle *(Carduus pycnocephalus)*, summer mustard *(Hirschfeldia incana)* and milk thistle *(Silybum marianum)* are scattered in sometimes dense patches throughout the grassland habitat.

Suitability of the Habitat Within a 10 mile Radius

The approximately 280-acre study area is located in the City of Antioch in Contra Costa County, California. The site is surrounded by residential development on all sides with Highway 4 bordering the site to the south and east. In addition, a railroad track parallels the southern boundary. Residential housing and a cemetery are to the north. Other residential development virtually surrounds the site. A small patch of grasslands extends south from the southeastern corner of the site on the other side of Highway 4. In addition, a narrow strip of agricultural land extends north from the northeastern corner of the study area.

The Delta is less than 2.5 km to the north and most of the land use between the site and delta is developed including industrial and residential with some orchards and a few patches of disturbed grasslands. Residential development extends about 4.4 km to the south, and Oakley residential development is immediately east of the Highway 160 bordering the eastern edge. A patch of grasslands extends south of the southwest corner of the site on the south side of Highway 4. Residential development extends southwest, west and northwest of the site.

Habitat Suitability of the Study Area

A total of 9 potential dens (4" or greater in diameter for at least 3.5') were detected, mapped and monitored from May 28 to May 31, 2008 (Table 3, Figure 8). In addition, two camera stations were established near potential dens to further monitor these burrows (Figure 7). These burrows were fairly large and appeared to be coyote dens. Burrowing owls were present at and occupying three of these burrows. The remainder showed ground squirrel activity with a few possible cottontail or jackrabbit tracks. No canids were detected at the potential dens or the camera stations, but a coyote was observed near these burrows on May 31, 2008. The results from tracking medium at the potential burrows are shown below (Table 3).

TABLE 3: TRACKING MEDIUM RESULTS FROM POTENTIAL DEN MONITORING, MAY 28 TO MAY 31, 2008

Burrow Number	Sign and tracks detected
1	Pellets, white wash, burrowing owls observed
2	Prob ground squirrel tracks, white wash, bird tracks
3	probable ground squirrel, unidentified tracks (too small to be kit fox),
4	Ground squirrel tracks, bird tracks,
5	Ground squirrel tracks, snake tracks, insect tracks
6	Small rodents tracks, insect tracks,
7	Ground squirrel tracks,
8	Ground squirrel tracks
9	Small rodent tracks, tail drags

5 CONCLUSION

5.1 AMPHIBIAN AND REPTILE SPECIES

We conducted an initial analysis prior to species specific surveys as to the likelihood that the five special status herp species considered in Table 1 would occur within the study area. This analysis incorporated a number of factors including general habitat surveys of the study area, review of the literature regarding historical records for the target species and an analysis of the connectedness of this site to other potentially suitable landscapes in the region.

Our analysis was generally consistent with the ECCCHCP habitat suitability species models (see Appendix B) that served as the foundation for the regionally HCP. While the City of Antioch is not a signatory to the HCP, the HCP nonetheless included the City within its analysis.

Both our analysis and that of the species models of the ECCCHCP considered potentially suitable habitat within the study for the CRLF and WPT. In addition, we both felt that the site lacked suitable habitat for the CTS and GGS. The lone disagreement occurs with the SLL. The ECCCHCP species model for the SLL concludes that the sandy soils of the study area provide suitable habitat. Historically that was probably true, but given the extensive disturbance that has occurred on the site from mining to agricultural practices, the species is likely absent (Jennings and Hayes 1994).

In the end, while the site supports potentially suitable habitat for CRLF and WPT, neither species was detected during any of the surveys. The only aquatic species detected during these surveys included common native species the Pacific treefrog and the non-native Louisiana crayfish, western mosquitofish and western painted turtle. Therefore, we have concluded that the CRLF and WPT are absent from the study area.

Visual surveys along East Antioch Creek and the two in-channel ponds between January 5, 2008 and July 2, 2008 failed to detect any life stages of CTS. The closest extant population of CTS is over 4 km south of Highway 4 in the Sand Creek Area of the City of Antioch. No potentially suitable ponds have been observed during driving surveys of the region north of Highway 4, nor were we able to detect any on available aerial photos. Thus, the negative findings of our surveys are not surprising and we conclude that CTS are absent from the study area.

GSS may have historically occurred in the Antioch Area but presently the creek systems appear unsuitable for them (see ECCCHCP discussion). The closest sighting of GSS is on the north side of the Sacramento River and the ECCCHCP habitat models predict that the nearest core

habitat and movement/foraging habitat is more than 3 km east of the study area. Thus, the negative findings of our surveys are consistent with the conclusions of the ECCCHCP.

Dr. Mark Jennings conducted SLL surveys during appropriate times and weather in the sandy areas of the study area. No SLL were observed during these surveys and he largely attributes these negative findings to the severe disturbed nature of the site. SLL are typically found within the first meter of soil and human activities such as mining (which occurred extensive in this portion of the study area) usually destroy or degrade the conditions for this species. Therefore, based on the disturbed nature of the site and negative findings of our surveys we conclude this species is absent from the site.

We have concluded that these 5 species are absent from the site based on the negative survey results, the unsuitable nature of the habitat for at least 3 herp species (i.e., CTS, GGS and SLL) and the study areas general isolation from other areas in the region that could or do support any of these species.

5.2 WESTERN BURROWING OWL AND TREE NESTING RAPTORS

Surveys of the site detected a pair of breeding burrowing owls on the north side of East Antioch Creek. The detection of owls on this site is not surprising and is consistent with the conditions of the site and the ECCCHCP species models. WBO have become more prevalent in this region of East Contra Costa County in the last decade due in large part to recolonization of ground squirrels that had long been absent due to the extensive poisoning program instituted from the 1940's to 1970's. Unless site conditions change appreciably in the near future, we expect that breeding burrowing owls will continue to breed and potentially winter on the site in future years.

The ECCCHCP conducted an extensive analysis related to the Swainson's hawk presence in East Contra Costa County. This analysis included among other things, close consultation with the principle Swainson's hawk experts in which they concluded that the hawk would only occur in the very eastern edge of the county several km east of the study area. However, volant species that regularly forage several km from their nests, can and do at times either forage or nest in unusual locales well outside their normal range. These nests sometimes represent simple outlier occurrences that are used once by the species, but at times these unusual nesting events represent a range extension and will become established. The Swainson's hawk nest on the study area not only occurs well outside the current range of the species, but occurred in a modest-sized pepper on a site that suffers from extensive human disturbance. While atypical on many levels, we are not able to predict whether or not this is a one time excursion or a range extension that will become established.

5.3 SAN JOAQUIN KIT FOX

The site supports habitat largely unsuitable for kit fox due to the fact that the ruderal grasslands have become overgrown and are neither mowed nor grazed; the vegetation height often exceeded 3 feet in height and the grasslands that were present were thatch. The exceptions were two horse paddocks, but the grasses were still thick and tall and mostly over 7 to 10 inches in height. We detected 9 potentially suitable dens of which the majority appeared to be abandoned coyote dens. The presence of other fox species and coyotes could present some competition, but this co-occurrence of canid species is not uncommon in California. The creek flowing through the site supported riparian and emergent freshwater vegetation. In general, it would be unlikely for kit fox to move into or through the site due to the high and thick vegetation. Very little suitable kit fox habitat is contiguous with the site and the patches of grasslands near the site are small and surrounded by residential development.

Kit fox sightings from EBRP Black Diamond Mines are about 5 km from the study area but there is no habitat connectivity with the project area. The latest occurrence (1995) was from 13 years ago and it is unclear the status of kit fox in this region. The rapid rate of development associated with Antioch, Oakley and Brentwood have further diminished the likelihood that kit fox would move north from the EBRP to the project area. The occurrences to the south are mostly from the 70's, 80's and early 90's; there is some open space to the north of these sightings but development from Antioch also separates the study area from these occurrences. Based on land use surrounding the study area (freeway, highways and residential development), it seems unlikely that kit fox could successfully navigate to the site.

Based on the little available marginal habitat, limited denning opportunities, and largely unsuitable habitat within the study area, we consider it unlikely that kit fox could use the study area for denning, foraging or movement. Based on these findings, project development would likely have no impact on kit fox.

We consider the kit fox absent from the study area based on the lack of evidence of kit fox on the study area, the marginal nature of the habitat and the site's isolation from those region in the County that have or could support kit fox.

6 LITERATURE CITED

Archon, M. 1992. Ecology of the San Joaquin kit fox in western Merced County, California. M.A. Thesis, California State University, Fresno.

Berry, W.H., T.P. O'Farrell, T.T. Kato, and P. M. McCue. 1987. Characteristics of dens used by radiocollared San Joaquin kit fox, Vulpes macrotis mutica, Naval Petroleum Reserve #1, Kern County, California. U.S. Department of Energy Topical Report, EG&G/EM Santa Barbara Operations Report EGG 10280-2177.

California Department of Fish and Game. 1994. Staff report regarding mitigation for impacts to Swainson's hawks (*Buteo swainsoni*) in the Central Valley of California. Sacramento, CA.

_____. 2002. California fish and game code. Gould Publications. Binghamton, NY.

_____. 2007. Annual report on the status of California state listed threatened and endangered animals and plants. The Resources Agency, Sacramento, CA.

_____. 2007. California natural diversity database. The Resources Agency, Sacramento, CA.

Egoscue, H.J. 1956. Preliminary studies of the kit fox in Utah. J. Mammal. 37:351-357.

Egoscue, H.J. 1962. Ecology and life history of the kit fox in Tooele County, Utah. Ecology 43:481-497.

Egoscue, H.J. 1975. Population dynamics of the kit fox in western Utah. Bulletin of the Southern California Academy of Sciences 74:122-127.

Golightly, R.T., and R.D. Ohmart. 1984. Water Economy of Two Desert Canids: Coyote and Kit Fox. J. Mamm. 65:51-58.

Grinnell, J., J. S. Dixon, and J.M. Linsdale. 1937. Furbearing Mammals of California, Vol. II. University of California Press, Berkeley.

Jensen, C. C. 1972. San Joaquin kit fox distribution. U.S. Fish and Wildlife Service Report, Sacramento, CA.

McGrew, J.C. 1979. Vulpes macrotis. Mammalian Species No. 123. 6 pp.

Mercure, A., Ralls, K., Koepli, K. and R. Wayne. 1993. Genetic subdivisions among small canid: mitochondrial DNA differentiation of swift, kit and arctic foxes. Evolution 47:1313-1328.

Morell, S.H. 1972. Life history of the San Joaquin kit fox. CDFG. 58:162-174.

Morrell, S.H., 1975 San Joaquin kit fox distribution and abundance in 1975. Administraitve Report 75-3, CDFG, Sacramento , CA. 28 pp.

O'Farrell, T.P. 1980. Elk Hills Endangered and Threatened Species Program, Phase 1 Progress Summary. U.S. Dept. Energy Tropical Rep. No. EGG 1183-2403, Santa Barbara Operations. U.S. Department of Energy, Goleta, CA. 19 pp.

O'Farrell, T.P., and P.M. McCue. 1981. Inventory of San Joaquin Kit Fox on USBLM Lands in the western San Joaquin Valley-Final Report. Rep. No. EGG 1183-2416, EG&G Energy Measurements, Goleta, CA 33 pp.

Ralls, K. and P.J. White. 1995. Predation on endangered San Joaquin kit foxes by larger canids. J. Mammal. 276:723-729.

Swainson's Hawk Technical Advisory Committee. 2000. Recommended timing and methodology for Swainson's hawk nesting surveys in California's Central Valley. Swainson's Hawk Technical Advisory Committee, California.

U. S. Fish and Wildlife Service. 1998. Recovery Plan for Upland Species of the San Joaquin Valley, California. Region 1, Portland, Oregon.

U.S. Fish and Wildlife Service. 1999. Draft Recovery Plan for the Giant Garter Snake (*Thamnophis gigas*). U.S. Fish and wildlife Service, Portland, Oregon. Ix+ 192 pp.

_____. 2007. Species account: giant garter snake (*Thamnophis gigas*). Sacramento, California.

_____. 2005. Endangered and threatened wildlife and plants.

United States Fish and Wildlife Service (USFWS). 1999. Standardized Recommendations for Protection of the San Joaquin Kit Fox Prior To or During Ground Disturbance.

United States Fish and Wildlife Service (USFWS). 1998. Recovery Plan for Upland Species of the San Joaquin Valley, California. Region 1, Portland, Oregon.

United States Fish and Wildlife Service (USFWS). 1999. San Joaquin Kit Fox Survey Protocol for the Northern Range.

Zoellick, B.W., T.P. O'Farrell, and T.T. Kato. 1987. Movements and home range of San Joaquin kit foxes on the Naval Petroleum Reserves, Kern County, California. Rep. No. EGG 10282-2184, EG&G Energy Measurements, Goleta, CA. 38 pp.

APPENDIX A: SPECIES ACCOUNTS

CALIFORNIA TIGER SALAMANDER

Federal listing status: Threatened; State listing status: Species of Concern

The U.S. Fish and Wildlife Service listed the California tiger salamander as Threatened under the authority of the Federal Endangered Species Act on 3 September 2004. The California tiger salamander was listed because it has been extirpated from approximately 55 per cent of its historical range (Long 1992, Shaffer et al. 1993, Jennings and Hayes 1994). Remaining populations are currently threatened by a wide variety of human impacts, including: urban development, conversion of natural habitat to agriculture, construction of reservoirs and water diversions, introduction of exotic predatory animals, and other anthropogenic factors such as rodent control programs, vehicular-related mortality, etc. (Sorensen 1994, Fisher and Shaffer 1996, Jennings 1998). To date, the USFWS has not released a Draft Recovery Plan for the California tiger salamander. On 23 August 2005, the USFWS released a final ruling for designating critical habitat for the California tiger salamander (*Designation of Critical Habitat for the California Tiger Salamander, Central Population; Final Rule)* USFWS 2005), which took affect on 22 September 2005. Approximately 199,109 acres occurring in 19 counties fall within the boundaries of what the USFWS determined as critical habitat for the central population of California tiger salamander. It is important to note that only those areas that support the critical elements for the salamander were classified as critical habitat.

The California tiger salamander is a large terrestrial salamander with adults attaining a total length of over 8 inches (203 millimeters) [Stebbins 1951]. Adult males are generally slightly larger than females. Dorsally, the background color appears to be jet black--normally with an overlain pattern of white or yellow spots, or bars (Stebbins 1985, Petranka 1998). Undersurfaces are highly variable in pattern, ranging from nearly uniform white or pale yellow to variegated white or pale yellow and black (Jennings and Hayes 1994). These salamanders have relatively small, but protruding eyes that have black irises (Jennings and Hayes 1994).

Juvenile salamanders are 1.7-2.8 inches (42-70 mm) from the tip of the snout to the rear of the vent (SVL) and have the same coloration pattern as adults. Salamanders that are recently metamorphosed often have a pale yellowish-brown, tan, or greenish-colored dorsum with dark flecks and blotches. These blotches soon fade to a white or yellow color after only a few weeks. Larval salamanders range in size from 0.4-6.6 inches (11-150 mm) in total length with a pale yellowish-brown, tan, or dark-colored dorsum (Anderson 1968). External gills and legs are prominent features on all salamander larvae over two weeks old (Storer 1925).

Life History and Ecology. Breeding of adult California tiger salamanders has been observed from late November through February, following the onset of warm rains (Storer 1925, Barry and Shaffer 1994). Based on observations during the 1990's (Jennings, unpub. data) salamanders often do not breed during periods of aseasonally cold rains or during drought

(whether breeding ponds are filled with water or not) [Barry and Shaffer 1994]. Both males and females engage in nocturnal breeding migrations traveling up to 1 mile (1.6 km) [Austin and Shaffer 1992] or more from subterranean refuge sites (e.g. small mammal burrows) [Loredo et al. 1961] to egg deposition sites (long-lasting rain pools) [Twitty 1941, Andersen 1968]. Adult salamanders are possibly stimulated to move to breeding sites by the vibrations of rainwater falling on the soil, as adult male salamanders have been observed (after preceding night(s) of rainfall) wandering on the dry soil of rain pools that had not yet filled (Jennings, unpub. data).

Males generally precede females during the breeding season by 1-2 weeks (Shaffer et al. 1993, Loredo et al. 1996). Following underwater courtship from one or more males, females deposit moderate-sized [0.13- 0.21 inches (3.6-5.9 mm) diameter] eggs singly on vegetation and other debris in the shallow margins of rainwater pools (Storer 1925). Under rare conditions, fertilized eggs may be deposited in small groups of 2-4 (or more) on submerged vegetation (Twitty 1941). Large females may deposit up to 350 eggs per season, although most females only deposit 100-200 eggs (Jennings, unpub. data). Adult salamanders apparently leave breeding ponds soon after spawning (Storer 1925), although they may forage for up to a month in the general area if conditions continue to be moist (Barry and Shaffer 1994). Most salamanders soon return to estivation habitats in small mammal burrows where they spend approximately 9-10 months underground until the next winter rains (Barry and Shaffer 1994).

Embryos of California tiger salamanders hatch in approximately 14-28 days after being laid (Storer 1925, Twitty 1941) and the resulting gilled, aquatic larvae [0.41-0.43 inches (10.5-11 mm) in length] require a minimum of about 10-12 weeks to complete development through metamorphosis. At metamorphosis, young salamanders have attained a total length of about 2.6 inches (75 mm) [Anderson 1968, Feaver 1971]. Metamorphosis is apparently initiated by receding water levels in breeding ponds and most larval salamanders do not metamorphose until they are as large as possible (Feaver 1971). Although the native breeding habitat for this species normally dries each year and metamorphosis is paramount under such conditions, there are a few observations of larval salamanders over wintering in artificially constructed, permanent ponds. The over wintering of larvae (especially to sexual maturity) is common in many closely related species of mole salamanders (*Ambystoma* spp.) found in other parts of North America (Stebbins 1985, Petranka 1998).

California tiger salamander larvae are carnivorous and feed on just about any organism they can overpower--including smaller conspecifics (Feaver 1971). Larger larvae have been observed to feed on the larvae of Pacific treefrogs (*Hyla regilla*), California toads (*Bufo boreas halophilus*) and western spadefoots (*Scaphiopus hammondii*), as well as many aquatic invertebrates (Anderson 1968, Feaver 1971). Since salamander larvae are very cryptic in coloration, they are often hard to observe in the turbid waters of breeding habitats.

Following metamorphosis (normally from early May through July), juveniles emigrate *en masse* at night from the drying breeding pond after spending a few hours or days near the pond margin (Holland et al. 1990). Traveling distances of 1 mile (1.6 km) or more from breeding sites, juvenile salamanders wander into small mammal burrows or deep cracks in the soil, which they use as refugia during the hot summer and fall months (Shaffer et al. 1993, Loredo et al. 1996). Juveniles will also wander into certain man-made structures such as wet basements, wells, underground pipes, and septic tanks drains [Storer 1925]. Mortality of juveniles can be high during this transition period due to the stress of metamorphosis and the problems of finding a suitable refuge site before the sun comes up. Juveniles probably feed on the rich invertebrate fauna that is normally associated with small mammal burrows and grow rapidly over the next several months. Data suggest that most individuals require 2 years to become sexually mature, but some individuals may be slower to mature during periods of drought or aseasonal rainfall (Shaffer et al. 1993).

Adult salamanders apparently eat the same food organisms as juvenile salamanders (Morey and Guinn 1992) and may live as long as 20+ years in the wild based on the longevity of other closely related species in captivity (Snider and Bowler 1992). Although predation to salamanders is minimal in underground refugia, juveniles and adults are known to be eaten by bullfrogs (*Rana catesbeiana*), garter snakes (*Thamnophis* spp.), and probably black-crowned night herons (*Nycticorax nycticorax*) and raccoons (*Procyon lotor*) when they are present on the surface during the wet winter and spring months (Morey and Guinn 1992). Larvae are eaten by a wide variety of predators including garter snakes, bullfrogs, California red-legged frogs (*Rana aurora draytonii*), herons (Ardeidae), terns (*Sterna* spp.), and apparently fish when the latter are introduced into breeding ponds (Baldwin and Stanford 1987; Shaffer et al. 1993; Fisher and Shaffer 1996).

Anecdotal evidence indicates that salamanders have a high degree of site fidelity to their breeding ponds and also to the small mammal burrows they use for refugia (Shaffer et al. 1993). For example, a gravid, adult, female California tiger salamander removed from a breeding site and transported to a newly-created mitigation pond, moved a straight line distance of approximately 0.9 mile (1.4 km) back to the original point of capture over a 3-week period (Duke et al. 1998). Sites used for reproduction are typically natural pools that fill with rainwater and artificial stock ponds; however, salamanders have also been observed to breed in springs, wells, artificial reservoirs, quarry ponds, man-made canals, and rarely, in the slack waters of oxbows in small- to medium-sized streams. Such sites may, or may not contain dense amounts of aquatic and streamside vegetation. The highest numbers of larvae appear to occur in aquatic habitats that are largely devoid of any vegetation and contain very turbid water. Salamanders may also turn up in certain man-made structures (e.g. wet basements, wells, swimming pools, underground pipes, and septic tank drains [Storer 1925, Pickwell 1947]), sometimes many years after their local breeding site has been destroyed by urbanization.

Juvenile and adult salamanders typically use the burrows of California ground squirrels (*Spermophilus beecheyi*) and pocket gophers (*Thomomys bottae*) as underground refugia (Storer 1925, Jennings and Hayes 1994, Jennings 1996, Loredo et a1. 1996), but may use a variety of burrows including cracks within the soil which may extend up to 15-feet (4.6-m) deep from the soil surface (Jennings, unpub. data). Juvenile and adult salamanders are especially common in situations where piles of concrete, rock, or other rubble are mixed with dirt and are located near breeding sites (Jennings, unpub. data). This is probably because such sites are attractive to burrowing rodents that create extensive tunnel and burrow systems that in turn are used by juvenile and adult salamanders.

CALIFORNIA RED-LEGGED FROG

This federally threatened frog is the largest native frog in California with adults attaining a length of 3.4-5.4 inches (85-138 mm) snout-to-vent length (SVL) (Jennings and Hayes 1994). On the dorsal surface, the background color varies from brown to gray to reddish-brown, normally with some dark mottling peppered around spots with light-colored centers (Stebbins 1985). The distribution of reddish pigment is highly variable, but is usually restricted to the groin and undersurfaces of the thighs, legs, and feet (Jennings and Hayes 1994). This red coloration is not diagnostic for species identification. Two distinctive, prominent folds of skin ("dorsolateral folds"), run in a complete line from the rear of the eyes to the groin. The groin has a distinctly mottled pattern of black on a light-colored background. Juvenile frogs range from 1.5-3.4 inches (40-84 mm) SVL and have the same coloration as adults except that the dorsolateral folds are normally yellow or orange colored (Stebbins 1985). This coloration is distinct even at a distance. Larval frogs range from 0.6-3.1 inches (14-80 mm) SVL.

Adult California red-legged frogs have been observed breeding from late November through early May after the onset of warm rains (Storer 1925, Jennings and Hayes 1994). Male frogs typically attract females by emitting low short calls in small mobile groups of 3-7 individuals (Jennings and Hayes 1994). Females move toward the calling groups and amplex a male. Following amplexus, the females move to chosen oviposition sites where they attach an egg mass of 2,000-6,000 moderate-sized (2.0-2.8 mm diameter) eggs to an emergent vegetation brace such as tule stalks, grasses, or willow roots located just below the water surface (Storer 1925, Livezey and Wright 1947). Once laid, the egg mass will swell with water for about 24 hours, finally reaching the size of a softball. Males usually remain at the breeding sites for several weeks after reproduction before moving to foraging habitats, while females immediately remove to foraging habitats.

California red-legged frog embryos hatch about 6-14 days following fertilization. The resulting larvae (8.8-10.3 mm) require 14-28 weeks to reach metamorphosis, which usually occurs between July and September, although there are scattered observations of overwintering larvae in perennial ponds such as at the arboretum at Golden Gate Park in San Francisco (Jennings,

pers. obs). Tadpoles generally metamorphose at 65-85 mm total length (Storer 1925) and the newly emerged juvenile frogs are generally 25-30 mm SVL. Larvae are thought to graze on algae, but they are rarely observed in the field because they spend most of their time concealed in submergent vegetation, algal mats or detritus (Jennings and Hayes 1994). Post-metamorphic frogs grow rapidly feeding on a wide variety of invertebrates.

Males typically reach sexual maturity at 2 years and females at 3 years; however, frogs of both sexes may reach sexual maturity in a single year if resources are sufficient (Jennings, unpub. data). Conversely, frogs may take 3-4 years to reach maturity during extended periods of drought (Jennings and Hayes 1994). Based on limited field data, California red-legged frogs appear to live up to 10 years in the wild (Jennings, unpub. data). Adult frogs apparently eat a wide variety of animal prey including invertebrates, small fishes, frogs, and small mammals.

California red-legged frogs have been observed in a number of aquatic and terrestrial habitats throughout their historic range. Larvae, juveniles, and adult frogs have been collected from natural lagoons, dune ponds, pools in or next to streams, streams, marshlands, sag ponds, and springs, as well as human-created stockponds, secondary and tertiary sewage treatment ponds, wells, canals, golf course ponds, irrigation ponds, sand and gravel pits (containing water), and large reservoirs (Jennings 1988). The key to the presence of frogs in these habitats is the presence of perennial (or near perennial) water and the general lack of introduced aquatic predators such as largemouth bass (*Micropterus salmoides*), green sunfish (*Lepomis cyanellus*), and bluegill (*L. macrochirus*), crayfish (*Pacifastacus leniusculus* and *Procambarus clarkii*), and bullfrogs (*Rana catesbeiana*).

WESTERN POND TURTLE

Federal Listing Status: None; State Listing Status: Species of Special Concern.

Life history and ecology. The western pond turtle is the only native aquatic, freshwater turtle in California and normally associates with permanent or nearly permanent aquatic habitats, including streams, lakes, and ponds. Historically, this species occurred in Pacific Coast drainages from Washington to Mexico. This species occurs in aquatic habitats with 1) basking sites such as rocks and logs, 2) dense stands of submergent or emergent vegetation, 3) abundant aquatic invertebrate resources, 4) suitable nearby nesting sites, and 5) the lack of native and exotic predators (Bury 1972; Jennings and Hayes 1994; Bury and Holland, in press). This species can move along streams up to 3.1 miles (5 kilometers) in a short period of time, and they can tolerate at least 7 days without water (Jennings and Hayes 1994; Bury and Holland, in press).

SILVERY LEGLESS LIZARD

The California Department of Fish and Game (CDFG) designated the silvery legless lizard (*Anniella pulchra pulchra*) a Species of Special Concern in 1994 (CDFG 2008), and the United States Fish and Wildlife Service (USFWS) has this species listed as sensitive. General threats to the population of this species includes conversion of habitat to agriculture, sand mining, golf courses, and housing; introduction of invasive species such as ice plant; and off-road vehicle use. This species cannot sustain its population in urban or otherwise disturbed environments.

The silvery legless lizard, also known as the California legless lizard, is a small to medium sized lizard with a distinctive legless body from 4 3/8 to 7 inches (11.1 to 17.8 cm) in length. The top of the lizard is generally silver and beige in coloration and appears polished. Also, this species features a yellow underside and a black middorsal line running the length of the body. This species uniquely has eyelids and can be observed blinking.

This species occurs primarily under sparse vegetation in sandy or otherwise loose soils within chaparral, oak woodland, beaches, and along streams and washes. The presence of soil moisture may be vital to this species. Highly favorable habitat features for this species appear to be dunes, leaf litter, logs, rocks, and other stiff debris (Contra Costa County 2006; Stebbins 2003). Legless lizards construct burrows within the sandy soil and utilize them during cold nights and the majority of the day. They emerge during the morning, evenings, and during warm nights to hunt for insects; however, they often take shelter under various habitat features that provide for thermoregulation and protection from predators such as various snakes, birds, and small mammals.

The silvery legless lizard gives birth to 1-4 live young in September through November after an approximately four month gestation period (Stebbins 2003). The usual number of young per brood is two. Legless lizards are sexually mature after 2 or 3 years and the longevity of this species in the wild is unknown (this species has lived approximately 6 years in laboratory conditions) (Jennings and Hayes 1994).

Though this species is known to overwinter or hibernate communally, it is generally a solitary creature.

There is little to no information on the movement behavior of this species; however, its range in California is known to include from Antioch, in Contra Costa County south through the Coast, Transverse, and Peninsular Ranges, along the western edge of the Sierra Nevada and in parts of the San Joaquin Valley and Mojave Desert south to the Mexico boarder (Contra Costa County 2006).

GIANT GARTER SNAKE

Federal Listing Status: Threatened; State Listing Status: Threatened.

By the time it was listed as federally threatened on October 20, 1993, the giant garter snake population had suffered severe declines as a result of habitat loss due to urbanization and agricultural activities. A draft recovery plan was submitted for the giant garter snake in 1999, but a final recovery plan has not been adopted to date.

Life history and ecology. The giant garter snake is one of the largest garter snakes, reaching a total length of at least 63 inches. Females typically weigh 1 to 1.5 pounds and tend to be slightly longer and proportionately heavier than males. Dorsal background coloration varies from brownish to olive with a checkered pattern of black spots, separated by a yellow dorsal stripe and two light colored lateral stripes. Background coloration and prominence of a black checkered pattern and the three light stripes are geographically and individually variable. The ventral surface (the snake's underside) is cream to olive or brown and sometimes infused with orange, especially in northern populations. Giant garter snakes feed primarily on small fishes, tadpoles, and frogs (USFWS 2007).

The giant garter snake inhabits small mammal burrows and other soil crevices above prevailing flood elevations throughout its winter dormancy period. Giant garter snakes typically select burrows with sunny exposure along south- and west-facing slopes. Their breeding season extends through March and April, and females give birth to live young from late July through early September. Brood size is variable, ranging from 10 to 46 young, who immediately scatter into dense cover and absorb their yolk sacs, after which they begin feeding on their own. Sexual maturity averages three years for males and five years for females (USFWS 2007).

In April 2002, Dr. Mark Jennings, who served on the technical subteam writing the recovery plan for the giant garter snake, determined that habitats of the San Joaquin River were still suitable for the giant garter snake, and that this species could forage in upland habitats adjacent to the San Joaquin River. The Mendota area, less than seven miles southeast of Firebaugh, represents one of only thirteen Central Valley locations in which a giant garter snake population is thought to be present (USFWS 1999). Although giant garter snakes generally remain in close proximity to aquatic and wetland habitats, they have been observed foraging or dispersing through upland habitats up to 800 feet from marshes and pools. The giant garter snake is generally inactive during the winter and seeks cover in rodent burrows that may be as much as 800 feet from marshes and ponds.

SWAINSON'S HAWK

Federal Listing Status: None; State Listing Status: Threatened.

The Swainson's hawk is designated as a California Threatened species. The loss of agricultural lands (i.e., foraging habitat) to urban development and additional threats such as riverbank protection projects have contributed to its decline.

Life history and ecology. Swainson's hawks are a large, broad-winged, broad-tailed hawks. Male and female Swainson's hawks have similar body types, with a length generally between 17 and 22 inches and a wingspan between 47 and 57 inches. They weigh up to 2.5 pounds.

Swainson's Hawks have a high degree of mate and territorial fidelity. They arrive at their nesting sites in March or April, and their nests, measuring three to four feet in diameter, can take up to two weeks to complete. The nest is likely to be in a low tree, or giant cactus, ledges, or on the ground. The female will lay and incubate two to four eggs for approximately 28 to 35 days. The male helps with incubation when the female leaves the nest to feed. The young hatch sometime between March and July and do not leave the nest until some 4 to 6 weeks later. The young hawks chase grasshoppers and crickets on the ground before they learn how to catch other kinds of prey.

These birds patrol open areas or scan for prey from a perch; they may also catch insects in flight. Swainson's hawks are unique in switching from a diet of primarily small mammals when raising young to insects when migrating or wintering. As a soaring, open-country hunter, it often hunts from perches such as tree tops, poles or posts, rocks, and elevated ground.

In the Central Valley, Swainson's hawks typically nest in large trees in or peripherally to riparian systems adjacent to suitable foraging habitats. Other suitable nest sites include lone trees, groves of trees such as oaks, other trees in agricultural fields, and mature roadside trees. Swainson's hawks forage in large, open fields with abundant prey, including grasslands or lightly grazed pastures, alfalfa and other hay crops, and certain grain and row croplands.

BURROWING OWL

Federal Listing Status: None; State Listing Status: Species of Special Concern.

The burrowing owl is designated as a California Species of Special Concern. This designation was based on the species' declining population within the state over the past 40 years. The population decline is mainly due to habitat destruction resulting from development and agricultural practices.

Life history and ecology. The burrowing owl is a small, long-legged, semi-fossorial bird that averages a height of 9.5 inches, has an average wingspan of 23 inches, and weighs an average of 5.25 ounces. Burrowing owls are unique in that they are the only owl that regularly lives and breeds in underground nests. In California, these birds typically occur in the Central and

Imperial Valleys, primarily utilizing ground squirrel burrows (or the burrows of other animals, e.g., badgers, prairie dogs and kangaroo rats) found in grasslands, open shrub lands, deserts, and, to a lesser extent, grazed and agricultural lands. Burrowing owls in this region are typically found at elevations below 250 ft. and exhibits strong site fidelity. Pairs have been known to return to the same area year after year, and some pairs are known to utilize the same burrow as the previous year. Burrowing owls are colonially nesting raptors, and colony size is indicative of habitat quality. It is not uncommon to find burrowing owls in developed and cultivated areas where California ground squirrels are active.

Burrowing owls feed on various small mammals including deer mice, voles, and rats. They also prey on various invertebrates including crickets, beetles, grasshoppers, spiders, centipedes, scorpions and crayfish. Peak hunting periods occur around dusk and dawn.

SAN JOAQUIN KIT FOX NATURAL HISTORY

The kit fox (*Vulpes macrotis*) is one of nine species in the genus Vulpes in the family Canidae in the order Carnivora. The San Joaquin kit fox is one of seven subspecies of kit fox and is considered the most genetically distinct (Mercure et al. 1993). The San Joaquin kit fox is the smallest North American canid (member of the dog family, Canidae). Adult males weigh approximately 2.3 kilograms (approximately 5 lbs.) and adult females weigh 2.1 kilograms (about 4.6 lbs.), on average (Morrell 1972).

Historically, the San Joaquin kit fox (*Vulpes macrotis mutica*) occurred extensively throughout California's Central Valley and parts of the Salinas and Santa Clara valleys. Kit fox currently inhabit some areas of suitable habitat on the San Joaquin Valley floor and in the surrounding foothills of the coastal ranges, Sierra Nevada, and Tehachapi Mountains, from southern Kern County north to Contra Costa, Alameda, and San Joaquin Counties on the west, and near La Grange, Stanislaus County on the east side of the Valley and some of the larger scattered islands of natural land on the Valley floor in Kern, Tulare, Kings, Fresno, Madera, and Merced Counties (taken from the *Recovery Plan for Upland Species of the San Joaquin Valley, California*, USFWS 1998).

Kit fox prefer habitats of open or low vegetation with loose soils. In the northern portion of their range, they occupy grazed grasslands and, to a lesser extent, valley oak woodlands. In the southern and central portion of the Central Valley, kit foxes are found in valley sink scrub, valley saltbrush scrub, upper Sonoran subshrub scrub and annual grassland (USFWS 1998). Kit fox are also found in grazed grasslands including areas adjacent to tilled or fallow fields and suburban settings (see USFWS 1998).

The kit fox requires underground dens to raise pups, to avoid predators (Golightly and Ohmart 1984), to regulate temperature, and avoid other adverse environmental conditions. In the northern portion of their range, burrowing mammals, primarily California ground squirrels

(*Spermophilus beecheyi*), usually provide these holes. Dens are usually located on loose-textured soils on slopes less than 40 degrees (O'Farrell 1980). Natal pupping dens are generally found on slopes of less than 6 degrees (O'Farrell and McCue 1981).

Pairs may share home ranges all year but may use different dens (USFWS 1998). Kit foxes breed from late December to March (Egoscue 1956, Morrell 1972, Zoellick et al. 1987). One litter of two to six pups is born sometime between February and late March (Egoscue 1962, Morrell 1972, McGrew 1979, Zoellick et al. 1987). Males provision the female and pups for some period after birth. Dispersal distances vary considerably. A six-year study at Elk Hills Petroleum Preserves in California showed that pups dispersed an average distance of 5.0 miles (Scrivner et. al. 1987, USFWS 1998).

Age range of kit fox varies from 2 years (Egoscue 1975) to over 10 years in captivity (McGrew 1979). Kit foxes in the wild have been known to live to 7 (Egoscue 1962) and even 8 years (Berry et al. 1987). However, kit foxes have high mortality rates as adults (0.50) and as juveniles (0.70) (Morrell 1972, Egoscue 1975, Ralls and White 1995).

APPENDIX B: EAST CONTRA COSTA COUNTY HABITAT CONSERVATION PLAN & NATURAL COMMUNITY CONSERVATION PLAN HABITAT SPECIES MODELS

APPENDIX C: RESUMES

RICK A. HOPKINS, PH.D.
PRINCIPAL
SENIOR CONSERVATION BIOLOGIST/ECOLOGIST

EDUCATION

- Ph.D. Wildlands Resource Science, University of California, Berkeley, CA. 1990.
- Dissertation Title: Ecology of the cougar in the Diablo Range.
- M.A. Biology, San Jose State University, San Jose, CA. 1981.
- B.A. Wildlife Zoology, San Jose State University, San Jose, CA. 1976.

AREA OF EXPERTISE

Population ecology, mammalogy, predator ecology, survey techniques, wildlife/habitat relationships, conservation biology, threatened and endangered species, and environmental regulations (CEQA, NEPA, FESA, CESA)

PROFESSIONAL EXPERIENCE

- Live Oak Associates, Inc., (formerly Hartesveldt Ecological) Oakhurst, CA. Co-Owner, Vice-President, Senior Wildlife Biologist. 1999 to Present
- Consulting Biologist 1990 to present
- San Jose State University, San Jose, CA. Spring Lecturer. 1991
- University of California at Berkeley, Berkeley, CA. Research Assistant. 1984 to 1989
- San Jose State University, San Jose, CA. Lecturer. 1983 to 1985
- University of California at Berkeley, Berkeley, CA. Teaching Assistant. 1982 to 1983
- San Jose State University, San Jose, CA. Graduate/Teaching Assistant, Biology. 1977 to 1981

PROFESSIONAL TRAINING

Habitat Evaluation Procedure (HEP). U.S. Fish and Wildlife Service. 6/92

MEMBERSHIPS IN PROFESSIONAL ORGANIZATIONS

Wildlife Society, American Society of Mammalogists, Society for Conservation Biology, Ecological Society of America

QUALIFICATIONS

Dr. Hopkins is a national recognized wildlife ecologist whose training and research has focused on population ecology and movements of wildlife, particularly mammalian carnivores and threatened and endangered (T&E) wildlife species. His areas of expertise include the following:

- **Special status Species Surveys.** Dr. Hopkins has designed and managed a considerable number of surveys for special status species and/or their habitats during the last 15 years. While Dr. Hopkins is a broadly trained ecologist with experience with several wildlife species, he has dedicated the last 25 years to the study of mammalian carnivores. During the last 15 years he has focused a great deal of attention in studying the distribution of the San Joaquin kit fox within its range. He has continued to search for ways to establish survey techniques that will provide statistical rigor to the methods employed to ascertain the presence or absence of wildlife species on sites, particularly in marginal habitats. He has also assisted his clients with mitigation that reduced impacts to such species, including (but not limited too) listed crustaceans (e.g., vernal pool fairy shrimp), Bay checkerspot butterfly, Mission blue butterfly, San Bruno elfin, Callippe butterfly, Valley elderberry longhorn beetle, California tiger salamander, California red-legged frog, western pond turtle, blunt-nosed leopard lizard, Alameda whipsnake, western burrowing owl, Swainson's hawk, golden eagle, bald eagle, Buena Vista Lake shrew, giant kangaroo rat, salt marsh harvest mouse, San Joaquin kit fox. He has also contributed to the development of the California Wildlife Habitat Relationships Program and is trained in Habitat Evaluation Procedures.
- **Endangered Species Consultations.** Dr. Hopkins has prepared supporting material for both section 7(a) and 10(a) consultations with the U.S. Fish and Wildlife Service. As Principal, he has supervised the collection of data on listed species within project areas, analysis of project impacts, the development of

mitigation measures, and has been the primary contact with the resource agencies during the process. Dr. Hopkins has prepared a number of Habitat Conservation Plans for a variety of projects.

- **Preparation of CEQA/NEPA Documents.** Dr. Hopkins has supervised interdisciplinary teams of biologists characterizing the biological setting of project sites and planning areas, determining project impacts, and developing conceptual mitigation plans consistent with the requirements of CEQA and NEPA for over 600 projects during the last 15 years.

PUBLICATIONS

Grigione, M.M., P. Beier, R.A. Hopkins, D. Neal, W.D. Padley, C.M. Schonewald and M. L. Johnson. 2002. Ecological and allometric determinants of home-range size for mountain lions (Puma concolor). Animal Conservation 5:317-324.

Hopkins, R. A., M. J. Kutilek, and G. L. Shreve. 1986. The density and home range characteristics of mountain lions in the Diablo Range of California. Pages 223-235 In S. D. Miller and D. Everett eds, Proc. International Cat symposium, Kingsville, Texas, October 1982.

Hopkins, R.A. 1984. Current techniques used in the research of pumas. Pages 216-229 in J. Roberson and F. Lindzey, eds. Second Mountain Lion Workshop. Utah Div. Wildl. Res., Utah.

Hopkins, R.A. 1990. Ecology of the Puma in the Diablo Range. Ph.D. Dissertation University of California at Berkeley, California.

Kutilek, M.J., R.A. Hopkins, E.W. Clinite, and T. E. Smith. 1983. Monitoring population trends of large carnivores using track transects. Pages 104-106 in J. F. Bell, and T. Atterbury, eds. Proc. Internat. Conf. Renewable Resource Inventories for Monitoring Changes and Trends. School of Forestry, Oregon State University, Corvallis, Oregon.

PROFESSIONAL PRESENTATIONS

1979. Annual Meeting of American Society of Mammalogist. Current Techniques in the Capturing of Mountain Lions. Corvalis, Oregon.

1981. Annual Meeting of the Western Section of the Wildlife Society. Home Range Characteristics of the Mountain Lion in the Diablo Range. San Luis Obispo, California.

1983. International Cat Symposium. The Density and Home Range Characteristics of Mountain Lions in the Diablo Range of California, Kingsville, Texas.

1984. Second Mountain Lion Workshop. Progress Report on the Home Range Characteristics of Cougars in the Diablo Range, Zion National Park, Utah.

1989. Third Mountain Lion Workshop. Duke, R. D., R. C. Klinger, R. A. Hopkins, and M. J. Kutilek, Yuma Puma: Population Status Update. Arizona.

1989. Third Mountain Lion Workshop. Hopkins, R.A. The comparison of home range estimators in the analysis of puma movements.

1992. Annual Meeting of the Western Section of the Wildlife Society. Duke, R.D., R.A. Hopkins, H.T. Harvey, and H.S. Shellhammer. The Distribution and Abundance of Salt Marsh Harvest Mice in 3 South Bay Marshes Influenced by Effluent Discharge. San Diego, California.

1997. 5th Mountain Lion Workshop. California Statewide Estimates And Trend Analysis: Lessons From The Diablo Range. San Diego, California.

1997. Annual Meeting of the American Society of Mammologist. Townsend, S.E., R. A. Hopkins, and R.R. Duke. Distribution of the San Joaquin Kit fox in the North part of its Range. Stillwater, Oklahoma.

2000. An Invited Ecological Co-chair for the Central Coast Ecoregion of California for the Missing Linkages Conference: Restoring Connectivity to the California Landscape. The mission of the conference was "to bring together land managers and planners, conservationists, and top scientists from each ecoregion in the state to identity the location of, and threats to the most important movement corridors for California's wildlife."

2000. California Wilderness Conference. Invited Panel Participant for the Wilderness Management Section. Other panel members included Dr. Peter Moyle, Dr. David Chipping, Dr. Robert Stack.

2002. Carnivore Conference. November 2002. Mystery, Myth and Legend, Challenges for the Management of Cougars. Monterey, California.

2003. 7th Mt. Lion Workshop. May 2003. Mystery, Myth and Legend: The Politics of Cougar Management in the New Millennium. Rick Hopkins. Jackson, Wyoming.

2003. 7th Mt. Lion Workshop. May 2003. Management of cougars (*Puma concolor*) in the western United States. Deanna Dawn, Michael Kutilek, Rick Hopkins, Sulehka Anand, and Steve Torres.

2004. Science and the Endangered Species. June 2004. CLE Endangered Species Conference, Santa Barbara, California. An invited panel member.

TESTIMONY AT STATE WILDLIFE COMMISSION MEETINGS OR STATE LEGISLATIVE HEARINGS.

Dr. Hopkins has provided both written and oral testimony at state wildlife commission hearings and at Legislative Hearings in several western states. These include California, Oregon, Washington, Colorado, Wyoming and South Dakota. The purpose of these testimonies was to provide decision makers the best available scientific information regarding the biology and ecology of the cougar and to evaluate the ramifications of or effectiveness of proposed actions.

BOARD MEMBER OF NON-PROFIT ORGANIZATION

- Cougar Fund, Jackson, Wyoming. An organization dedicated to the preservation of the cougar in its present and historic range. Other board members include Jane Goodall, Marc Beckoff, Tom Mangelsen (Co-founder), Cara Blessley (Co-founder), Howard Buffett, Corinne E. Rutledge, Webb Blessley.

SCIENTIFIC ADVISORY BOARDS

- Department of Biological Sciences, San Jose State University.
- Predator Defense; an Oregon organization dedicated to the use of sound science in the management of mammalian predators.
- Sinapu; a Colorado organization focused on the conservation and restoration of carnivores in the Southern Rockies.

MARK R. JENNINGS, PH.D.
SENIOR ASSOCIATE ECOLOGIST AND HERPETOLOGIST

EDUCATION

- Ph. D. Wildlife and Fisheries Science, University of Arizona, Tucson, AZ. 1986
- M. S. Natural Resources, Humboldt State University, Arcata, CA. 1981
- B. S. Fisheries, Humboldt State University, Arcata, CA. 1978

AREAS OF EXPERTISE

Ichthyology, fisheries ecology, herpetology, special status species studies, compliance with state and federal endangered species acts

PROFESSIONAL EXPERIENCE

- Live Oak Associates, Inc. Associate Ecologist. 2000 to Present.
- Rana Research, Sacramento, CA. Consulting Herpetologist. 1990 to Present.
- California Academy of Sciences, San Francisco, CA. Research Associate. 1987 to Present.
- U. S. Fish and Wildlife Service, Sacramento, CA. Fishery Biologist. 1986 to 1990.
- Harding Lawson Associates. Biologist. 1985 to 1986.
- University of Arizona, Tucson, AZ. Research Associate. 1982 to 1986.

QUALIFICATIONS

Dr. Jennings is a versatile, highly trained ecologist with specialties in both fisheries ecology and herpetology. He has worked extensively with a variety of fishes, reptiles, and amphibians throughout California and is a noted authority on a number of species including the tidewater goby, steelhead, California tiger salamander, red-legged frog, western pond turtle and giant garter snake. As a research associate at the California Academy of Sciences, he completed a 4-year study of the status of third category (species of special concern) amphibians and reptiles in California for the California Department of Fish and Game. The product of this research is the most comprehensive description of the distribution and status of all species of special concern ever produced in the state. This report served as the model for subsequent species of special concern reports for other vertebrate groups, which includes recommendations for changes in listing status as warranted, and for future research.

Dr. Jennings has consulted on more than 500 projects over the last 10 years throughout California. As an Associate Ecologist for LOA, he has assisted on numerous projects regarding the California red-legged frog (more than a dozen ongoing projects in the Bay Area), California tiger salamander, western pond turtle, San Francisco garter snake, and Alameda whipsnake.

Dr. Jennings has held a research position as a fish biologist with the U. S. Fish and Wildlife Service, National Fisheries Contaminant Research Center, Dixon, California. His research efforts concentrated on the effects of selenium on fisheries of the San Joaquin Valley, California. He supervised both field and laboratory studies.

Dr. Jennings is certified as a fisheries scientist and has conducted a variety of studies prior to his work with the Fish and Wildlife Service. Included in these surveys were stream surveys in Pima County, Arizona, an assessment of impacts of dredge mining on streams, the effects of fire on fish populations, and an assessment of anadromous fish stocks in the Clearwater River, Idaho. He has taught an upper division fisheries course and assisted in several laboratory courses.

Since 1980, Dr. Jennings has published over 75 scientific papers in the field of ichthyology and herpetology. He is currently working on a major study of the tidewater goby for the California Department of Transportation.

SUSAN E. TOWNSEND, PH.D.
SENIOR ASSOCIATE CONSERVATION BIOLOGIST

EDUCATION

- Ph.D. Environmental, Population and Organismic Biology, University of Colorado, Boulder, CO. 1996
- B.A. Sarah Lawrence College, Bronxville, NY. 1985

AREA OF EXPERTISE

Population ecology, mammalogy, predator ecology, wildlife/habitat relationships, conservation biology, threatened and endangered species and environmental regulations (CEQA, NEPA, FESA, CESA)

PROFESSIONAL EXPERIENCE

- Live Oak Associates, Inc., San Jose, CA. Wildlife Ecologist. 2000 to Present.
- Consulting Biologist 1996 to Present.
- Jan Ross Island, Antarctic. Ecologist. 1997 to 1998.
- Rocky Mountain Wolf Sanctuary, Central City, CO. Director of Research. 1991 to 1995.
- Marine Biological Laboratories, Woods Hole, MA. Research Assistant. 1988 to 1989.

QUALIFICATIONS

Dr. Townsend is a wildlife ecologist whose training and experience has focused on conducting surveys for special status wildlife, writing biological assessments, evaluating environmental impact reports and coordinating projects. Her area of expertise include the following:

- **Special status Species Surveys.** Dr. Townsend has several years of experience conducting San Joaquin kit fox (*Vulpes macrotis mutica*) surveys using spotlighting, camera and track stations as detection tools. She conducted surveys in Hollister, Dublin, Livermore, and at the Lemoore Naval Air Station. She completed a geographical range assessment for the San Joaquin kit fox in the north part of its range as well as assisting Dr. Jennings with projects concerning the California red-legged frog in Santa Clara County. Her research experience includes an ecology study on Adelie penguins in the Antarctic, a behavioral study on wolves (*Canis lupus* ssp.) in Colorado and a chemosensory behavior study of hermit crabs at the Marine Biological Laboratories in Woods Hole, Massachusetts. She has assisted on a project involving hyenas at a captive facility at the University of Berkeley, studied squirrels in montane habitat in Colorado and American kestrels in foothill habitats of Colorado.
- **Preparation of CEQA/NEPA Documents.** Dr. Townsend has designed mitigation measures and biological monitoring plans. She has reviewed and assisted in completing biological sections of NEPA and CEQA documents. She has experience working with various government agencies including the California Department of Fish and Game and U. S. Fish and Wildlife Service.

PUBLICATIONS

Townsend, S. E. 1997. The Role of and Audience in Marking and Caching in Captive Wolves, *Canis lupus lycaon* and *Canis lupus baileyi* in *Advances in Ethology* 32. (eds. M. Taborsky and B. Taborsky) Blackwell Wissenschafts-Verlag, Berlin, Vienna.

M. Bekoff, S. E. Towsend and D. Jamison. 1994. Beyond Monkey Minds: Toward a Richer Cognitive Ethology. Behavorial and Brain Sciences. 17:571-584.

Bekoff, M., L. Gruen, S. E. Townsend, and B. E. Rollin. 1992. Animals in Science: Some Areas Revisited. Animal *Behavior* 44: 473-484.

COLLEEN M. LENIHAN, PH.D. (CANDIDATE)
WILDLIFE ECOLOGIST

EDUCATION

- M.A. Ecology, University of California, Davis, Davis, CA 1995
- B.S. Zoology, Oregon State University, Eugene, OR 1985

AREAS OF EXPERTISE

Wildlife ecology, raptor biology, mammalogy, conservation biology, radio telemetry, remote cameras, GIS, wildlife survey techniques.

PROFESSIONAL EXPERIENCE

- Live Oak Associates, Inc. San Jose, CA. Associate Ecologist. 2000 to Present.
- Consulting Ecologist. 1995 to Present.
- Rocky Mountain Biological Laboratory, U.C. Davis Ecology Group, Davis, CA. Master Thesis Work 1991 to 1995.
- Santa Fe National Forest Hawk Watch International, Santa Fe, AZ. Biological Technician. 1989.
- Steven W. Carruthers & Associates, AZ. Research Assistant. 1989.
- BioSystems Analysis, AZ. Research Assistant. 1989.
- Los Medanos Cooperative Raptor Research Program, CA. Research Assistant. 1988.
- Western Foundation for Raptor Conservation. CA. Research Assistant. 1987.
- Santa Cruz Predatory Bird Research Group, CA. Research Assistant. 1986 to 1988.

QUALIFICATIONS

Ms. Lenihan is an experienced wildlife biologist with extensive skills in the observation, handling and collection of behavioral data for various avian and mammal species. Her area of expertise includes trapping, banding, marking, and taking biological measurements of these vertebrate species. She has conducted foraging studies of the bald eagle (*Haliaeetus leucocephalus*) in central Arizona, as well as surveys in the Santa Fe National Forest for spotted owls (*Strix occidentalis lucida*), and surveys for peregrine falcon (*Falcon peregrinus*) along the rim of the Grand Canyon in Grand Canyon National Park. As a research assistant, Ms. Lenihan has studied Harris' hawks (*Parabuteo unicinctus*) and co-authored and collected data for the Alameda County Birds of Prey Research report, in which a 150 square mile area was surveyed and all raptors within monitored. In addition, she conducted a habitat survey along the lower Colorado Rivers and reintroduced 65 Harris' hawks into the area.

Ms. Lenihan assisted Dr. F. Lynne Carpenter on her study of rufus hummingbird (*Selasphorus rufus*) energetics and Dr. Andrew R. Blaustein on his kin selection studies with *Rana cascadae* tadpoles. As part of the U.C. Davis Ecology Group, Ms. Lenihan conducted her master's thesis research on "Costs and Benefits of Sociality in Yellow-bellied Marmots" at the Rocky Mountain Biological Laboratory in Colorado. She has assisted the U.S. Army Corps of Engineers with monitoring Swainson's hawks (*Buteo swainsoni*) and has taught wildlife ecology, field ecology, and mammalogy at U.C. Davis. She is currently working as an Associate Ecologist for Live Oak Associates, Inc. where she conducts special status wildlife surveys throughout the state.

PUBLICATIONS

Lenihan, C. and D. Van Vuren. 1996. Costs and Benefits of Sociality in Yellow-bellied Marmots: Do non-colonial Females have lower fitness? Ecology, Ethology, and Evolution 2:177-189.

Lenihan, C. and D. Van Vuren. 1996. Growth and Survival of Juvenile Yellow-bellied Marmots. Canadian Journal of Zoology, 74:297-302.

Spear, L.B., S.B. Terrill, C. M. Lenihan, and P. Delevoryas. 1999. Detection of Black Rails in Relations to Environmental Factors at Suisun Bay, California. J Field Ornith. 70: 465-480.

NATHAN HALE
STAFF ECOLOGIST

EDUCATION

- M.S. (Candidate), Environmental Studies, San Jose State University, San Jose, CA. Present
- B.A. Environmental Studies, with Highest Honors, University of California Santa Cruz, CA. 2005.

AREAS OF EXPERTISE

Natural history of avian species, restoration ecology, invasive plant species management, environmental interpretation, community-based conservation

PROFESSIONAL EXPERIENCE

- Live Oak Associates, Inc., San Jose, CA. Staff Ecologist/Field Assistant. 2006-Present.
- Red Panda Project, Santa Clara County, CA. Communications Intern. Present.
- Santa Clara Valley Audubon Society, Cupertino, CA. Conservation Intern. 2004-2006.
- Earthwatch International, Costa Rica, Field Assistant, Tropical Montane Forest Restoration, 2005.
- Santa Clara Valley Audubon Society, Cupertino, CA. Associate Editor, Creekside News 2004.
- University of California Santa Cruz, Research Assistant, Invasive Plant Species 2004.
- University of California Santa Cruz, Research Assistant, Fish Bycatch Policy 2004.

PROFESSIONAL TRAINING

- Natural History of California Field Study, University of California, Santa Cruz, 2004.

MEMBERSHIP IN PROFESSIONAL ORGANIZATIONS

- Society for Conservation Biology
- National Audubon Society
- Orion Society

QUALIFICATIONS

Nathan Hale has experience and knowledge in the areas of natural history, general ecology and environmental writing. He has applied this knowledge in research projects including a tropical montane forest restoration project in southern Costa Rica, several vegetation research and management projects on Santa Cruz Island, CA, and the creation of conservation and natural history publications for several non-profit conservation organizations. He has also conducted burrowing owl, loggerhead shrike, California horned lark, and general raptor surveys as well as blunt-nosed leopard lizard surveys, wetland delineations, and vegetation sampling for Live Oak Associates, Inc. Furthermore, Nathan has a working knowledge of CEQA and NEPA documentation. He is currently working toward a graduate degree focused on the study area of restoration ecology.