ATTACHMENT III:

STATUS AND LIFE HISTORY OF THE SAN FRANCISCO BAY LISTED SPECIES

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1: ALAMEDA WHIPSNAKE

1.1 Species Listing Status

The Alameda whipsnake (*Masticophis lateralis euryxanthus*) was listed as threatened on December 5, 1997 (62 FR 64306) by the U.S. Fish and Wildlife Service (USFWS) (USFWS, 1997 and Westphal, 1998). A recovery plan for the chaparral and scrub community species east of San Francisco Bay, California was approved by the USFWS on March 20, 2003 (USFWS, 2003 and 2005). Critical habitat was designated for this subspecies on October 2, 2006 (USFWS, 2005 and 2006).

1.2 Description

The Alameda whipsnake is one of two subspecies of the California whipsnake (*Masticophis lateralis*) (USFWS, 2003 and 2005). The other subspecies, which is more common, is the chaparral whipsnake (*Masticophis lateralis lateralis*) (USFWS, 2005). The Alameda whipsnake was described in 1954 from a total of six specimens collected in the vicinity of Berkeley, Alameda County, and near Somersville, Contra Costa County, and from Mount Diablo, Contra Costa County, California (USFWS, 1997).

The Alameda whipsnake, also known as the 'Alameda striped racer', is a member of the family Colubridae which includes most of the species of snakes found in the western United States. It is a slender, fast-moving, diurnally active snake with a slender neck, broad head and large eyes (USFWS, 1997, 2003, 2005, and 2006). Adult whipsnakes obtain lengths of 3 to 4 feet (91 to 122 centimeters). Their dorsal side is colored "sooty" black or dark brown with a distinguishing yellow-orange stripe down each side. Their ventral side is comprised of an amber brown-colored frontal section, a cream-colored midsection, and a pinkish rear and tail section (USFWS, 1997 and 2005).

1.3 Distribution and Status

Historical Range

The historical range of the Alameda Whipsnake is difficult to determine due to limited collection data. Six specimens were identified when the Alameda whipsnake was first described in 1954. Up until 1970, the total number of observations and specimens of the Alameda whipsnake amounted to 14, and two of these specimens were later identified as chaparral whipsnake (USFWS, 2003). These limited collections and observations suggest that the historical distribution extended through Berkeley Hills and around Mt. Diablo (USFWS, 2003). However, the Alameda whipsnake likely inhabited suitable chaparral and scrub habitats within Alameda, Contra Costa, and possibly western San Joaquin and northern Santa Clara Counties (USFWS, 2003 and 2005).

Current Distribution

The Alameda whipsnake inhabits the Inner Coast Ranges in western and central Contra Costa and Alameda counties, with occurrences additionally recorded in San Joaquin and Santa Clara counties (USFWS, 1997, 2005, and 2006). The current distribution of the subspecies has been reduced to five separated ranges, all occurring on private or public, non-Federal, land, with little or no interchange due to habitat loss, alteration, and fragmentation:

1. Sobrante Ridge, Tilden/Wildcat Regional Parks area to the Briones Hills, in Contra Costa County (Tilden-Briones population)
2. Oakland Hills, Anthony Chabot area to Las Trampas Ridge, in Contra Costa County (Oakland-Las Trampas population)
3. Hayward Hills, Palomares area to Pleasanton Ridge, in Alameda County (Hayward-Pleasanton Ridge population)
4. Mount Diablo vicinity and the Black Hills, in Contra Costa County (Mount Diablo-Black Hills population)
5. Wauhab Ridge, Del Valle area to the Cedar Mountain Ridge, in Alameda County (Sunol-Cedar Mountain population) (USFWS, 1997 and 2005).

The potential for gene flow between these five disjointed populations is limited to only two or perhaps three habitat-connecting corridors. A northern corridor connects the Tilden-Briones and the Oakland-Las Trampas populations, and a southern corridor links Hayward-Pleasanton Ridge and Sunol-Cedar Mountain populations. The remaining natural habitat between the populations provides land for movement, but whether the Alameda whipsnake can utilize these areas to promote gene flow remains unknown. For instance, the Oakland-Las Trampas population and the Hayward-Pleasanton Ridge population are divided by Interstate 580, and it has not yet been determined whether whipsnakes can move between these populations by traveling underneath the raised portions of the road (USFWS, 2003). Therefore, there may be some subpopulations within each population that are geographically and genetically isolated, and others that may contribute to gene flow within each population (USFWS, 2003).

1.4 USFWS Critical Habitat

Approximately 154,834 acres (ac) (62,659 hectares (ha)) of critical habitat in the counties of Alameda, Contra Costa, Santa Clara, and San Joaquin was designated for the Alameda whipsnake on October 2, 2006 (USFWS, 2005 and 2006). Critical habitat is defined in the Endangered Species Act (ESA) as specific areas within the geographic area that are occupied by a species at the time of its listing, containing physical and biological features necessary for the species' conservation, and that may require special management to protect the listed species (USFWS, 2006). Critical habitat is not limited to the geographic area and may include defined areas outside the geographic area if they are determined to be essential for the conservation of the species (USFWS, 2006). The designation of critical habitat is based on habitat areas that provide essential life-cycle needs of the species or areas that contain primary constituent elements (PCEs). The PCEs for the Alameda whipsnake include:

1) Scrub/shrub communities with a mosaic of open and closed canopy: "Scrub/shrub vegetation dominated by low- to medium-stature woody shrubs with a mosaic of open and closed canopy, as characterized by the chamise, chamise-eastwood manzanita, chaparral whitethorn, and interior live oak shrub vegetation series occurring at elevations from sea level to approximately 3,850 feet (1,170 meters)" (USFWS, 2006).

2) Woodland or annual grassland plant communities contiguous to lands containing PCE 1: "Woodland or annual grassland vegetation series comprised of one or more of the following: Blue oak, coast live oak, California bay, California buckeye, and California annual grassland vegetation series" (USFWS, 2006).

3) Lands containing rock outcrops, rock debris piles (talus), and small mammal burrows within or adjacent to PCE 1 and/or PCE 2: "These areas are used for retreats (shelter), hibernacula, foraging, and dispersal, and provide additional prey population support functions" (USFWS, 2006).

Six units of critical habitat comprising 154,834 ac (62,659 ha) were designated for the Alameda whipsnake (Table 1.1) (USFWS, 2006).

Table 1.1: Critical habitat units for Alameda whipsnake[1] by land ownership (excerpted from USFWS, 2006)

Unit	Federal		State		Local		Private		Total	
	ac	ha	ac	ha	ac	ha	ac	ha	ac	ha
1	--	--	15	6	8,108	3,281	25,997	10,520	34,119	13,808
2	--	--	--	--	4,386	1,775	20,050	8,114	24,436	9,889
3	--	--	--	--	404	163	25,562	10,345	25,966	10,508
4	23	9	13,855	5,607	--	--	9,348	3,783	23,225	9,399
5A	2,492	1,008	--	--	246	99	21,986	8,897	24,723	10,005
5B	--	--	--	--	361	146	17,854	7,225	18,214	7,371
6	--	--	720	291	265	107	3,166	1,281	4,151	1,680
Total	2,515	1,018	14,590	5,904	13,768	5,572	123,962	50,166	154,834	62,659

[1]Area [acre / hectare (ac / ha)] estimates reflect all land within critical habitat unit boundaries

Unit 1: Tilden-Briones; Alameda and Contra Costa Counties
This unit is bordered approximately by State Highway 4 and the cities of Pinole, Hercules, and Martinez to the north; by State Highway 24 and the City of Orinda Village to the south; Interstate 80 and the cities of Berkeley, El Cerrito, and Richmond, to the west; and Interstate 680 and the City of Pleasant Hill to the east. The South end of Unit 1 abuts Unit 6. Land ownership within the unit includes approximately 8,108 ac (3,281 ha) of land owned by the East Bay Regional Park District (EBRPD), 15 acres (6 ha) owned by the State, and 25,997 ac (10, 520 ha) of land owned privately (USFWS, 2006).

This unit is designated as critical habitat because it contains features essential to the conservation of the Alameda whipsnake, is occupied currently, and represents the northwestern portion of the subspecies' range as well as representing one of five population centers (USFWS, 2006). Unit 1 "contains a complex mosaic of grassland with woody scrub vegetation of several types (PCE 1, PCE 2), as well as rock outcrops or other talus features (PCE 3) distributed throughout the unit with little habitat fragmentation" (USFWS, 2006). Alameda whipsnake occurrence has been documented uniformly throughout the unit, spanning a time period from before the species' listing to after in 1986 (USFWS, 2006). In addition, this unit has been subjected to very little development (USFWS, 2006).

<u>Unit 2: Oakland-Las Trampas; Contra Costa and Alameda Counties</u>
Unit 2 is located south of State Route 24, north of Interstate 580, east of State Route 13, and west of Interstate 680 and the cities of Danville, San Ramon, and Dublin. The North edge of Unit 2 abuts Unit 6. Land ownership includes 4,386 ac (1,775 ha) of EBRPD and East Bay Municipal Utilities District lands and 20,050 ac (8,114 ha) of land under private ownership (USFWS, 2006).

Unit 2 is designated as critical habitat because it contains features essential to the conservation of the Alameda whipsnake, is occupied currently by the subspecies, and represents the central distribution of the Alameda whipsnake as well as representing one of five population centers (USFWS, 2006). This unit "contains a range of vegetation (PCE 1, PCE 2), soil types, and rocky features (PCE 3) essential to the conservation of the subspecies, supports viable Alameda whipsnake populations, and has minimal development such as roads and structures" (USFWS, 2006). Areas not included in the critical habitat were those with development or reduced soil and vegetation characteristics (USFWS, 2006). Multiple records have documented the Alameda whipsnake uniformly distributed within the unit as well as adjacent to the unit, and dispersal of snakes between Units 2 and 1 is possible by way of Unit 6 (USFWS, 2006). Impediments to such movement do not appear to be present (USFWS, 2006).

<u>Unit 3: Hayward-Pleasanton Ridge; Alameda County</u>
Unit 3 is located immediately to the west of Interstate 680 and to the south of Interstate 580. Land ownership includes 404 ac (163 ha) of EBRPD land and 25,562 ac (10,345 ha) of privately owned land (USFWS, 2006). The Stonebrae Country Club project site was not included in the critical habitat for this unit (USFWS, 2006).

This unit is designated as critical habitat because it contains features essential to the conservation of the Alameda whipsnake, is occupied currently by the subspecies, and represents the southwestern portion of the subspecies' range as well as representing one of the five population centers (USFWS, 2006). "Unit 3 contains the mosaic of scrub and chaparral vegetation and rocky outcrops (PCE 1, PCE 3) considered essential to the conservation of the subspecies. The unit also includes variation in the vegetation patch size, an abundant edge between grassland and woodland, and a minimal amount of development or planned development" (USFWS, 2006). The records of Alameda whipsnake occurrence have been associated with areas containing Gaviota rocky sandy loam, likely providing talus, and appear to coincide in aerial imagery to the species' preferred scrub or chaparral vegetation (USFWS, 2006). Unit three is largely comprised of oak woodland communities of variable densities and statures (trees, shrubs), interspersed with grassland. Peripheral portions of habitat surrounding the unit were not included as critical habitat due to the high degree of development-related disturbance and fragmentation of the habitat (USFWS, 2006).

Unit 4: Mount Diablo-Black Hills; Contra Costa and Alameda Counties

This unit encompasses Mount Diablo State Park and surrounding lands, which lies largely within Contra Costa County except for a small portion within Alameda County. Lands are owned by the Bureau of Land Management (23 ac (9 ha)), State Department of Parks and Recreation (13,855 ac (5,607 ha)), and private landowners (9,348 ac (3,783 ha)) (USFWS, 2006). EBRPD lands and lands covered by the draft East Contra Costa County Habitat Conservation Plan and Natural Community Conservation Plan were not included from the critical habitat in this unit (USFWS, 2006).

Unit 4 is designated as critical habitat for this subspecies because it contains features essential to the conservation of the Alameda whipsnake, is occupied currently by the subspecies, and represents the northeastern portion of the subspecies' range as well as representing one of the five populations centers (USFWS, 2006). From 1972 to 2004, more than 90 observations of Alameda whipsnake have been documented throughout the unit, many of which are associated with dense rock outcrops (PCE 3) and chaparral, scrub, and oak woodland (PCE 1, PCE 2). "The pattern of woody vegetation with grasslands and rock outcrops forms an intricate landscape mosaic that is highly functional habitat for the Alameda whipsnake" (USFWS, 2006). Unit 4 likely provides some of the very highest quality and largest contiguous blocks of habitat within the range of the subspecies, indicated by the vegetation and soil characteristics, the mosaic habitat pattern, the abundance of Alameda whipsnake records, and the lack of surrounding development and relative absence of roadways. The unit also likely supports one of the species' most robust populations (USFWS, 2006).

Unit 5A: Cedar Mountain; Alameda and San Joaquin Counties

Unit 5A is located east of Lake Del Valle along Cedar Mountain Ridge and Crane Ridge to Corral Hollow west of Interstate 580. Land ownership within this unit includes approximately 2,492 ac (1,008 ha) of Department of Energy land, 246 ac (99 ha) of EBRPD land, and 21,986 ac (8,897 ha)) of private land (USFWS, 2006).

Unit 5A is designated as critical habitat because it contains features essential to the conservation of the Alameda whipsnake, is occupied currently by the subspecies, and represents the southernmost and easternmost distribution of Alameda whipsnake as well as representing one of the subspecies' five populations centers (USFWS, 2006). "The vegetation pattern within this unit consists of various woodland, scrub, and/or chaparral communities on northeast-facing slopes (PCE 1, PCE 2). Rock bearing soils are abundant, which are associated with multiple Alameda whipsnake records (e.g., Vallecitos rocky loam) and rock lands, indicated presence of PCE 3. While open, grassland-dominated communities are prominent on southwest-facing slopes, there is also a significant component of woodland habitat on these slopes, vegetation types known to support the Alameda whipsnake. These significant areas include coastal oak, chamise-chaparral, mixed chaparral, blue-oak-foothill pine woodland, blue oak woodland, valley oak woodland, and montane hardwood. About 50 Alameda whipsnake records from 1973 through 2002 are known in this unit. Very few structures or other land modifications are present in the unit, with a moderate number of light duty roads (e.g., paved or unpaved lightly used) (USFWS, 2006).

Unit 5B: Alameda Creek; Alameda and Santa Clara Counties
This unit is located northeast of Calaveras Reservoir and south of the town of Sunol, including the areas along Wauhab Ridge in Alameda County and Oak Ridge in Santa Clara County. Alameda Creek is located at the west margin of the unit, with the unit containing the Sunol Regional Wilderness and Camp Ohlone Regional Park (approximately 361 ac (146 ha)). Both the Wilderness and Park are managed by the EBRPD, and the remaining 17,854 ac (7,225 ha) of land are in private ownership (USFWS, 2006).

Unit 5B is designated as critical habitat because it contains features essential to the conservation of the Alameda whipsnake, is occupied currently by the subspecies, and represents the southern most distribution of Alameda whipsnake as well as representing one of the subspecies' five population centers (USFWS, 2006). The vegetation in this unit "is a mix of blue oak—foothill pine and annual grassland with a significant amount of woodland patches. Coastal live oak is present in the vicinity of Lleyden Creek" (USFWS, 2006). Soil types in which Alameda whipsnakes are found dominate the unit, including coastal oak, chamise-chaparral, mixed chaparral, blue oak—foothill pine woodland, blue oak woodland, valley oak woodland, and montane hardwood interspersed with rock outcrops or talus (PCEs 1, 2, 3). This subunit contains six Alameda whipsnake records documented between 1972 and 2000. Very few structures or other land modifications are present in the unit, with a moderate number of light duty roads (e.g., paved or unpaved lightly used) (USFWS, 2006). Due to low development pressure from within or adjacent to the unit, the survey efforts for the Alameda whipsnake in unit 5B have not been as extensive as in the other units (USFWS, 2006).

Unit 6: Caldecott Tunnel; Contra Costa and Alameda Counties
Unit 6 lies between Units 1 and 2, along the Alameda and Contra Costa County lines. Land ownership within this unit includes 265 ac (107 ha) of EBRPD land, 720 ac (291 ha) of State land, and 3,166 ha (1,281 ha) of private lands (USFWS, 2006).

Unit 6 is designated as critical habitat because it contains features essential to the conservation of the Alameda whipsnake, is occupied currently, and represents the last remaining habitat connecting Unit 1 and Unit 2, which are two of the five population centers for the subspecies. Maintaining connectivity between the units allows for dispersal and genetic exchange among all three units (USFWS, 2006). This "unit is bounded by dense urban development to the east and west. However, the vegetation and soil types that are known to support Alameda whipsnake are dominant throughout the unit (PCEs 1, 2, 3)" (USFWS, 2006). About eight Alameda whipsnake records are known from the unit between 1990 and 2002 (USFWS, 2006).

1.5 Habitat

Alameda whipsnakes have been documented in several types of scrub and chaparral communities, including coastal sage scrub, chaparral, and northern coastal scrub. Telemetry data for six snakes indicated that home ranges of Alameda whipsnakes were centered on shrub communities, but that snakes ventured into adjacent habitats, including grassland, oak savanna, and oak-bay woodland. Radio locations of telemetered snakes were clustered in areas of scrub with an open or partially open canopy, and on south-, southwest-, southeast-, east-, and northeast-facing slopes. Most radio locations for five snakes at a study site in Tilden Regional Park, Berkeley, California, were within the distribution of major rock outcroppings and talus. The study also found Alameda whipsnakes frequently in adjacent grasslands and oak woodland/savanna habitats. Most grassland and woodland locations were within 50 meters (170 feet) of the scrub habitat, but distances of greater than 150 meters (500 feet) from scrub were also documented during the telemetry study. The distance that whipsnakes will move into open grassland is unknown; however, California whipsnakes have been observed in grassland, oak savanna, and along the edge of riparian vegetation at distances greater than 300 meters (1,000 feet) from scrub habitats, usually in areas where rock outcrops are abundant (USFWS, 2003). The majority of grassland use was documented during spring. The most common types of retreat site in both the grassland and scrub communities were small rodent burrows and rock crevices; however, brush piles, deep soil crevices and debris piles were also used (USFWS, 2003).

1.6 Diet

Lizards, especially the western fence lizard (*Sceloporus occidentalis*), appear to be the most important prey item of whipsnakes, although other prey items include skinks, frogs, snakes and birds (USFWS, 2005). Stomach contents of field-captured whipsnakes were exclusively lizards, including western fence lizard and western skink (*Eumeces skiltonianus*). Furthermore, prey preference tests with both adult and hatchling Alameda whipsnakes have shown a preference for lizard prey suggesting that this species is a feeding specialist (USFWS, 2003). However, other sources state that the diet of the Alameda whipsnake also includes invertebrates and small mammals (USFWS, 1997 and Westphal, 1998), and may depend on an individual’s size, sex, age, and location (USFWS, 2006).

1.7 Life History and Reproduction

Adults are characterized by having a bimodal seasonal activity pattern with a peak during the spring mating season and a smaller peak during late summer and early fall. Alameda whipsnakes generally enter into a hibernaculum (shelter used during the dormancy period) during the months of November to March, although some above-ground movements may occur during this time. Hibernaculum sites include rodent burrows and crevices between rocks (USFWS, 2003, 2005, and 2006).

Sperm is stored by the male over winter, and copulation commences soon after emergence from winter hibernacula (USFWS, 2003). Courtship and mating have been observed from late March through mid-June. During this time males move around throughout their home ranges, but females appear to remain at or near their hibernacula, where mating occurs (USFWS, 1997, 2003, 2005, and 2006). One female was observed copulating with more than one male during a mating season, but the extent to which females mate with multiple males (polyandry) is unknown (USFWS, 2003). Females begin yolk deposition in mid-April, and intervals of 47, 50, and 55 days have been recorded between dates of first known mating and first egg laid. Average clutch size is 7.21 (6-11, n=19), with a significant correlation between body size and clutch size (USFWS, 2003). The eggs are laid May through July (USFWS, 1997), and young whipsnakes appear after 3 months of incubation in the late summer and fall (USFWS, 2003). California whipsnakes take 2 to 3 years to reach maturity, with adults growing to nearly 1.5 meter (5 feet). Captive whipsnakes may live for about 8 years (USFWS, 2003).

1.8 References

U.S. Fish and Wildlife Service (USFWS). 1997. Endangered and Threatened Wildlife and Plants; Determination of Endangered Status for the Callippe Silverspot Butterfly and the Behren's Silverspot Butterfly and Threatened Status for the Alameda Whipsnake. Available online at: http://ecos.fws.gov/docs/federal_register/fr3183.pdf (Accessed on April 17, 2008).

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2: BAY CHECKERSPOT BUTTERFLY

2.1 Species Listing Status

The Bay Checkerspot Butterfly [BCB] (*Euphydryas editha bayensis*) was listed as threatened on September 18, 1987 (52 FR 35366) by the U.S. Fish and Wildlife Service (USFWS). Critical habitat for the BCB was designated by USFWS on April 30, 2001 (66 FR 21449-21489) and revised designated critical habitat was proposed in 2007 (72 FR 48177-48218). A recovery plan for the BCB was approved by the USFWS on August 30, 1998 (USFWS, 1998). A 5-year review, which provides an updated life history for the BCB, was initiated by the USFWS in March of 2008 (73 FR 11945-11950).

2.2 Description

The adult BCB is a medium-sized butterfly in the brush-footed butterfly family (Nymphalidae) with a wingspan of about 2 inches (5 cm) (USFWS 1998). The Bay Checkerspot Butterfly is considered an obligate with its primary larval host plant, the dwarf plantain (*Plantago erecta*).

2.3 Distribution

All areas currently inhabited by the BCB are island-like patches of suitable habitat separated by areas of unsuitable habitat and urban development (USFWS 1998). The BCB uses three different types of habitat: 1) primary habitat – native grasslands on large serpentine outcrops; 2) secondary habitat – 'islands' of smaller serpentine outcrops with native grassland; and 3) tertiary habitat – non-serpentine areas where larval food plants occur (all known tertiary habitat are in areas mapped geologically as Franciscan formation). The total area of suitable serpentine habitat in the entire historic range of the BCB does not exceed 5,000 ha (USFWS 1998).

The historic range of the BCB included the area around the San Francisco Bay from Twin Peaks and San Bruno Mountain (west of the Bay) and Contra Costa County (east of the Bay) south through Santa Clara County.

BCB populations have gone extinct in "… Contra Costa County (Franklin Canyon and Morgan Territory areas), Alameda County (Oakland Hills), San Francisco County (Twin Peaks and Mount Davidson), and San Bruno Mountain, Buri Buri Ridge (Hillsborough), Pulgas Ridge (sometimes referred to as 'San Mateo'), and Redwood City (part of the site historically referred to as Woodside) in San Mateo County" (USFWS 1998, p. II-175 and II- 177). The distribution of known BCB populations is currently limited to Santa Clara and San Mateo Counties (66 FR 21449-21489). Because the BCB distribution is considered a metapopulation (a group of spatially distinct populations that can occasionally exchange dispersing individuals), individual populations may go 'extinct' and later be 'recolonized' from another extant population. Therefore, the exact distribution of the BCB varies through time, and "…any site with appropriate habitat in the vicinity of the historic range of the bay checkerspot should be considered potentially occupied by the butterfly" (USFWS 1998, p. II-177).

2.4 USFWS Critical Habitat

Critical habitat for the BCB was designated by USFWS on April 30, 2001 (66 FR 21449-21489). A revised critical habitat ruling became effective on September 25, 2008 (73 FR 50405-50452), with 18,293 acres (7,403 hectares) of critical habitat designated for the BCB (73 FR 50405-50452).

2.5 Habitat

All BCB habitat includes shallow, serpentine-derived (or similar)) soils that support larval food plants and adult nectar sources (USFWS 1998). The primary larval host plant for the BCB is the dwarf plantain (*Plantago erecta*). In many drier years, BCB larvae also rely on secondary host plant species [primarily purple owl's-clover (*Castilleja densiflora*) or exserted paintbrush (*Castilleja exserta*)] that are used when the plantain dries up while the larvae are still feeding. Adults most commonly feed on the nectar of desertparsley (*Lomatium* spp.), California goldfields (*Lasthenia californica*) and tidy-tips (*Layia platyglossa*) (USFWS 1998).

Topography can also influence habitat quality for BCB. South-facing slopes are warmer and drier than north-facing slopes, which can affect the timing of the development of the butterfly and its host plants. Larvae on south-facing slopes develop faster and emerge (a month or more) earlier than larvae on north-facing slopes and host plants on warmer slopes flower and senesce three to four weeks before those on cooler slopes. Either south- and north-facing slopes are beneficial in different years, depending on the weather conditions. Therefore, a serpentine habitat area having a range of slopes and exposures can reduce the chances of population-wide reproductive failure in years with extreme weather (USFWS 1998).

'Pre-diapause' larvae (see below) have only limited mobility, while 'post-diapause' larvae may travel tens of meters in search of feeding, basking, and/or pupating sites. Adult BCBs are considered largely sedentary, however, a small fraction of a population may disperse up to 7.6 km from their natal site (USFWS 1998).

2.6 Diet

The primary diet for the BCB larvae are dwarf plantain plants (although they may also feed on purple owl's-clover or exserted paintbrush if the dwarf plantains senesce before the larvae pupate). Adults feed on the nectar of a variety of plants found in association with serpentine grasslands [*e.g.*, California goldfields, tidy-tips, desertparsley, scytheleaf (*Allium falcifolium*), sea muilla (*muilla maritime*), false babystars (*Linanthus androsaceus*), and intermediate fiddleneck (*Amsinckia intermedia*)] (USFWS 1998).

2.7 Life History and Reproduction

The BCB's life cycle is closely tied with the biology of its host plants. "Host plants germinate anytime from early October to late December, and senesce from early April to mid May. Most of the active parts of the bay checkerspot life cycle also occur during this time" (USFWS 1998, p. II-183). The BCB reproduces once and dies within a single year. Adults emerge from pupae, feed on nectar, mate and lay eggs during a flight season that lasts 4 to 6 weeks from late February to early May. Males emerge up to 10 days prior to the emergence of females and may mate several times before dying. Females normally (although not always) only mate once. Adults of both sexes live on average for 10 days (with a maximum adult life span of over 3 weeks reported) (USFWS 1989). Females lay up to 5 egg masses (250 eggs/mass) typically in March and April. Eggs are deposited primarily near the base of dwarf plantain plants, and less commonly on purple owl's-clover and exserted paintbrush.

Larvae hatch from eggs in roughly 10 days and grow to the 4th instar in about two weeks. Once reaching the 4th instar, the larvae enter into a period of dormancy (diapause) that lasts through the summer. The larvae spend this time under rocks or in soil cracks (USFWS 1998). If larvae do not enter into dormancy before the dwarf plantain plants senesce, they may successfully reach diapause by switching to a nearby purple owl's-clover or exserted paintbrush as a food source.

The larvae resume activity with the start of the rainy season and the germination of dwarf plantain plants. The post-diapause larvae are more mobile than the pre-diapause larvae and may travel tens of meters in search of food and/or warm microclimates to bask or pupate in (USFWS 1998). Larvae pupate, with the pupae suspended few meters above the ground on vegetation, once they reach a weight of 300 - 500 milligrams. Adults emerge within 15 to 30 days depending on thermal conditions, although there is some evidence that a few larvae in very dry years may enter into a second diapause and complete their development the second spring after hatching (USFWS 1998) (see **Fig. 2.2**).

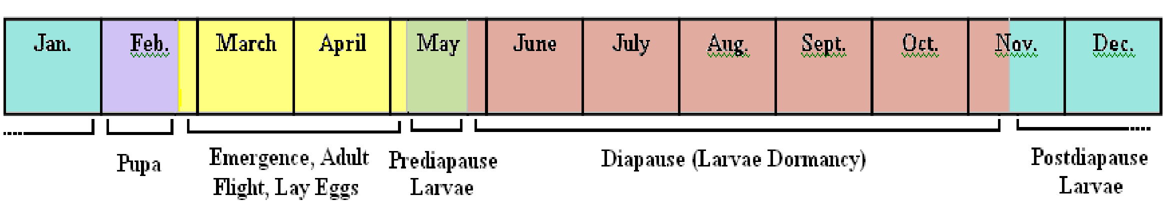

FIGURE 2.2: General Annual Life-History Parameters for the BCB (this is a generalized schematic; the timing of the life-history parameters for the BCB are influenced by climatic and microclimatic factors)**.**

2.8 References

Federal Register 52:35366; September 18, 1987.
http://ecos.fws.gov/docs/federal_register/fr1327.pdf

Federal Register 66:21449; April 30, 2001.
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3: CALIFORNIA CLAPPER RAIL

3.1 Species Listing Status

The California clapper rail (CCR) (*Rallus longirostris obsoletus*) was listed with the salt marsh harvest mouse as endangered on October 13, 1970 (35 FR 16047) by the U.S. Fish and Wildlife Service (USFWS). A recovery plan for the CCR and the salt marsh harvest mouse was approved by the USFWS on November 16, 1984 (USFWS, 1984).

3.2 Description

CCRs, also known as marsh clappers or marsh hens, are described as "hen-like" in appearance with a short neck (USFWS, 1984 and 2007; and REFUGEnet). Their bodies are compact and narrow, hence the term "thin as a rail," which allows them to move easily within the marsh (Environmental Impact; and REFUGEnet). They have brownish-gray cheeks, a rust or cinnamon-buff colored breast, and black-and-white bars that criss-cross their flanks (USFWS, 1984 and 2007; Environmental Impact; Goals Project, 2000; and CDFG website). Dark brown streaks mark their olive-brown back and wings and white undertail coverts become visible when they are agitated (USFWS, 1984 and 2007; and Environmental Impact). CCRs are typically darker on their dorsal side compared with their ventral side and their body patterning is effective camouflage in the marsh vegetation (USGS website and Goals Project, 2000). They have strong legs that are bright orange in color and long legs and toes, as well as a long, somewhat orange, slightly downward-curving bill (USFWS, 1984 and 2007; Environmental Impact; and Save the Bay). The base and sides of the bill are "pinkish to bright orange in males" and duller in females (USGS website). The only other difference between male and female CCRs is size, with the males being slightly larger than the females (USFWS, 2007). Juvenile CCRs have a "gray body, black flanks and sides, and indistinct light streaking" on their flanks and undertail coverts (USFWS, 2007). Their bill is paler and plumage darker than adult CCRs (USFWS, 2007).

The CCR is one of the largest rails (USFWS, 1984 and 2007). They measure 32 to 47 cm (13-19 inches) in length from bill to tail and 35 to 40 cm (14-16 inches) in height (USFWS, 1984 and 2007; REFUGEnet; and Invasive Spartina Project). They weigh about 250 to 350 grams and the males are typically about 20% larger than the females (Goals Project, 2000; and USGS website). However, another source reported that the body weight of 19 female CCRs from South San Francisco Bay ranged from 300 to 400 grams, with a mean weight of 346.1 grams (USFWS, 2003). The maximum recorded age for a wild clapper rail was seven and a half years old (USGS website).

The CCR was first described as a king rail in 1874 (USFWS, 1984). In 1880, CCRs were reclassified as clapper rails (*Rallus obsoletus*), because they were found in saltwater marshes and the king rail was found in inland freshwater marshes, but also as a "geographically isolated species distinct from other clapper rails (*Rallus longirostris*)" (USFWS, 1984). All of the Pacific coast clapper rails were combined into one species (*Rallus obsoletus obsoletus*) in 1929 (USFWS, 1984). In 1937, 25 clapper rails were described as subspecies of the same species, and the CCR became *Rallus longirostris obsoletus*. A taxonomic change occurred in 1977 and now the CCR is one of 24 subspecies of the clapper rail (USFWS, 1984).

3.3 Distribution

Historic Range

CCRs were abundant in the tidal marshes of San Francisco Bay and smaller populations were found in coastal tidal salt marshes and brackish marshes throughout central and northern California, from Humbolt Bay in Humbolt County in the north to Morro Bay in San Luis Obispo County in the south (Environmental Impact; Save the Bay; Albertson, 1996; and Goals Project, 2000). The former range of this subspecies also included Elkhorn Slough in Monterey County; however, before 1908 this slough may not have been suitable for CCRs because of its limited tidal access to Monterey Bay (CDFG website and USFWS, 1984). Historically, the largest populations of CCRs were found in the "salt marshes of South San Francisco Bay, including portions of San Mateo, Santa Clara, and Alameda counties" (USFWS, 1984).

Dispersing juvenile CCRs were described in "residential and agricultural areas along the open coast and east of San Francisco Bay" in 1976 and 1979 (USFWS, 1984). In the mid-1980s, CCRs were found in South San Francisco Bay in remnant salt marshes including Bair and Greco Islands in San Mateo County, Dumbarton Point in Alameda County, as well as in Santa Clara County (USFWS, 1984). In San Mateo County, CCRs could be found as far north as San Bruno Point (USFWS, 1984). Remnant populations could also be found "near creek mouths in northern Alameda County, western Contra Costa County, and in eastern Marin County" (USFWS, 1984). Records from Richardson Bay in Marin County indicated that a small CCR breeding population may have existed there (USFWS, 1984). A breeding CCR population could also be found in northern San Pablo Bay "along the Petaluma River as far north as Schultz Creek and along most major tidal sloughs and creeks in Sonoma and Napa counties" (USFWS, 1984). They could also be found "north to Bull Island on the Napa River" (USFWS, 1984). A small breeding population also existed at Southampton Bay in Solano County (USFWS, 1984). At least 25 CCR were found during the 1979 breeding season on Joice and Grizzly Islands in Suisun Marsh (USFWS, 1984). CCRs were also found in 1979 in late April in Martinez in Contra Costa County which may have also indicated breeding in this area (USFWS, 1984).

Current Range

Southern San Francisco Bay Area has historically supported the largest populations of CCRs. Salt marshes of the southern Bay Area included portions of San Mateo, Santa Clara, and Alameda Counties. Smaller populations occurred in San Francisco County and western Contra Costa County. Records indicated populations around Southampton Bay in Solano County, Napa Marsh in western Napa County, next to Petaluma in Sonoma County, and Tomales Bay in Marin County (counties all bordering the Bay). CCRs occurred further south of the San Francisco Bay Area in Monterey County (Elkhorn Slough). Reports from the 1930s and 1940s indicated populations in Humboldt County (Humboldt Bay) and San Luis Obispo County (Morro Bay), respectively (USFWS, 1984).

Currently, known CCR breeding populations are found only in tidal marshes in the San Francisco estuary (USFWS, 2007; Berkeley, 2004; and SFEISP online). The CCR only occurs in coastal wetlands in Alameda, Contra Costa, Marin, Napa, San Francisco, San Mateo, Santa Clara, Solano, and Sonoma counties, which form the San Francisco-Suisun Bay complex (CDPR online). Populations of CCRs can be found in all of the larger tidal marshes in south San Francisco Bay; however, the distribution of CCRs in the north Bay is fragmented (USFWS, 2007). Small populations of CCRs are found throughout San Pablo Bay (USFWS, 2007) and in the Suisun Marsh and surrounding areas (USFWS, 2007).

Suisun Marsh and Carquinez Strait:

CCRs are scattered at several sites throughout Suisun Bay and Marsh indicating that some populations are present in some years but not in other years (Goals Project, 2000). CCRs have been found with some regularity since 1978 in the "shoreline marshes from Martinez east to Point Edith, bayshore marshes near the mouth of Goodyear Slough, the upper portions of Suisun and Hill sloughs, and the western reaches of Cutoff Slough and associated tributaries" (Goals Project, 2000). Records of CCRs in this location in the winter are more abundant than records during the breeding season (Goals Project, 2000). Persistent CCR populations have been found in "Hill Slough in the northern reaches of the Suisun Marsh and in the upper Napa Marsh" both of which are tidally influenced but not salt marsh (Foin et al., 1997). The CCR population at Hill Slough has been observed every year since 1992 (except for 1995) and the population at Napa Marsh was first recorded in 1939 (Foin et al., 1997). Although the CCR habitat is limited at Carquinez Strait, a small CCR population of one to three breeding pairs has persisted at this location (Southampton Marsh) since 1948 (Goals Project, 2000).

North Bay:

CCRs in the North Bay are concentrated "near the mouths of the larger tributaries (e.g. Gallinas Creek, Novato Creek, Petaluma River, Black John Slough, Sonoma Creek, and Napa River)" (Goals Project, 2000). The CCR population at the Napa River was defined as a North Bay population center in 1979 because it supported 40% of the entire population (Goals Project, 2000). Studies performed in the 1990's show that this population is declining but concentrations of CCRs are still found at White Slough and Coon Island (Goals Project, 2000).

Central Bay:

The areas of the Central Bay that support CCRs include Corte Madera and Muzzi marshes, the San Leandro Area (Arrowhead and Elsie Romer marshes), and inner

Richmond Harbor (Goals Project, 2000). Muzzi Marsh is a restored marsh (Goals Project, 2000; Foin et al., 1997). Other sites in the Central Bay include Richardson Bay and Creekside Marsh in Marin County (Goals Project, 2000).

South Bay:
The CCR populations in the South Bay have remained stable on the western side of the Bay; however, the East Bay population (Ideal, Dumbarton, and Mowry marshes) has decreased considerably (Goals Project, 2000). This population seems to be making a recovery with over 330 individuals in 1997-1998 (Goals Project, 2000). This increase was likely due to predator management in this area (Goals Project, 2000). The largest populations of CCRs are currently found in Dumbarton and Mowry marshes in the East Bay, and in Palo Alto and Greco marshes in the West Bay (Goals Project, 2000). CCR populations seem equally divided between the east and west sides of the South Bay (Goals Project, 2000). The marshes in South San Francisco Bay still support the largest number of rails in California (CDPR online).

3.4 USFWS Critical Habitat

No critical habitat has been designated for the CCR (USFWS, 1984).

3.5 Habitat

CCRs require tidal marsh habitat because it provides protection from predators and also contains the types and concentration of invertebrate species on which they feed (Foin et al., 1997). CCRs use second and third order marsh channels to move within the marsh, feed, and also as escape routes to move to higher ground during high tides (Foin et al, 1997). Marshes typically have three zones: a low marsh that receives maximum submergence comprised of cordgrass (*Spartina foliosa*) or tules (*Scirpus* spp.); a middle marsh zone comprised of pickleweed (*Salcornia virginica*), alkali bulrush (*Scirpus robustus*), or cattails (*Typha* spp.); and a high marsh dominated by "peripheral halophytes, which receives infrequent to no tidal coverage" (USFWS, 1984). Salt tolerant plants (halophytes) include gum-plant (*Grindelia* spp.), salt grass (*Distichlis spicata*), jaumea (*Jaumea carnosa*), and alkali heath (*Frankenia grandifolia*) (USFWS, 1984). Within the salt marsh CCRs prefer low marsh habitat (below mean higher-high water) which corresponds with tall marsh vegetation, especially cordgrass (Foin et al, 1997). CCRs prefer emergent wetland areas dominated by dense native cordgrass and pickleweed, as well as brackish areas dominated by these two species in addition to bulrush (Berkeley, 2004; and Harvey, 1999). CCRs also use the ecotone (a transition zone between two ecosystems) between the wetland and the upland areas (Harvey, 1999).

High quality CCR habitat should include "direct tidal circulation sufficient to allow the full tidal cycle; a predominant pickleweed marsh with cordgrass, gumplant, and other high marsh plants; abundant, dense high marsh cover; and an intricate network of tidal sloughs" (Goals Project, 2000). "The wetland border within 15 m (49.2 ft) of open, tidally influenced, salt or brackish water seems optimum for food and nest sites" and "at least 2 hectares (5 acres) of contiguous habitat, of the appropriate plant species, must be present to support a rail population" (Lewis and Garrison, 1983). The two largest areas of contiguous habitat are in the San Francisco Bay National Wildlife Refuge (SFBNWR) and San Pablo Bay (Foin et al, 1997).

CCRs are found year-round in coastal salt and brackish marshes and tidal sloughs in San Francisco and Suisun Bay and are rarely seen in non-tidal (diked) marshes (USFWS, 2007; CDPR website, and Environmental Impact). Some non-tidal marshes have been used by breeding pairs but it is thought that nearby tidal marshes that support other breeding pairs contribute to the use of non-tidal marshes (Goals Project, 2000). CCRs can also be found in the brackish marshes associated with the "major sloughs and rivers of San Pablo Bay and Suisun Marsh, and along Coyote Creek in south San Francisco Bay" (USFWS, 2007).

In the south and central San Francisco Bay areas and along San Pablo Bay, CCRs live in salt marshes dominated by pickleweed (*Salicornia virginica*) and Pacific cordgrass (*Spartina foliosa*), whereas the CCR in the North Bay (Petaluma Marsh, Napa-Sonoma marshes, and Suisun Marsh) can be found in tidal brackish marshes with varying vegetation (Invasive Species Project and USFWS, 2007). Another source states that "along the larger creeks in the South Bay, in some areas of Napa Marsh, Petaluma River, and Sonoma Creek in San Pablo Bay, and in Suisun Bay" the CCR can be found in "brackish wetlands consisting of bulrush" (Goals Project, 2000). Bulrush in these areas is used for building their nests and cover (Goals Project, 2000). In the North Bay, CCR habitat is found in the "saline and marginally brackish tidal marshland with small channels that extend through or into patches of tall monocot vegetation" which is used as nesting material (Goals Project, 2000). The vegetation must be at least 50 cm tall at elevations near Mean High Water to allow the nest to be hidden but still high enough to not become inundated by maximum high tides (Goals Project, 2000). The vegetation used can be shorter if the elevation of the marsh is higher (Goals Project, 2000). CCRs typically use the tallest vegetation available for cover which is usually *S. foliosa* (Foin et al, 1997). CCRs use *Scirpus* "for cover in several brackish marshes, including the Napa River" (Foin et al, 1997).

Pickleweed has become more abundant in Suisun Marsh and will continue to do so as the salinity in this area increases (USFWS, 1984). The salinity in the Suisun and San Pablo marshes has increased because "nearly 50% of the historic median freshwater flow of the Central Valley no longer reaches those bays because of diversions for agricultural, as well as municipal and industrial uses" (USFWS, 1984).

The "most heavily used portions of San Francisco Bay salt marshes are the lower, cordgrass-dominated areas" (USFWS, 1984). Calling pairs and the majority of the nests in 1980 were found in areas of cordgrass in South San Francisco Bay marshes (USFWS, 1984). In addition, in 1972, the highest densities of rails in the summer were found in areas dominated by cordgrass (USFWS, 1984). It is thought that cordgrass may be preferred because it seems to allow CCR nests to float (USFWS, 1984). It also occurs "along tidal sloughs and at the marsh edge, where rails prefer to forage" (Goals Project, 2000). Cordgrass habitat may also be preferred because it is farther from the drier uplands where predation is more likely and it seems to provide better protection for the CCR adults and young because it is denser and more uniform than the vegetation in the upper marsh areas (USFWS, 1984). Rails may be more dependent on upper marsh vegetation in the winter especially during high tides (USFWS, 1984).

Both low and high marsh areas must be available to sustain a successful CCR population (Albertson, 1996). CCRs forage in shallow water, mudflats, and small tidal sloughs within the marsh during low tide (USFWS, 1984 and Harvey, 1999). Clapper rails are not expected to forage in mudflats that are more than 15 m (49.2 ft) from vegetative cover (Lewis and Garrison, 1983). Optimal habitat is defined as having at least 50% of the shoreline of persistent emergent wetland bordered by tidal flats and exposed channels (Lewis and Garrison, 1983). Food is abundant in these channels because of the constant supply of nutrients entering the channel during each tide cycle (Albertson, 1996). The number of tidal channels affects the number of rails that can be supported by a marsh with the number of rails increasing as the number of channels increases (Albertson, 1996 and Goals Project, 2000). These channels also provide a safe haven from predators because they are too narrow to allow the predators to hunt effectively (Albertson, 1996). CCRs are preyed on most often during high tide when they cannot hide within the tidal channels (Albertson, 1996). Predation is highest in the winter when high tides are common (Albertson, 1996). Low marsh areas, including tidal sloughs, have little vegetation and are used for foraging, whereas higher marsh areas complete with dense vegetation are used for nesting and cover during periods of high water (Albertson, 1996; Harvey, 1999; and Goals Project, 2000). In the late 1970's, one site within Suisun Marsh, characterized by a well-developed high marsh plant community, supported the greatest number of clapper rails (USFWS, 1984).

Populations of CCR are "most dense where patches of habitat are at least 100 hectares in size" (Goals Project, 2000). Less than 15 of these patches are found within the northern estuary and one third of these patches "adjoin the mouths of major tributaries downstream from Carquinez Straits" (Goals Project, 2000). Generally, CCR density decreases upstream "toward the headward extent of the major tributaries of the estuary" (Goals Project, 2000). Marsh habitat areas provide "food resources, cover from predators, breeding and nesting habitat, and refuge areas at high tides" (Goals Project, 2000).

During the winter, CCR can be found in medium-height *Spartina* in areas with fewer tidal streams and ditches compared to the nesting habitat (Lewis and Garrison, 1983). Rails can also be found during high fall and winter tides in "large racks of floating, dead cordgrass, usually deposited along the marsh side of creek levees" (Lewis and Garrison, 1983).

3.6 Diet

CCRs are generalist and opportunistic feeders that forage for food in tidal sloughs and channels (CDPR website; USGS website; Garrison, 2000; and Berkeley, 2004). During low tide, the soft mud in these areas is exposed and the CCRs use their long bill to probe for invertebrates and seeds (CDPR website). CCRs consume worms, mussels, snails, clams, crabs, insects, and spiders (Save the Bay and Berkeley, 2004). Amphipods have also been found in the esophagus of CCRs (USFWS, 1984). Although CCRs typically consume invertebrates, they have also been known to occasionally consume small birds and mammals, including the salt marsh harvest mouse, which is also an endangered species (Save the Bay and Harvey, 1999). Dead fish may also be scavenged (Harvey, 1999).

A study examining the stomach contents of 18 CCRs in South San Francisco Bay showed that 85.5% of the contents were animal matter, indicating that these animals are primarily carnivores (USFWS, 1984). The stomach contents included the non-native horse mussel (*Modiolus demissus*), wolf spiders (*Lycosidae* spp.), little macoma clams (*Macoma balthica*), yellow shore crabs (*Hemigrapsus oregonensis*), and nassa snails (*Ilyanassa obsoletus*) (USFWS, 1984 and USFWS, 2003). Worms, insects, and carrion accounted for about 1% of the diet in these CCRs (USFWS, 2003). The CCR diet may contain up to 15% plant material but it is believed that this represents a maximum value (USFWS, 2003). This belief is due to the fact that the CCRs were collected in February when animal prey items would be least abundant (USFWS, 2003).

Rails have been observed consuming the striped shore crab (*Pachygrapsus crassipes*) in Elkhorn Slough in Monterey County (USFWS, 1984). The diet of the CCR in San Pablo and Suisun Marsh has not yet been investigated; however, in Suisun Marsh which is brackish, CCRs may consume saltwater invertebrates including mussels and crustaceans as well as freshwater prey including crayfish (*Pasifastacus leniusculus*) and the Asiatic clam (*Corbicula* spp.) (USFWS, 1984). Salt glands allow the CCR to drink either fresh or salt water (Harvey, 1999).

Non-native horse mussels, although a favorite prey item of the CCR, are capable of injuring or killing CCRs by closing on their bills or feet if they step on or probe the mussel (USFWS, 1984). Invertebrate prey items preferred by the CCR can be negatively affected by pollution, sedimentation, and fluctuations in freshwater (USFWS, 1984). Low numbers of CCR have been associated with low numbers of invertebrate prey items (USFWS, 1984).

3.7 Life History and Reproduction

CCRs display year-long circadian activity and are most vocal nocturnally and crepuscularly (Harvey, 1999). They forage in the early morning and late evening and "roost at high tide during the day" (USFWS, 2007). Night-time CCR activities are expected to be minor (USGS-WERC website). CCRs are seen most often during very low or very high tides, either flapping awkwardly into the vegetation to escape the high tide, or crossing the sloughs (Save the Bay). They typically spend "most of their time hidden in thick marsh vegetation" (Garrison, 2000).

The CCR blends in well with its surroundings and is hard to see in dense vegetation; however, its "unmistakable, clattering call often gives it away" (USFWS, 2007 and REFUGEnet). CCRs often freeze when they are spotted and flushed; however, they may also hide "in small sloughs or under overhangs" or run quickly through the vegetation or along sloughs, "hunched over with their necks outstretched and plumage compacted" (USFWS, 1984 and 2007). CCRs prefer to walk or run and generally walk upright (USFWS, 2007). They have been "compared to chickens in size, shape, and maneuverability" as these birds are not particularly graceful when swimming or flying (Save the Bay). If they have been discovered they will sometimes fly a short distance and then land (USFWS, 2007). They are good swimmers but only swim when crossing sloughs or escaping an immediate threat at high tide (USFWS, 2007).

CCRs make a number of calls including a "he-e-eh-heh-heh-heh" and a "chack-chack-chack" (REFUGEnet). They also make a "harsh, clattering" kek-kek-kek-kek or cha-cha-cha call and will respond with a "clappering" call when alarmed (Invasive Spartina Project and Save the Bay). CCR calls are loud and typically have 20 to 25 notes that lower in pitch and increase in tempo (REFUGEnet). Female CCRs occasionally make a purring call (REFUGEnet). Rails use calls to contact each other, advertise their breeding status, and defend their territories (Albertson, 1996). CCRs will "fiercely defend overlapping, year-round territories" (Goals Project, 2000). Most CCRs show "strong site tenacity, with very little movement between seasons" (Goals Project, 2000). Home range size differs by individual and "significant within-season differences are apparent among marshes, particularly in core-use areas" which are "defined as the highly defended portion of the territory" which also contains the nest site (Goals Project, 2000). Predation pressure, habitat quality, as well as size and orientation of the marsh are likely factors that affect the CCR's home range size (Goals Project, 2000).

CCRs are considered to be non-migratory; however their movements between marshes are unknown (USFWS, 1984 and Goals Project, 2000). It is known that juveniles disperse widely from the breeding habitat and that adults disperse during the fall and early winter after breeding (USFWS, 1984). Several older records suggest that "there is a fairly regular fall dispersal period from August through November" although this may only occur in some years (Goals Project, 2000). A study looking at dispersal showed that many birds did not leave the marsh where they were banded, although three of 54 birds moved one km and one bird moved 10 km (Goals Project, 2000). Another study showed that one individual moved 3 km and established a breeding territory; however, CCRs typically disperse between one and three km (Goals Project, 2000).

The CCR breeding season begins in February, with nesting starting in mid-March and extending into August (USFWS, 2007). "Clapper rails tend to concentrate along tidal creeks of marshes during the breeding season" and it appears that these concentration areas are ancestral nesting grounds with a long history of use (Lewis and Garrison, 1983). High densities of breeding pairs are typically centered around second and third order tidal channels in the high marsh in pickleweed dominated habitat (Foin et al., 1997). Males initiate courtship and this activity includes "the male approaching the female with an uplifted tail, pointing his bill to the ground and swinging it from side to side" (Goals Project, 2000). The male also sometimes feeds the female during courtship (Goals Project, 2000).

Rails typically nest in lower marsh zones where cordgrass is abundant (Harvey, 1999). They "lay their eggs on the ground in a shallow nest of dead marsh grasses" (Save the Bay). The male clapper rail typically builds the nest which has been described as domed; however, other sources have described the nest as basket or funnel shaped with an inside diameter of about 14.2 cm (5.6 inches), an inside depth of 5.3 cm (2.1 inches), and an outside diameter of 23.6 cm (9.3 inches) (Garrison, 2000; Goals Project, 2000; USGS website; and Lewis and Garrison, 1983). CCR nests typically have a canopy over the nest constructed using vegetation including: "cordgrass, pickleweed, gum-plant, salt grass, and drift materials" (USFWS, 1984). CCR nests in the South Bay are typically found in gumplant bushes, pickleweed, cordgrass, saltgrass, and wrack (Goals Project, 2000). In the North Bay, CCR nests are found in alkali bulrush, pickleweed, or gumplant (Goals Project, 2000). It is thought that pickleweed is used more frequently in the "summers with disruptive high tides of +6.7 feet or more" whereas; gum-plants and drift materials are used early in the summer before the cordgrass is long enough to provide sufficient cover (USFWS, 1984). The differences in nesting material may also be due to "rainfall-induced fluctuations in the biomass of cordgrass and its availability as nesting habitat" (USFWS, 1984). Dried cordgrass stems seem to be the preferred material for the nest platform; however, dead drift vegetation may also be used (USFWS, 1984; and Harvey, 1999). CCRs also build "brood" nests which function as "high tide refuges for young rails" (USFWS, 1984). These nests typically consist of "a platform of stems without a canopy" (USFWS, 1984).

CCR nests are typically constructed near (usually within 10 m) of tidal sloughs because these areas provide the CCR "with a protected route for movement within the marsh as well as easily accessible foraging habitat and a nearby avenue of escape, particularly for vulnerable flightless young" (USFWS, 1984). Nests are often located "less than two meters from first-order channels and at least 100 meters upstream from the marshland shoreline" (Goals Project, 2000). Nests are also constructed above mean high higher water (Goals Project, 2000). One source reported that all CCR nests they observed were "constructed entirely above mean high water, with rims of the nests closely corresponding to the maximum elevation of tides during the breeding season" (Schwarzbach et al., 2006). Most clapper rail nests are "about 20 to 35 cm (7.9 to 13.8 inches) above the ground and 10 to 50 m (32.8 to 164.0 ft) from other nests" (Lewis and Garrison, 1983). Nests were also about 7 m (23 ft) from a variation in cordgrass height and density, with a "correlation between the density of nests and the amount of edge between tall and medium-height smooth cordgrass (20-46 cm or 8-18 inches) (Lewis and Garrison, 1983).

CCRs lay their eggs March through July (Goals Project, 2000). Clutches range from five to 14 eggs, with the average around seven eggs per clutch (USFWS, 1984 and 2007; and

Goals Project, 2000). The eggs are about 45 mm long and “light tan or buff-colored with cinnamon-brown or dark lavender spotting concentrated at the broader end” (USFWS, 1984). Both males and females are involved in incubation of the eggs, which lasts from 23 to 29 days, and rearing of the young (USFWS, 1984 and 2007; and Goals Project, 2000). This behavior suggests that this subspecies may be monogamous (Birds of North America website; Goals Project, 2000; and Lewis and Garrison, 1983). The nestlings are precocial and able to leave the nest soon after they hatch; however, their parents usually continue to care for or accompany them for the first eight weeks (CDPR website; Berkeley, 2004; and Goals Project, 2000). The young are chased by their parents from the parents’ territory once there are able to feed on their own, usually after 35 to 42 days (Lewis and Garrison, 1983). Juveniles fledge at ten weeks and can breed during the spring after they hatch (Goals Project, 2000 and Lewis and Garrison, 1983).

The breeding season ends at the end of August “when eggs laid during renesting attempts have hatched and the young are mobile” (USFWS, 2007 and USFWS, 2003). There are two peaks in nesting activity; in late April to early May and late June to early July (USFWS, 1984 and USFWS, 2003). It has been hypothesized that the second peak is due to “late nesters” or “second attempts after initial nesting failures” (USFWS, 1984). Clapper rails can “re-nest up to five times if their first attempts fail” (Garrison, 2000 and Birds of North America website). Nest failures are most often caused by predation of the eggs and chicks by the Norway rat (*Rattus norvegicus*) or inundation of the nest during high tide (USFWS, 1984). Nests that had been abandoned or disrupted were usually preyed on by rats and nests composed of cordgrass and gum-plant were disrupted by tides greater than +6.7 feet (USFWS, 1984). Heavy spring storms in combination with high tides can “destroy up to half of the clapper rails nests found in the marsh” (Garrison, 2000). In 1980, there was 38% hatching success for 31 CCR nests; however, “28 of 50 nests successfully hatched the majority of their eggs (56% nest success)” (USFWS, 1984). The fledging success of CCR is difficult to determine and unknown at this time (USFWS, 1984).

A study of CCR hatching success in six marshes in San Francisco Bay over four breeding seasons (1991, 1992, 1998, and 1999) determined that egg predation and contamination are the “major factors limiting the reproductive success of California clapper rails in both the northern and southern reaches of the bay” (USFWS, 2003 and Schwarzbach, 2006). This study was conducted in two marshes (Corte Madera and Wildcat) in the North Bay (north of the Golden Gate Bridge) and four marshes (Greco Island, Mowry, Laumeister, and Faber) in the South Bay (south of the San Mateo Bridge) (Schwarzbach, 2006). The results of this study showed that CCR productivity was lower than their natural potential (Schwarzbach, 2006). Egg hatchability was depressed in all six of these marshes below their normal hatchability rate of greater than 90% (Schwarzbach et al., 2006). Only 69% of the CCR eggs that could be assessed for viability were viable (Schwarzbach, 2006). Thirty-one percent of the eggs were therefore nonviable (Schwarzbach et al., 2006). Hatchability for the North and South bays were 65% and 70%, respectively (Schwarzbach, 2006). “Only 45% of the nests successfully hatched at least one egg” (Schwarzbach, 2006). The mean clutch sizes for the North and South bays were 6.7 and 6.9, respectively; however, CCRs only produced 1.9 and 2.5 young per nesting attempt

(Schwarzbach, 2006). Predation was a major factor affecting nest success because it reduced productivity by a third (Schwarzbach, 2006). In 1992, in marshes in the South Bay, 90% of the eggs lost to predation were lost to rodents and the Norway rat in particular (Schwarzbach, 2006). Flooding was not a major factor and only reduced the number of eggs available to hatch by 2.3% in this study although it was acknowledged that flooding may vary by marsh and year (Schwarzbach, 2006). Tides in San Francisco Bay that were greater than two meters were "particularly detrimental to California clapper rail nests located in Grindelia humilis bushes, with eggs being lost from all such nests" (Schwarzbach et al., 2006)

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4. CALIFORNIA FRESHWATER SHRIMP

4.1 Species Listing Status

The California freshwater shrimp (*Syncaris pacifica*) was listed as endangered on October 31, 1988 (53 FR 43884) by the U.S. Fish and Wildlife Service (USFWS) (USFWS, 1988). A recovery plan for this species was approved by the USFWS on July 31, 1998 (USFWS, 1998). A 5-year review for this species was finalized in December of 2007 (USFWS, 2007).

4.2 Description and Taxonomy

The California freshwater shrimp (CA shrimp) is a decapod or 10-legged crustacean of the family Atyidae. Adult CA Shrimp are generally less than 50 millimeters (2.17 inches) in postorbital length (from eye orbit to tip of tail) (USFWS, 1988 and 1998). Females are generally larger and deeper bodied than males (USFWS, 1998 and 2007). Females range between 32 to 45 millimeters (1.3 to 1.8 inches) in length, whereas males range in length from 29 to 39 millimeters (1.2 to 1.5 inches) (USFWS, 1998).

S. pacifica was first described as *Miersia pacifica* in 1895 (USFWS, 1988). In 1990, a new genus, *Syncaris*, was described for the California atyids based on notable differences in the chelae (pinchers) and rostrum (horn-shaped structure between the eyes). *S. pacifica* can be distinguished from *Palaemonias*, the only other atyid genus in the United States, by its well-developed stalked eyes. *Palaemonias* are blind and dwell in caves in the eastern United States. *S. pacifica* is the only surviving species in the genus *Syncaris* (USFWS, 1988 and 1998).

4.3 Distribution and Status

Historical Range:
The historic distribution of the shrimp is unknown, but it probably extended across the low elevation, perennial freshwater streams in Marin, Sonoma, and Napa counties in California (USFWS, 1998 and 2007). The CA shrimp was known to occupy only areas within restricted portions of 12 streams in the three counties listed above when the species was listed in 1988 (USFWS, 1988). A study published in 1985 reported that the species inhabited eleven streams in the Russian River, San Francisco Bay, and other coastal drainages (USFWS, 1988). These streams were East Austin, Salmon, Lagunitas, Big Austin, Sonoma, Huichica, Green Valley, Jonive, Walker, Yulupa, and Blucher (USFWS, 1988). CA shrimp were also found in the Napa River near Calistoga (USFWS, 1988). This finding increased the total number of streams in the area known to contain CA shrimp to 12 (USFWS, 1988). Since the species was listed, the CA shrimp has been rediscovered in Stemple Creek, and new populations have been found in Keys, Redwood, and Garnett Creeks (USFWS, 1998). A total of eleven separate stream systems (sixteen streams) are inhabited in the three counties mentioned above (Marin, Sonoma, and Napa) (Serpa, 1996 and USFWS, 2007). Another CA shrimp population was found in a new

location on Austin Creek, upstream of its confluence with East Austin Creek (USFWS, 1998). With the exception of Stemple Creek, CA shrimp at these locales are adjacent to previously known populations. As evidenced by the recent discovery of CA shrimp within Keys, Garnett, and Redwood Creeks, unsampled and inadequately sampled streams within Marin, Sonoma, and Napa Counties could contain additional populations (USFWS, 1998).

Current Range:
The recovery plan listed populations of the California freshwater shrimp remaining in reaches of 17 streams (USFWS, 1998). These included five streams in Marin County (Lagunitas, Olema, Walker, Keys, and Stemple), and twelve streams in Sonoma County (Blucher, Jonive, Redwood, Green Valley, Salmon, East Austin, Big Austin, Sonoma, Yulupa, Garnett, Huichica, and Napa (USFWS, 1998). As of the 5-year Review, more recent surveys place the number of known locations of the CA shrimp up to 23. In addition to those already mentioned, the five reaches of streams known to support the CA shrimp are “Bud Creek” (Sonoma County), Franz Creek (Sonoma County), Ebabias Creek (Sonoma County), Cheda Creek (Marin County, an unnamed tributary of Huichica Creek (Napa County), and a second location on the Napa River (Napa County) (USFWS, 2007). The majority of new information documenting the existence of these species in the additional streams is a result of recent independent surveys. It should be noted, these findings do not represent an attempt at a systematic canvassing of habitats for the CA shrimp to examine their full spatial distribution and extent (USFWS, 2007). It is unknown if shrimp populations still persist in Laguna de Santa Rosa or Atascadero Creeks. The Yulupa Creek shrimp population is probably under the greatest threat of extirpation (USFWS, 1998). Lagunitas is the only shrimp stream on federal and state land, all others are in private ownership (Serpa, 1996 and USFWS, 1998). A substantial portion of Lagunitas Creek flows through the Samuel P. Taylor State Park, managed by the California Department of Parks and Recreation, and the Golden Gate National Recreation Area, managed by the National Park Service. A small segment of Salmon Creek flows through the Watson School historic site, managed by the Sonoma County Department of Parks and Recreation. On East Austin Creek, the Austin Creek State Recreation Area lies immediately upstream of shrimp populations (USFWS, 1998).

Distribution:
Based on existing information, the distribution of shrimp within streams is quite restricted and without continuity, primarily because unsuitable habitat is often interspersed between suitable habitat (USFWS, 1998). Furthermore, because access is not available to survey all potential habitats, the actual extent of distribution may extend beyond the reported locations (USFWS, 1998). Distribution of shrimp populations within streams is not expected to be static because of habitat changes by natural or human made forces. For example, recent long-term drought conditions in California may have resulted in more discontinuous shrimp populations in Huichica Creek (USFWS, 1998). Gradual removal of unnatural barriers to shrimp dispersal and restoration of natural habitat conditions in Austin Creek are expected to expand the distribution of shrimp beyond its existing occurrence (USFWS, 1998). Distribution of age classes varies within

streams; streams sampled in the fall have contained proportionally higher numbers of juveniles than adults (USFWS, 1998).

In instances where shrimp are present (historically or currently) in two connecting watercourses, the smaller tributaries generally support more abundant numbers of shrimp than the larger, receiving streams (USFWS, 1998). An exception to this pattern, Yulupa Creek (tributary to Sonoma Creek) contained fewer shrimp than Sonoma Creek (USFWS, 1998). However, Yulupa Creek has less suitable habitat than Sonoma Creek due to relatively high channel gradient and the absence of overhanging vegetation and undercut banks (USFWS, 1998). Populations on Salmon and Lagunitas Creeks were rated “good” to “excellent” due to the relatively high numbers of sampled shrimp over a relatively long distance. Populations on Stemple, Green Valley, Austin, Walker, and Yulupa Creeks and Napa River were rated “extremely poor” to “fair poor” due to limited distribution and low numbers of sampled shrimp. No ratings are available for Atascadero Creek, Redwood Creek, Olema Creek, and Laguna de Santa Rosa due to insufficient information (USFWS, 1998). These ratings are based on a qualitative, relative index of health (USFWS, 1998). The index assumes equivalent abundance estimates and lengths of distribution on separate streams afforded somewhat similar levels of protection from disturbance (USFWS, 1998).

4.4 USFWS Critical Habitat

No critical habitat for the CFS has been designated by the USFWS to date.

4.5 Habitat

The CA shrimp is endemic to perennial streams in Marin, Napa, and Sonoma Counties, California (USFWS, 1998). This species is adapted to freshwater environments and cannot tolerate salt or brackish water and does not occur in the intertidal reaches or estuarine areas of any of the streams in which it is found (USFWS, 1988 and 1998). Although laboratory studies indicate that the shrimp can tolerate brackish water conditions, at least for short periods of time, all records of CA shrimp are from freshwater reaches in streams (USFWS, 1998).

The shrimp is found in low elevation (less than 116 meters, 380 feet), low gradient (generally less than 1 percent) perennial freshwater streams or intermittent streams with perennial pools where banks are structurally diverse with undercut banks, exposed roots, overhanging woody debris, or overhanging vegetation (USFWS, 1998). The species, a true freshwater shrimp, inhabits quiet portions of tree-lined streams with underwater vegetation and exposed tree roots in free-flowing, permanent streams (USFWS, 1988). The species is found within stream pools, in areas away from the main current, where there are often undercut banks, exposed root systems, and vegetation hanging into the water (Serpa, 1996).

Excellent habitat conditions for the shrimp include streams 30 to 90 centimeters (12 to 36 inches) in depth with exposed live roots (e.g., alder and willow trees) (USFWS, 1998 and 2007). They are usually found along completely submerged undercut banks (horizontal depth greater than 15 centimeters, 6 inches) with overhanging stream vegetation and vines (e.g., blackberry) (USFWS, 1998 and 2007). Filamentous blackberry roots sprout from stems wherever they extend beneath the surface, and form an ideal refuge most of the year (Serpa, 1996). Dense beard-like willow roots, often extending more than a foot out into the water, are more dependable for habitat by remaining submersed in water. Alders provide both short filamentous roots, and the coarser hard roots that support the stream banks. As the bank soils partially erode from the force of the current, a network of the rigid roots is exposed. Overhanging the undercut banks, these roots reduce the erosive power of the water, and protect the banks from further damage (Serpa, 1996). The roots also form a useful highway system for the shrimp. During the heavy flows of water accompanying storms, the shrimp abandon the softer vegetation and travel close to these sturdy roots, or even move within the undercut banks for protection (Serpa, 1996). With the exception of Yulupa Creek, shrimp have not been found in stream reaches with boulder and bedrock bottoms. In fact, high velocities and turbulent flows in these streams may hinder upstream movement of shrimp (USFWS, 1998).

Some of the shrimp streams are completely enclosed with streamside vegetation, while others have just a few scattered trees along the banks. In the latter case, dark, shaded water is necessary to help protect the CA shrimp from visual predators (Serpa, 1996). Typically only the sides of the pools are utilized. Shrimp avoid the pool bottoms, and are only found there after being disturbed, or when populations are especially high (Serpa, 1996). Undisturbed shrimp move slowly and are virtually invisible on submerged leaf and twig substrates, and among the fine, exposed, live roots of vegetation along undercut stream banks (USFWS, 1998 and 2007).

Precipitation falls mainly between the months of October and March in the CA shrimp range with annual precipitation ranging from 71 centimeters (28 inches) in the town of Sonoma, Sonoma County, to 104 centimeters (41 inches) in the town of Graton, Sonoma County (USFWS, 1998). Consequently, stream flows are markedly different throughout the year with flash flood flows in the winter to minimal or zero flows in the summer and fall months (USFWS, 1998). As a result, habitat preferences change during late-spring and summer months (USFWS, 1998). During the winter, the CA shrimp is found beneath undercut banks with exposed fine root systems or dense, overhanging vegetation (USFWS, 1998 and 2007). These microhabitats may provide shelter from high water velocity as well as some protection from high suspended sediment concentrations typically associated with high stream flows (USFWS, 1998 and 2007). However, in the summer shrimp were rarely found beneath undercut banks (USFWS, 1998). Submerged leafy branches were the preferred summer habitat. In Lagunitas Creek, Marin County, the shrimp was found in a wide variety of trailing, submerged vegetation (USFWS, 1998). Populations of shrimp were proportionately correlated with the quality of summer habitat provided by trailing terrestrial vegetation (USFWS, 1998). The highest concentrations of shrimp were in reaches with adjacent vegetation consisting of stinging nettles (*Urtica* sp), grasses, vine maple and mint (USFWS, 1998). However, in the late summer and fall some shrimp streams are reduced to isolated pools (Serpa, 1996). As temperatures rise and oxygen diminishes, trapped fish begin to die (Serpa, 1996). However, these conditions are still conducive to CA shrimp persistence and can be still considered good habitat. As long as some water remains in the pools, the species can survive (Serpa, 1996). Isolated pools with minimal cover and opaque waters may allow the shrimp to escape predation and persist despite the lack of cover (USFWS, 1998).

The CA shrimp has evolved to survive a broad range of stream and water temperature conditions characteristic of small, perennial coastal streams (USFWS, 1998 and 2007). However, no data are available for defining the optimum temperature and stream flow regime for the shrimp or the minimum and maximum limits it can tolerate. The shrimp appears to be able to tolerate warm water temperatures (greater than 23 degrees Celsius, 73 degrees Fahrenheit) and no-flow conditions (USFWS, 1998). One study that collected both shrimp and water quality information found shrimp in Salmon, Jonive, Blucher, Lagunitas, and Yulupa Creeks between temperatures of 7 and 16 degrees Celsius (45 to 61 degrees Fahrenheit), dissolved oxygen levels of 3.3 to 12.3 parts per million, and pH ranges from 5.85 to 9.1. However, the study period did not sample during the summer months when water quality conditions for aquatic organisms are generally the most stressful (USFWS, 1998). The toxicity of ammonia is of particular concern for the shrimp, because many streams drain land uses such as grazing and dairy operations, which are sources of nitrogenous waters (USFWS, 1998).

4.6 Diet

California freshwater shrimp are detritus feeders, feeding on the small, diverse particles brought downstream to their pools by the current. As the water slows, the particles are filtered out by exposed roots and other vegetation. The shrimp simply brush up the detritus which may be colonized by algae, bacteria, fungi, and microscopic animals with tufts at the ends of their small claws, and lift the collected particles to their mouths (Serpa, 1996). Larger pieces of detritus are picked up or manipulated with the claws (Serpa, 1996). The food sources may range from fecal material produced by shredders (a functional group that feeds on coarse particulate organic matter), organic fines produced by physical abrasion and microbial maceration, senescent periphytic (organisms attached to underwater surfaces) algae, planktonic (free-floating) algae, aquatic macrophyte (large plants) fragments, zooplankton (microscopic animals), particles formed by the flocculation (small loose clusters) of dissolved organic matter, and aufwuchs (a matrix of bacteria, extracellular materials, fungi, algae, and protozoa) (USFWS, 1998).
Much of this material is picked up indiscriminately, and contains indigestible material along with the more edible items. Although shrimp usually walk slowly about the roots as they feed, these crustaceans will undertake short swims to obtain particular particles (Serpa, 1996).

Presumably, shrimp diets change with food availability and age (USFWS, 1998). Shrimp observed on pool bottoms, submerged twigs and vegetation seemed to feed on fine particulate matter (USFWS, 1998). However, much of the material ingested is probably indigestible cellulose (USFWS, 1998). Shrimp maintained in aquaria scavenge dead fish and shrimp (USFWS, 1998). Shrimp may use visual, tactile, or chemical cues in foraging activities (USFWS, 1998).

4.7 Life History and Reproduction

The reproductive ecology of the California freshwater shrimp has not been formally described (USFWS, 1998). However, it is known that they breed once a year in the fall, typically September (Serpa, 1996; USFWS, 1998 and 2007). Based upon the reproductive physiology and behavior of other marine and freshwater shrimps, the male probably transfers and fixes the sperm sac to the female shrimp immediately after her last molt, before autumn. It is typical for aquatic crustaceans to copulate during the female's molt just prior to the time of year she becomes egg bearing. The timing of the mating was deduced from the presence of ovigerous (egg bearing) females starting in September (USFWS, 1998). One researcher noted that by November, most adult females in Huichica Creek are bearing eggs (USFWS, 1998).

Adult females produce relatively few eggs, generally, 50 to 120 (USFWS, 1998 and 2007). Average egg dimensions for shrimp from Salmon Creek are 1.3 by 0.9 millimeter (0.05 by 0.04 inch) (USFWS, 1998). Although not documented, fecundity and egg size may vary based on the size of the female. In studies of other freshwater atyid shrimps, fecundity and egg size increased as the size of the female increased (USFWS, 1998). The eggs adhere to the pleopods (swimming legs on the abdomen) where they are protected and cared for during the winter incubation (Serpa, 1996; USFWS, 1998 and 2007). While she carries the eggs on her body for 8 to 9 months, slow overwintering development of the eggs occurs (USFWS, 1988). During this period, many larvae die due to adult female death and genetic or embryonic developmental problems. As a result, the number of embryos emerging from eggs during May is reduced from those formed, typically by 50 percent (USFWS, 1988). However, one researcher determined that the winter (December-March) incubation period was advantageous because the larvae are released during the favorable part of the hydrologic cycle in California, following winter and spring high flows (USFWS, 1998). This adaptation ensures that the juveniles do not have to face the heavy stream flows of the rainy season (Serpa, 1996).

The young shrimp are released as miniature adults in late Spring, after the rainy season is almost over, and the streams are carrying much less water (Serpa, 1996). Young are released in May or early June and are approximately 6 millimeters (0.24 inch) in length (USFWS, 1998). Newly hatched young (postlarvae) grow rapidly and reach 19 millimeters (0.75 inch) in length by early autumn (USFWS, 1988 and 1998). Growth slows through the fall, winter, and early spring, and then increases through the second summer (USFWS, 1998). By the end of their second summer of growth, a size difference between males and females is apparent and shrimp reach sexual maturity (USFWS, 1998 and 2007). No information is available on the percentage of larvae that reach reproductive maturity (USFWS, 1998). Although a few shrimp have been known to survive three years, the CA shrimp may live longer than 3 years (Serpa, 1996 and USFWS, 1998).

4.8 References

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5: CALIFORNIA TIGER SALAMANDER: CENTRAL CALIFORNIA AND SONOMA COUNTY DISTINCT POPULATION SEGMENTS

5.1 Species Listing Status

There are currently three Distinct Population Segments [DPS] of the California tiger salamander [CTS] (*Ambystoma californiense*): the Central California DPS, the Santa Barbara County DPS, and the Sonoma County DPS.

Santa Barbara County DPS:
The Santa Barbara population was the first CTS DPS to be listed; it was listed on September 21, 2000, and was determined to be endangered (USFWS, 2000). On August 4, 2004, the CTS was listed as threatened throughout its range (including all current DPSs), thereby downlisting the Santa Barbara County DPS from endangered to threatened (USFWS, 2004 a). On August 19, 2005, the downgrading of the Santa Barbara County DPS was vacated. As a result, the endangered species status for the Santa Barbara County DPS was reinstated (USFWS, 2007). This DPS is not considered in this assessment because it is not found in the counties named in the suit filed by the Center for Biological Diversity against the EPA (Civ. No. 07-2794-JCS).

Sonoma County DPS:
The Sonoma County DPS of the CTS was listed as endangered on March 19, 2003 (USFWS 2003 a). On August 4, 2004, the CTS was listed as threatened throughout its range (including all current DPSs), thereby downlisting the Sonoma County DPS from endangered to threatened (USFWS, 2004 a). On August 19, 2005, the downgrading of the Sonoma County DPS was vacated. As a result, the endangered species status for the Sonoma County DPS was reinstated (USFWS, 2007).

Central California DPS:
The Central California DPS of the CTS was listed as threatened on August 4, 2004 (USFWS, 2004 a).

5.2 Description and Taxonomy

The CTS is a large, stocky, terrestrial salamander (USFWS, 2007). The average adult CTS is 190 mm (7.5 inches) in length with some adults reaching a total length of 208 mm (8.2 inches) (Hurt, 2000 and USFWS, 2003 a). Male CTS average about 203 mm (8 inches), and females average about 173 mm (6.8 inches) (USFWS, 2003 a). The average snout-vent length for both sexes is about 91 mm (3.6 inches) (USFWS, 2003 a). The average weight for the CTS is 50 g (www.saczoo.com). CTS larvae range from 11.5 to 14.2 mm (0.45 to 0.55 inches) in length (USFWS, 2003 a).

Gray first described the CTS as *A. californiense* in 1853, based on specimens collected in Monterey, California (USFWS, 2003 a). Some considered the CTS to be a distinct species, whereas others considered the CTS a subspecies (*A. t. californiense*) of the more widely spread tiger salamander (*A. tigrinum*) (USFWS, 2004a). The CTS is now considered to be a separate species, *A. californiense*, because of its geographic isolation from *A. tigrinum*, differences in coloration between the two species, and the findings of recent genetic comparison studies (USFWS, 2003 a). These two species, *A. tigrinum* and *A. californiese* will hybridize if *A. tigrinum* are introduced into the habitat of *A. californiese* (USFWS, 2003 a). However, the range of the CTS does not naturally overlap with any other species of tiger salamander (USFWS, 2003 a).

5.3 Distribution

The CTS is found only in California and requires seasonal ponds, vernal pools, or vernal pool complexes in association with annual grasslands, oak savannah, or coastal scrub plant communities. CTS spend most of their life-cycle estivating underground (primarily in abandoned mammal burrows) in valley oak woodland or grassland habitat (from sea level to about 1,500 ft). The historic range of the CTS included large portions of the Central Valley of California, from the southern Sacramento Valley (north of the Sacramento River delta) to the southern San Joaquin Valley (USFWS, 2002). The CTS was also found, in the lower foothills along the eastern side of the Central Valley and in the foothills of the Coast Ranges (USFWS, 2002). Approximately 9.1 million acres of valley and coastal grassland comprised the historic range of the Central California CTS (USFWS, 2004a). CTS have been historically documented in 27 counties but are no longer found in three of these counties (USFWS, 2005c).

Although the CTS has been eliminated from much of its former range in the Central Valley, it still occurs throughout most of its overall historical range and can be locally common (Hammerson, 2004). In addition, it has been recently rediscovered on the San Francisco Peninsula (Hammerson, 2004). The quality, connectivity, and distribution of the habitat within the current range has been degraded, even though the current range of the CTS is close in size to its historic range (USFWS, 2004a).

In the coastal region, populations of CTS are scattered from Sonoma County in the northern San Francisco Bay Area to Santa Barbara County, and in the Central Valley and Sierra Nevada foothills from Yolo to Kern County (USFWS, 2007).

The USFWS admits that they do not have a good understanding of the historic distribution of the CTS and that what is reported above is based on the estimated current distribution, habitat availability, and the assumption that the available habitat is populated (USFWS, 2004 a).

Mitochondrial DNA studies identify 6 populations of CTS which are found in Sonoma County (the Sonoma County DPS), Santa Barbara County (the Santa Barbara County DPS), and the remaining populations represent the Central California DPS found in the Bay Area, Central Valley, southern San Joaquin Valley, and the Central Coast Range.

Sonoma County DPS:

The Sonoma County CTS are primarily found on the Santa Rosa Plain in Sonoma County. The breeding sites of Sonoma County CTS are limited to areas with Huichica-Wright-Zamora and Clear Lake-Reyes soils series/associations as defined by the USDA (USDA 1972, 1990 and USFWS, 2002). The Huichica-Wright-Zamora association is limited to the Santa Rosa Plain and the vicinity of the town of Sonoma. The Clear Lake-Reyes association is found from the Cotati region south and east of the city of Petaluma to the northern part of the San Francisco Bay.

Central California DPS:
The Central California DPS of CTS occupies the Bay Area (central and southern Alameda, Santa Clara, western Stanislaus, western Merced, and the majority of San Benito Counties), Central Valley (Yolo, Sacramento, Solano, eastern Contra Costa, northeast Alameda, San Joaquin, Stanislaus, Merced, and northwestern Madera Counties), southern San Joaquin Valley (portions of Madera, central Fresno, and northern Tulare and Kings Counties), and the Central Coast Range (southern Santa Cruz, Monterey, northern San Luis Obispo, and portions of western San Benito, Fresno, and Kern Counties).

5.4 USFWS Critical Habitat

Critical habitat is defined in the ESA as specific areas within the geographic area occupied by a species at the time it is listed, containing physical and biological features necessary for the conservation of the species, and that may require special management to protect the listed species. The designation of critical habitat is based on habitat areas that provide essential life-cycle needs of the species or areas that contain primary constituent elements (PCEs). PCEs 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 the species (USFWS, 2004 b).

Sonoma County DPS:
On December 14, 2005, the USFWS determined that the designation of critical habitat for the Sonoma County DPS of the CTS would have a negative impact on the completion and implementation of the Santa Rosa Plain Conservation Strategy (USFWS, 2007). As a result, no critical habitat was designated for the Sonoma County DPS (USFWS, 2007).

Central California DPS:
Critical habitat was designated in the Federal Register (70 FR 49380) on August 23, 2005, for 199,109 acres of critical habitat in 19 counties for the central population of the CTS (USFWS, 2005 a). Thirty one units were designated in four regions: (1) the Central Valley Region; (2) the Southern San Joaquin Valley Region; (3) the East Bay Region (including Santa Clara Valley area); and (4) the Central Coast Region (USFWS, 2005 a).

The designated critical habitat areas for the central CTS have the following PCEs:

1. Aquatic Habitat: standing freshwater bodies including: natural and man-made (stock) ponds, vernal pools, and other ephemeral or permanent water bodies that become filled with water during winter rains and maintain this water for a minimum of 12 weeks (USFWS, 2005 a)
2. Upland (non-breeding season) habitat: accessible (barrier-free) uplands near the breeding ponds that contain small mammal burrows or other underground habitat.
3. Dispersal habitat: upland areas located between breeding areas and areas containing small mammal burrows that allow for the dispersal of the central CTS between sites (USFWS, 2005 a).

Critical habitat was selected for the CTS based on breeding locations that were occupied by the CTS at the time of listing and contained the PCEs essential for the protection of the species (USFWS, 2005 b). Additional areas which were found to be occupied subsequent to listing and also containing essential habitat feature were also used to select critical habitat. Critical habitat does not include areas where existing management practices are sufficient to protect the CTS (USFWS, 2005 a). The USFWS determined that about 189,032 acres (20%) of the total estimated central CTS habitat is protected to some degree (USFWS, 2004 a).

Central CTS Critical Habitat Units:
Thirty-two units were designated as critical habitat for the Central population of the CTS in four geographic regions (USFWS, 2005a). The units are described below.

Central Valley Region:
The Central Valley Region is found from northern Yolo County south and southeast to the northern half of Madera County, and includes eastern Solano and Contra Costa counties (USFWS, 2005 a). This region is 4.9 million acres (USFWS, 2005 a). The USFWS designated 12 critical habitat units in this region that total 97,045 acres (USFWS, 2005 a). The selected critical habitat units represent the varying habitats available to the CTS in this region (USFWS, 2005 a).

1. Dunnigan Creek Unit, Yolo County:
   Unit 1 includes 2,730 acres and is the only unit in Yolo County (USFWS, 2005 a). This unit is crucial because it represents the northernmost portion of the CTS range and the northernmost portion of the Solano-Colusa vernal pool region (USFWS, 2005 a). This region is bounded on the east by Interstate 5, to the south by Bird Creek, and to the north and west by Buckeye Creek (USFWS, 2005 a). The land in this unit is privately owned (USFWS, 2005 a).

2. Jepson Prairie Unit, Solano County:
   This unit includes 5,699 acres and represents the northwestern portion of the CTS's range and the southern end of the Solano-Colusa vernal pool region in Solano County (USFWS, 2005 a). This unit is located south of Dixon, west of State Route 113, north of Creed Road, and east of Travis Air Force Base (USFWS, 2005 a). The land comprising this unit is predominantly privately

owned but also includes some land that is owned by the California Department of Fish and Game (USFWS, 2005 a).

3. Southeastern Sacramento Unit, Sacramento County:
This unit includes 9,966 acres and is the only unit in Sacramento County (USFWS, 2005 a). It represents the northern-central part of the range of the CTS, the southern part of the Southeastern Sacramento Valley vernal pool region, and one of only a few areas occupied by this species in the Sacramento Valley (USFWS, 2005 a). This unit is bounded to the south by the Sacramento and San Joaquin County border, to the north by Laguna Creek, to the east by the Sacramento and Amador County border, and to the west by the Alta Mesa Road (USFWS, 2005 a). The land comprising this unit is privately owned (USFWS, 2005 a).

4. Northeastern San Joaquin Unit, and Amador Counties:
This unit includes 9,603 acres and is the only unit in San Joaquin and Amador counties (USFWS, 2005 a). This unit is located in an area south of the San Joaquin and Sacramento county line, east of Day Creek Road, north of Liberty Road, and west of Comanche and Jackson Valley Roads. The land comprising this unit is privately owned (USFWS, 2005 a).

5. Indian Creek Unit, Calaveras County:
This unit includes 3,128 acres and represents the northeastern part of the CTS range (USFWS, 2005 a). This unit is bordered to the south and east by State Route 26, to the west by Warren Road, and to the north by State Route 12 (USFWS, 2005 a). The land in this unit is privately owned (USFWS, 2005 a).

6. Rock Creek Unit, Calaveras, San Joaquin, and Stanislaus Counties:
This unit includes 23,491 acres and represents the northern end of the Southern Sierra Foothills vernal pool region and a part of the east-central portion of the San Joaquin Valley (USFWS, 2005 a). This unit is located west of San Joaquin County Road J6, north of Sonora Road, east of Stanislaus County Road J12, and south of the Calaveras River (USFWS, 2005 a). The land in this unit is privately owned (USFWS, 2005 a).

7. Rodden Lake Unit, Stanislaus County:
This unit includes 562 acres in the northern end of the Southern Sierra Foothill vernal pool region in the eastern San Joaquin Valley (USFWS, 2005 a). This unit is the only unit near the Stanislaus River (USFWS, 2005 a). It is bordered to the east by Horseshoe Road, to the north by Frankenheimer Road, to the west by Twenty Eight Mile Road, and to the south by the Stanislaus River (USFWS, 2005 a). The land in this unit is privately owned (USFWS, 2005 a).

8. La Grange Ridge Unit, Stanislaus and Merced Counties:
This unit includes 4,013 acres in the northeastern area of the Southern Sierra Foothills vernal pool region (USFWS, 2005 a). It represents the east central part

of the CTS distribution within the Central Valley and is bounded to the east by the Cardoza Ridge, to the west by Los Cerritos Road, to the north by State Route 132 and to the south by Fields Road (USFWS, 2005 a). The land in this unit is privately owned (USFWS, 2005 a).

9. Fahrens Creek Unit, Merced County:
   This unit includes 17,799 acres and represents the South Sierra Foothills vernal pool region in Merced County, the central part of the CTS distribution in the eastern San Joaquin Valley, and the south-eastern part of the CTS distribution in the Central Valley region (USFWS, 2005 a). This unit is located northeast of Merced, east of the Merced and Mariposa county line, north of Bear Creek, and south of the Merced River (USFWS, 2005 a). The land in this unit is privately owned (USFWS, 2005 a).

10. Miles Creek Unit, Merced County:
    This unit includes 10,585 acres and is the only other unit in the Southern Sierra Foothills vernal pool region in Merced County (USFWS, 2005 a). This unit represents the central part of the CTS distribution in the eastern San Joaquin Valley and the south-eastern part of the CTS distribution in the Central Valley region (USFWS, 2005 a). This unit is located to the "east of Owens Lake in Mariposa County, west of Cunningham Road in Merced County, south of South Bear Creek Road in Merced County, and north of Childs Avenue (USFWS, 2005 a). The land in this unit is privately owned (USFWS, 2005 a).

11. Rabbit Hill Unit, Madera County:
    This unit includes 8,291 acres and "represents the Sierra Foothills vernal pool region in Madera County and is the southernmost unit within the Central Valley Geographic Region" (USFWS, 2005 a). This unit is "located west of Hensley Lake, south of Knowles Junction, west of the Daulton Mine, and north of the Fresno River (USFWS, 2005 a). The land in this unit is privately owned (USFWS, 2005 a).

12. Doolan Canyon Unit, Alameda County:
    This unit includes 1,178 acres and represents the Livermore vernal pool region and the western part of the Central Valley region (USFWS, 2005 a). This unit is bounded to the north by the Contra Costa County line, near Collier Canyon Road on the east and the south, and the City of Dublin to the west (USFWS, 2005 a). The land in this unit is privately owned (USFWS, 2005 a).

Southern San Joaquin Region:
This region contains about 1.4 million acres and is found from the southern half of Madera County south to northeastern Kings County and northwestern Tulare County (USFWS, 2005 a). Four critical habitat units totaling about 20,293 acres were designated in this region (USFWS, 2005 a). These critical habitat units represent the San Joaquin Valley and Southern Sierra Foothills vernal pool regions in the southern San Joaquin Valley (USFWS, 2005 a).

Millerton Unit, Madera County:

1. This unit is comprised of two subunits and includes a total of 6,811 acres (USFWS, 2005 a). Subunit 1 a includes 3,808 acres and Subunit 1 b includes 3,003 acres (USFWS, 2005 a). This unit represents the Southern Sierra Foothills vernal pool region, one of two different vernal pool regions in the Southern San Joaquin region, and the southeastern part of the CTS range in the San Joaquin Valley (USFWS, 2005 a). This unit is the only critical habitat unit in this vernal pool region in Madera County (USFWS, 2005 a). It is located "west of State Highway 41 and generally north of the San Joaquin River" (USFWS, 2005 a). The unit is bounded to the east by the western side of Millerton Lake, and to the north by the by O'Neal Road, south of Berry Hill (USFWS, 2005 a). The land in this unit is privately owned (USFWS, 2005 a).

2. Northeastern Fresno, Fresno County:
   This unit includes 4,961 acres and represents the Southern Sierra Foothills vernal pool region within Fresno County, the northern end of the Southern San Joaquin region, and the southern part of the CTS range in the San Joaquin Valley (USFWS, 2005 a). This unit is located "northeast of Fresno, southwest of Millerton Lake, east of Friant Road, and generally west of Academy" (USFWS, 2005 a). The land in this unit is privately owned (USFWS, 2005 a).

3. Hills Valley Unit, Fresno and Tulare Counties:
   This unit includes 4,181 acres and two subunits (USFWS, 2005 a). Subunit 3 a includes 1,626 acres and subunit 3 b includes 2,553 acres (USFWS, 2005 a). This unit represents the foothills of northwest Tulare County, the Southern Sierra Foothills vernal pool region, and the southeastern part of the CTS range within the San Joaquin Valley (USFWS, 2005 a). This unit is located south of State Highway 180, west of George Smith and San Creek Roads, north of Curtis Mountain, and east of Cove Road (USFWS, 2005 a). The land comprising this unit is privately owned (USFWS, 2005 a).

4. Cottonwood Creek Unit, Tulare County:
   This unit includes 4,342 acres and represents a significant area at the very southernmost portion of the range of the Central population of the CTS (USFWS, 2005 a). "Unit 5 represents a low-elevation vernal pool complex within the San Joaquin Valley vernal pool region" (USFWS, 2005 a). This unit is bounded to the north by County Road J36, to the east by Dinuba Road, to the south by Avenue 352, and to the west by County Road 112 (USFWS, 2005 a). The land comprising this unit is privately owned (USFWS, 2005 a).

East Bay Region:

This geographic region is located in Alameda County, south to Santa Benito and Santa Clara counties, and west to the eastern portions of San Joaquin and Merced counties (USFWS, 2005 a). This region includes 2.4 million acres with 24,045 acres of critical habitat designated into 14 critical habitat units (USFWS, 2005 a). These 14 critical habitat units occur in the Livermore, Central Coast, and San Joaquin vernal pool regions (USFWS, 2005 a). Some of these critical habitat units are pristine (USFWS, 2005 a). It is thought that the CTS in the East Bay Region does not occur west of Interstate Highway 680, south of Interstate Highway 580, or north of State Highway 4 in Contra Costa or Alameda counties (USFWS, 2004 a).

1. Alameda Creek Unit, Santa Clara County:
   This unit includes 619 acres and represents the north-central part of the Bay Area region and the northwestern Livermore vernal pool region (USFWS, 2005 a). This unit is bounded to the south by the Calaveras Reservoir, to the west by Sugar Butte, to the east by Fremont, and to the north of Livermore. The land in this unit is a mixture of county parks and private land (USFWS, 2005 a).

2. Poverty Ridge Unit, Santa Clara County:
   This unit includes 2,814 acres and represents the north-central part of the Bay Area region and the southern end of the Livermore vernal pool region (USFWS, 2005 a). This unit is bounded to the east by Alum Rock, to the north by the Alameda and Contra Costa counties line, to the east by Kincaid Road, and to the south by Master Hill (USFWS, 2005 a). The land in this unit is privately owned (USFWS, 2005 a).

3. Smith Creek Unit, Santa Clara County:
   This unit includes 7,976 acres and represents the north-central portion of the range of the CTS within the Bay Area region, and the northern range of the Central Coast vernal pool region (USFWS, 2005 a). This unit is bounded to the east by Sugarloaf Mountain, to the north by Packard Ridge, to the west by Masters Hill, and to the south by Panochita Hill (USFWS, 2005 a). This unit is comprised of county, private, and University of California owned land (USFWS, 2005 a).

4. San Felipe Creek Unit, Santa Clara County:
   This unit includes 9,080 acres and represents the center of the Bay Area region and the north-central portion of the Central Coast vernal pool region (USFWS, 2005 a). This unit is bounded on the east by Silver Creek, on the north by Panochita Hill, on the west by Bollinger Mountian, and on the south by Morgan Hill (USFWS, 2005 a). The land in this unit is privately owned (USFWS, 2005 a).

5. Laurel Hill Unit, Santa Clara County:
   This unit includes 2,535 acres and represents the northwestern part of the CTS in the Bay Area region and the northwestern area of the Central Coast vernal pool region on the western side of the Santa Clara Valley (USFWS, 2005 a). Unit 8 is bounded to the west by Morgan Hill, to the north by San Jose, to the east by the Santa Cruz Mountains, and to the south by Croy Ridge (USFWS, 2005 a). The land in this unit is privately owned (USFWS, 2005 a).

6. Cebata Flat Unit, Santa Clara County:
   This unit includes 2,934 acres and represents the center of the Bay Area region and the central part of the Central Coast vernal pool region (USFWS, 2005 a). This unit is bounded to the east by Gilroy, to the north by Henry Coe State Park, to the west by Lake Mountain, and to the south by Canada Road (USFWS, 2005 a). The land in this unit is privately owned (USFWS, 2005 a).

7. Lions Peak Unit, Santa Clara County:
   This unit includes 892 acres and is divided into two subunits (USFWS, 2005 a). Subunit 10 a includes 194 acres and subunit 10 b includes 698 acres (USFWS, 2005 a). This unit represents the second unit on the west side of the Santa Clara Valley in the center of the Bay Area region and the center of the Central Coast vernal pool region (USFWS, 2005 a). This unit is bounded to the west by State Highway 101, to the north by Morgan Hill, to the south by Hecker Pass, and to the east by Uvas Reservoir (USFWS, 2005 a). The land in this unit is privately owned (USFWS, 2005 a).

8. Braen Canyon Unit, Santa Clara County:
   This unit includes 6,991 acres and represents the eastern central part of the CTS range within the Bay Area region and the central part of the Central Coast vernal pool region (USFWS, 2005 a). Unit 11 is located in southern Santa Clara County and is bounded to the east by Gilroy, to the north by Kelly Lake, to the west by Pacheco Lake, and to the south by Jamison Road (USFWS, 2005 a). The land in this unit is privately owned (USFWS, 2005 a).

9. San Felipe Unit, Santa Clara and San Benito Counties:
   This unit includes 6,642 acres and represents a part of the center of the CTS range in the Bay Area region and the southernmost part of Santa Clara County, northern San Benito County, and the center of the Central Coast vernal pool region (USFWS, 2005 a). Unit 12 is bounded to the east by Camadero, to the north by Kickham Peak, to the west by San Joaquin Peak, and to the south by Dunneville (USFWS, 2005 a). The land in this unit is privately owned (USFWS, 2005 a).

10. Los Banos Unit, Merced County:
    This unit includes 2,409 acres and represents a part of the southeastern range of the CTS in the Bay Area region and the San Joaquin Valley vernal pool region (USFWS, 2005 a). Unit 13 is bounded to the west by Los Banos Reservoir, to the south of Bullard Mountain, to the east of Cathedral Peak, and to the north by San Luis Reservoir State Recreation Area (USFWS, 2005 a). The land in this unit is privately owned (USFWS, 2005 a).

11. Landgon Unit, Merced County:
    This unit includes 2,212 acres and represents the easternmost range of the CTS in the Bay Area region and is the only other unit in the San Joaquin Valley vernal pool region (USFWS, 2005 a). Unit 14 is bounded to the east by Sweeny Hill, to

the north by Gasten Bide Road, and to the south by Ortigalita Peak (USFWS, 2005 a). The land in this unit is privately owned (USFWS, 2005 a).

12. Ana Creek Unit, San Benito County:
    Unit 15 includes 3,165 acres and consists of two subunits (USFWS, 2005 a). Subunit 15 a includes 2,722 acres and subunit 15 b includes 194 acres (USFWS, 2005 a). This unit represents the southwestern part of the CTS range in the Bay Area region and southern Central vernal pool region (USFWS, 2005 a). Unit 15 is bounded to the east by Hollister, to the south by Tres Pinos, to the west by Cibo Peak, and to the north by Coyote Peak (USFWS, 2005 a). The land in this unit is privately owned (USFWS, 2005 a).

13. Bitterwater Unit, San Benito County:
    This unit includes 16,952 acres and represents the southernmost range of the CTS in the Bay Area region and the southern end of the Central Coast vernal pool region (USFWS, 2005 a). This unit is bounded to the north by Pinnacles, to the west by Hernandez Reservoir, to the south by Lonoak, and to the east by Murphy Flat (USFWS, 2005 a). The land in this unit is privately owned (USFWS, 2005 a).

14. Gloria Valley Unit, Monterey and San Benito Counties:
    This unit includes 3,881 acres and represents the northeastern part of the CTS's range in the Bay Area region and the western area of the Central Coast vernal pool region (USFWS, 2005 a). Unit 17 is bordered to the south by Soledad, to the west by Pinnacles National Monument, to the north by Tres Pinos, and to the east by Gonzales (USFWS, 2005 a). The land in this unit is privately owned (USFWS, 2005 a).

Central Coast Region:
The Central Coast Region is found from Monterey County to northeastern San Luis Obispo County (USFWS, 2005 a). This region is 3.6 million acres and includes two critical habitat units consisting of 25,373 acres (USFWS, 2005 a). The critical habitat is designated in the Central Coast, Livermore, and Carrizo vernal pool regions (USFWS, 2005 a).

1. Haystack Hill Unit, Monterey County:
   Unit 3 includes 3,665 acres and represents the center of the Central Coast region and the northwestern area of the Central Coast vernal pool region (USFWS, 2005 a). This unit is bounded to the south by Soledad, to the west by Paloma Ridge, to the east by Jamesberg, and to the north by Carmel Valley (USFWS, 2005 a). The land in this unit is a mixture of privately owned land and Hastings Natural History State Reserve land (USFWS, 2005 a).

2. Choice Valley, Kern and San Luis Obispo Counties:
   This unit includes 9,233 acres and represents the southernmost extension of the CTS's range in the Central Coast region and is the only critical habitat unit in the

Carrizo vernal pool region (USFWS, 2005 a). This unit is bordered to the south by the Carrisa Highway, to the west by Antelope Valley, to the north by Cottonwood, and to the east by Shandon. The land in this unit is privately owned (USFWS, 2005 a).

5.5 Diet

Larval CTS eat algae, snails, zooplankton, small crustaceans, and aquatic larvae and invertebrates, including mosquito larvae for about six weeks after hatching (Hurt, 2000; and USFWS, 2000, 2003 a, 2005 b). CTS larvae switch to larger prey after this initial period, including smaller tadpoles of Pacific tree frogs, California red-legged frogs (CRLF), western toads, and spadefoot toads, as well as aquatic insects and other aquatic invertebrates (USFWS, 2000 and 2003 a). The CTS larvae may also eat each other (USFWS, 2000). Adult CTS eat terrestrial invertebrates, insects, frogs, and worms (USFWS, 2005 b). The juvenile and adult CTS eat very little during the summer and fall when they are aestivating (USFWS, 2003 a). However, during the fall and winter rains, the CTS emerge from their burrows to feed (USFWS, 2003 a). Adult and subadult CTS feed at night when relatively humidity is high (USFWS, 2004a).

5.6 Life History and Reproduction

Subadult and adult CTS spend the summer and fall months in a state of dormancy or inactivity (estivation). They estivate in the burrows of small mammals. CTS emerge from their burrows during the fall and winter rains (November through June) and migrate to the breeding ponds to mate and lay eggs (USFWS, 2004 a). The breeding migration typically takes place at night during a rainstorm when there is little threat of desiccation (Hurt, 2000 and USFWS, 2000). Adult CTS may migrate up to 2 km (1 mile) from their burrows to the breeding pond (USFWS, 2003 a). Males migrate before females and generally stay at the breeding pond five to six weeks longer than the females (USFWS, 2003 a). Males typically remain in the ponds for an average of 6 to 8 weeks, while the females only stay for 1 to 2 weeks (USFWS, 2003 a). If the weather is hot and dry, the CTS may not stay at the breeding ponds for very long (USFWS, 2003 a). If the rains occur late in the season, or if a drought occurs, CTS may not breed at all (USFWS, 2000 and 2003 a).

The adults mate and the females lay their eggs in the pond (USFWS, 2003 a). Female CTS in the East Bay area may lay eggs twice, once in December and a second time in February (USFWS, 2004a). The females lay their eggs singly, or on rare occasions, in small groups of two to four (USFWS, 2003 a). Females lay between 400 and 1300 eggs each breeding season (USFWS, 2000). These eggs are attached to grass or vegetation at the edge of the breeding ponds, if available. Rocks, branches, or other submerged debris are used if no vegetation is available (USFWS, 2003 a). After breeding the adults return to their burrows, although they may continue to emerge from the burrow at night for the next two weeks in order to feed (USFWS, 2003 a).

Salamander eggs typically hatch after 10 to 14 days (USFWS, 2003 a). The larval stage is aquatic and typically lasts three to six months, until the ponds dry out. Some larvae in Contra Costa and Alameda counties may remain in their breeding sites over the summer (USFWS, 2004 a). The larvae must reach a critical body size, about two to three inches in length, before they metamorphose into the terrestrial life-stage (Hurt, 2000 and USFWS, 2003 a). During their metamorphosis CTS larvae lose their gills and develop lungs and legs. Larvae metamorphose and leave the breeding pools 60 to 94 days after the eggs are laid (USFWS, 2003 a). Larvae develop faster in smaller pools because these pools dry out faster. The longer the pond contains water, the larger the larvae and metamorphose juveniles are able to grow, and the more likely they are to survive and reproduce (USFWS, 2003 a). The snout to vent length of newly metamorphosed CTS juveniles ranges from 41 to 78 mm (1.6 to 3.1 inches) (USFWS, 2000).

Once the larvae metamorphose into the terrestrial life-stage in late spring or early summer, they migrate to their own small mammal burrows (USFWS, 2003 a). Juveniles have been observed migrating up to 1.6 km (1 mile) from the breeding ponds to their aestivation sites (typically burrows) (USFWS, 2003 a). An estimated 50% of juveniles do not survive their first summer (USFWS, 2003 a). Juveniles typically do not return to the breeding pools until they reach sexual maturity (USFWS, 2003 a). Preliminary data suggest that most CTS become sexually mature after two years (USFWS, 2003 a). However, most individuals do not breed until they are four or five years old (USFWS, 2005 b). CTS usually go back to their natal pond to breed but one study showed that 20% of CTS were re-captured at ponds other than their natal pond (USFWS, 2000). Studies have also correlated dispersal distance with precipitation with CTS traveling farther in wetter years (USFWS, 2000).

Although CTS are generally long-lived, some may live up to 10 years, many individuals only reproduce once in their lifetime and others may not reproduce at all (USFWS, 2004 a). Individual animals may not survive to sexual maturity and others may not find a pond in which to mate. It has been estimated that less than 50% of CTS breed more than once in their lifetime (USFWS, 2000). In some populations, it has been determined that less than 5% of juveniles survive to breeding adults (USFWS, 2005 b). One study found that the average female CTS breeds 1.4 times and produces 8.5 young that survive to metamorphosis per reproductive effort (USFWS, 2005 b). The result of this finding is that over the lifetime of a female only about 11 metamorphic offspring are produced (USFWS, 2005 b).

5.7 References

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6: DELTA SMELT

6.1 Species Listing Status

The delta smelt (*Hypomesus transpacificus*) was listed as threatened on March 5, 1993 (58 FR 12854) by the U.S. Fish and Wildlife Service (USFWS) (USFWS, 2007 a). A recovery plan for the Sacramento/San Joaquin Delta Native Fishes, including the delta smelt, was approved by the USFWS on November 26, 1996 (USFWS, 1995). A 5-year review was published by the USFWS on March 31, 2004 (USFWS, 2004 a).

6.2 Description and Taxonomy

Delta smelt are slender-bodied, nearly transparent steely blue fish that typically reach 60-70 millimeters (2.4-2.8 inches) standard length, although a few may reach 120 millimeters (5.1 inches) standard length (USFWS, 1995 and 2007 a). This species typically lives only about one year (USFWS, 1993 and 2007 a).

6.3 Distribution and Status

Delta smelt occur only in Suisun Bay and the Sacramento-San Joaquin estuary (known as the Delta) near San Francisco Bay, in Contra Costa, Sacramento, San Joaquin, Solano and Yolo counties California (USFWS, 1993,1995, 2004 b and 2007 a and b). The Delta is the uppermost part of the system, where the Sacramento and San Joaquin Rivers meet, and is largely a tidal freshwater system (USFWS, 1995). Delta smelt are now known to spawn in the Napa River; however, it is unclear if these delta smelt are self perpetuating or if frequent recolonization from the delta is necessary to maintain a population in that location (USFWS, 2004 a).

Delta smelt abundance from year to year has fluctuated greatly in the past, and between 1982 and 1992 their population was consistently low (CDFG, 2008 b; and USFWS, 1995 and 2004 b). At the time of listing, the Delta smelt were under a high degree of threat from the severe drought in California between1987and 1992. The species persisted in small numbers and rebounded to pre-decline levels in 1993 (USFWS, 2004 a). Annual changes in the population appear to be affected by the amount of outflow from the upper Sacramento-San Joaquin Estuary which varies from year to year due to precipitation and water management (CDFG, 2008 a and b). The analysis of 22 years of monthly sampling data from the Suisun Marsh shows that the delta smelt have still not recovered to their former abundance, although there has been a general increase in numbers since their low point during the long period of drought (USFWS, 2004 a).

6.4 USFWS Critical Habitat

Critical habitat was designated for the delta smelt on December 19, 1994 (59 FR 65256) (USFWS, 1994 and 2007 a). The designation of critical habitat is based on habitat areas that provide essential life-cycle needs of the species or areas that contain primary constituent elements (PCEs). Critical habitat is designated in the following geographic area – areas of all water and all submerged lands below ordinary high water and the entire water column bounded by and contained in Suisun Bay (including the contiguous Grizzly and Honker Bays); the length of Goodyear, Suisun, Cutoff, First Mallard (Spring Branch), and Montezuma sloughs; and the existing contiguous waters contained within the Delta. Thus, critical habitat for the delta smelt is contained within Contra Costa, Sacramento, San Joaquin, Solano, and Yolo Counties, California (USFWS, 1994).

The PCEs essential to the conservation of the delta smelt are physical habitat, water, river flow, and salinity concentrations required to maintain delta smelt habitat for spawning, larval and juvenile transport, rearing, and adult migration (USFWS, 1994). The specific geographic areas identified for each habitat condition represent the maximum possible range of each of these conditions. Depending on the water-year type (i.e., wet, above normal, normal, below normal, dry, critically dry), each of the habitat conditions specified below requires fluctuation (within-year and between-year) in the placement of the 2 parts per thousand (ppt) isohaline (a line drawn to connect all points of equal salinity) around three historical reference points (USFWS, 1994). These three points are the Sacramento-San Joaquin River confluence, the upstream limit of Suisun Bay at Chipps Island, and in the middle of Suisun Bay at Roe Island. The actual number of days that the 2 ppt isohaline is maintained at the three points varies according to water-year type (USFWS, 1994). In addition, the number of days at each reference point must simulate that which historically existed in 1968. This year represents a period of time when the delta smelt was abundant (USFWS, 1994). The PCEs are organized by habitat conditions required for each life stage which are as follows:

- **Spawning Habitat:** Shallow, fresh or slightly brackish backwater sloughs and edgewaters are required for spawning (USFWS, 1994). These areas must also provide suitable water quality (i.e., low concentrations of pollutants) and substrates for egg attachment (e.g., submerged tree roots and branches and emergent vegetation) to ensure egg hatching and larval viability. Specific areas that have been identified as important delta smelt spawning habitat include Barker, Lindsey, Cache, Prospect, Georgiana, Beaver, Hog, and Sycamore sloughs and the Sacramento River in the Delta, and tributaries of northern Suisun Bay (USFWS, 1994).

- **Larval and Juvenile Transport:** Adequate river flow is necessary to transport larvae from upstream spawning areas to shallow, productive rearing or nursery habitat in Suisun Bay. The 2 ppt isohaline must be located westward of the Sacramento-San Joaquin River confluence during the period when larvae or juveniles are being transported, according to the historical salinity conditions which vary according to water-year type to ensure that suitable rearing habitat is available in Suisun Bay (USFWS, 1994). Maintenance of the 2 ppt isohaline will produce the high plankton and zooplankton densities that characterize most healthy estuarine ecosystems that ensure suitable rearing habitat. The specific season when habitat conditions identified above are important for successful larval transport varies from year to year, depending on when peak spawning occurs and on the water-year type (USFWS, 1994).

- **Rearing Habitat:** Maintenance of the 2 ppt isohaline according to the historical salinity conditions described above and suitable water quality within the upper Sacramento-San Joaquin Estuary is necessary to provide delta smelt larvae and juveniles a shallow, protective, food-rich environment in which to mature into adulthood. An area extending eastward from Carquinez Strait, Honker Bay, Montezuma Slough and its tributary sloughs, up the Sacramento River to its confluence with Three Mile Slough, and south along the San Joaquin River including Big Break, defines the specific geographic area critical to the maintenance of suitable rearing habitat. Protection of rearing habitat conditions may be required from the beginning of February through the summer (USFWS, 1994).

- **Adult Migration:** Adult delta smelt must be provided unrestricted access to suitable spawning habitat in a period that may extend from December to July. Adequate flow and suitable water quality may need to be maintained to attract migrating adults in the Sacramento and San Joaquin River channels and their associated tributaries. These areas should be protected from physical disturbance and flow disruption during migratory periods (USFWS, 1994).

6.5 Habitat

Delta smelt of all sizes are found in the main channels of the Delta and Suisun Marsh and the open waters of Suisun Bay where the waters are well oxygenated and temperatures are relatively cool, usually less than 20-22 degrees Celsius (68-72 degrees Fahrenheit) in the summer (USFWS, 1995 and 2004 b). When not spawning, they tend to be concentrated near the zone where incoming salt water and out flowing freshwater mix (mixing zone). This area has the highest primary productivity and is where zooplankton populations (on which delta smelt feed) are usually most dense. At all life stages, delta smelt are found in greatest abundance in the top 2 meters of the water column and usually not in close association with the shoreline (USFWS, 1995 and 2004 b).

The delta smelt is a euryhaline species (species adapted to living in fresh and brackish water) that occupies estuarine areas with salinities typically below 2 grams per liter (parts per thousand), but have been found in waters up to 18.5 ppt (USFWS, 1993, 1994, and 1995). Delta smelt live along the freshwater edge of the mixing zone (entrapment zone - saltwater-freshwater interface), where the salinity is approximately 2 ppt for a large part of their one-year life span (USFWS, 1994, 2004 b, and 2007 a). However, it should also be noted that the point in the estuary where the 2 ppt salinity is located does not necessarily regulate delta smelt distribution in all years (USFWS, 1995). In wet years, when abundance levels are high, their distribution is normally very broad. (USFWS, 1995 and 2004 b). In some cases food availability may also influence delta smelt distribution (USFWS, 1995). During years with wet springs (such as 1993), delta smelt may continue to be abundant in Suisun Bay during summer even after the 2 ppt isohaline has retreated upstream (USFWS, 1995).

6.6 Activity, Movement, and Behavior

Although delta smelt swim together in schools, they are unsteady, and are intermittent, slow speed swimmers (USFWS, 2004 a, USFWS, 2004 b and 2007 a). Delta smelt are unable to swim against the current for any substantial distance, and therefore are more susceptible to impingement and entrainment at major water diversions than other similar sized fish species (USFWS, 2004 a).

6.7 Diet

The most important food organism for all sizes of the delta smelt seems to be the euryhaline copepod and *Eurytemora affinis* (USFWS, 1995 and 2004 b). The primary food for all life stages of the delta smelt are the nauplius, copepodite, copepodid, and adult stages of the euryhaline copepod *Eurytemora affinis*.

6.8 Life History and Reproduction

The spawning season varies from year to year and may occur from late winter to early summer (USFWS, 1994 and 2004b). Gravid adult smelt have been collected from December to April, although ripe delta smelt were most common in February and March (USFWS, 1994 and 2004b). Delta smelts spawn in shallow, fresh or slightly brackish water upstream of the mixing zone (USFWS, 1994, 2004b, and 2007a) at temperatures ranging 7-22 degrees Celsius (44-72 degrees Fahrenheit) (USFWS, 1995 and 2004b). Most spawning happens in tidally influenced backwater sloughs and channel edgewaters in the upper Delta including Barker, Lindsey, Cache, Georgiana, Prospect, Beaver, Hog, and Sycamore sloughs, and in the Sacramento River above Rio Vista. (USFWS, 1994, 1995, and 2007a).

Delta smelt are broadcast spawners that spawn in a current, usually at night, distributing their eggs over a local area (USFWS, 1994). The eggs are demersal (i.e., they sink to the bottom) and contain an adhesive-like substance causing them to stick to hard substrates such as rock, gravel, tree roots or submerged branches, and submerged vegetation (USFWS, 1994, 1995, 2004b, and 2007a). Delta smelt reach their full length in 7-9 months and are considered to be sexually mature adults at this point (USFWS, 1993, 1995, and 2004b). Delta smelt have a low fecundity compared to two other species of Osmeridae occurring in California (USFWS, 1993). Based on observations, delta smelt greater than 1.97 inches found throughout their range when spawning season is over is rare indicating that adult delta smelt may die after spawning (USFWS, 1993).

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7: SALT MARSH HARVEST MOUSE

7.1 Species Listing Status

The salt marsh harvest mouse (SMHM) (*Reithrodontomys raviventris*) was listed as endangered on October 13, 1970 (35 FR 16047) by the U.S. Fish and Wildlife Service (USFWS). This species has been protected by the Endangered Species Act since it was enacted in 1973. A recovery plan for the SMHM was approved by USFWS on November 16, 1984 (USFWS 1984).

7.2 Description

The SMHM weighs between 8-14 grams (Goals Project 2000; Massicot 2005; CDPR website), and has a head to body length of 69-74 mm, with a total length (including tail) of 118-175 mm (Goals Project 2000; Massicot 2005; CDPR website). The lifespan of the SMHM is generally less than eight months, though can range up to one year, with the maximum observed lifespan being 18 months in the wild (Shellhammer 1998; Massicot 2005).

7.3 Distribution

There are two subspecies of the SMHM. The northern subspecies (*R. r. halicoetes*) is found in Marin, Sonoma, Napa, Solano, and Contra Costa counties (CDPR website). It lives in the Petaluma and Napa marshes, as well as marshes of the San Pablo and Suisun Bays (Goals Project 2000; Brylski 1999). The southern subspecies (*R. r. raviventris*) is found mainly in San Mateo, Alameda, and Santa Clara counties, with some isolated populations in Marin and Contra Costa counties (CDPR website). It occupies the marshes of Corte Madera, Richmond, and South San Franciso Bay, which are generally more highly developed areas (USFWS 1984; USFWS 2007a; Goals Project 2000).

SMHMs are currently found in tidal and non-tidal salt marshes in San Francisco, San Pablo, and Suisun Bays (USFWS 2007a; CDFG website). Currently, the highest consistent SMHM populations are found in large marshes along the eastern edge of San Pablo Bay that are or will be included in the San Francisco Bay National Wildlife Refuge (SFBNWR) (Goals Project 2000). The SMHM is also sustaining itself in a few marsh areas in the SFBNWR, including Calaveras and Dumbarton Points, Greco Island, and New Chicago Marsh (Shellhammer 1998). Some parts of the Contra Costa County coastline and some parts of the Petaluma Marshes as well as the Calaveras Point Marsh in South San Francisco Bay also support large populations of SMHM (Goals Project 2000).

7.4 USFWS Critical Habitat

There is no federally designated critical habitat for the SMHM (USFWS, 2007a).

7.5 Habitat

Salt marshes have three zones: a low marsh that receives maximum submergence comprised of cordgrass (*Spartina foliosa*) or tules (*Scirpus* spp.); a middle marsh zone comprised of pickleweed (*Salcornia virginica*), alkali bulrush (*Scirpus robustus*), or cattails (*Typha* spp.); and a high marsh dominated by peripheral halophytes (salt-tolerant plants) that receives infrequent to no tidal coverage (USFWS 1984; Shellhammer 1998). Other halophyte species include gum-plant (*Grindelia* spp.), salt grass (*Distichlis spicata*), jaumea (*Jaumea carnosa*), and alkali heath (*Frankenia grandifolia*) (USFWS 1984).

SMHM prefer habitat in the middle and upper parts of the marsh dominated by pickleweed (*Salicornia virginica*) and peripheral halophytes, as well as similar vegetation found in diked wetlands adjacent to the San Francisco Bay, and depend on dense, perennial cover (USFWS 1984; USFWS 2007a; Goals Project 2000; Brylski 1999; Shellhammer 1998). SMHM prefer pickleweed to salt grasses and alkali bulrush, as pickleweed provides more cover (USFWS 1984). The northern subspecies of the SMHM is usually found in brackish marshes with a wide range of salinities but an average of moderately saline, and the southern subspecies lives in marshes with an average salinity that is relatively high and stable (USFWS 1984). Diverse brackish marshes composed of various rushes, cattails and pickleweed support SMHM populations (USFWS 1984).

Although pickleweed is its primary habitat, SMHM also utilize non-submerged salt-tolerant vegetation in the upper marsh zone for escape during high tide, and may also spend a considerable amount of their lives there (Brylski 1999; USFWS 1984; USFWS 2007a). During the highest winter tides, SMHMs can move into adjoining grasslands (USFWS 1984; USFWS 2007a). SMHM also use grasslands in spring and summer when they provide maximum cover, though these movements represent daily activity and not complete shifts in habitat (Goals Project 2000; Brylski 1999; CDPR website).

7.6 Diet

SMHMs consume leaves, seeds, and plant stems (USFWS 1984; USFWS 2007a; Brylski 1999). They may also occasionally eat insects (Massicot 2005). Seasonal variation has been observed in SMHM stomach contents (Brylski 1999). They seem to prefer fresh green grasses in winter and pickleweed and saltgrass during the rest of the year (USFWS 1984; USFWS 2007a; CDPR website; Brylski 1999). The northern subspecies of SMHM can drink salt water for long periods of time but prefers fresh water, while the southern subspecies cannot subsist on salt water but prefers moderately salty water over fresh (USFWS 1984; USFWS 2007a; Brylski 1999; Shellhammer 1998).

7.7 Life History and Reproduction

SMHMs are active year-round (CDPR website; Massicot 2005). They are primarily nocturnal but are occasionally active during the day (USFWS 1984; USFWS 2007a; CDPR website; Massicot 2005). The southern subspecies of SMHM has been described as becoming torpid in the early morning but the northern subspecies does not become torpid (Brylski 1999). In general, SMHM are not extremely active and depend on cover for predator escape (USFWS 1984).

Roads or small open areas (10 meters wide) can act as homerange barriers to SMHM (USFWS 1984), so individual SMHMs do not seem to move between marshes (Brylski 1999). However, as adept swimmers and floaters, SMHM can sometimes re-colonize marshes separated by water after local extinctions by swimming or rafting to the new marsh (USFWS 1984).

SMHMs do not burrow (USFWS 1984; Brylski 1999; CDPR website; Goals Project 2000); however, Massicot (2005) suggested that "some winter nests are constructed in burrows and small crevices." SMHM nests are minimal and are often built over old birds' nests, including those of song sparrows (USFWS 2007a; Massicot 2005; CDPR website). SMHMs may also use Suisun shrew nests, after the young shrews have dispersed (Goals Project 2000). SMHM nests often consist of a loose ball of dry grasses and other vegetation, about 150 to 175 mm in diameter, built on the ground surface or up in the pickleweed, and may be abandoned at the next high tide (USFWS 1984; Massicot 2005; Goals Project 2000). The southern subspecies usually does not even make a nest, although it may construct a loosely organized structure of dry grasses (USFWS 2007a; Brylski 1999).

SMHMs breed from spring through fall (USFWS 2007; CDPR website). Male SMHMs are reproductively active from April through September, although some males appear to be active year-round (USFWS 1984). Females SMHMs have a longer breeding season that extends from as early as March through November (USFWS 1984). The northern subspecies of SMHM breeds from May to November and the southern subspecies breeds from March to November (Brylski 1999). Each female typically only has one or two litters per year with an average litter size of about three or four young per litter (USFWS 2007a; Shellhammer 1998; CDPR website). Brylski (1999) suggests that the southern subspecies may have two litters per year whereas the abbreviated breeding season for the northern subspecies may indicate only one litter per year. Reported gestation periods for the genus *Reithrodontomys* are 21 – 24 days (Massicot 2005).

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8: SAN FRANCISCO GARTER SNAKE

8.1 Species Listing Status

The San Francisco Garter Snake (SFGS) (*Thamnophis sirtalis tetrataenia*) was listed as endangered on March 11, 1967 (32 FR 4001; USFWS 1967) by the U.S. Fish and Wildlife Service (USFWS) and was grandfathered under the Endangered Species Act (ESA) when it was signed into law in 1973. A Recovery Plan for the SFGS was approved by the USFWS on September 11, 1985 (USFWS, 1985). In addition, a 5-year review, which provides an updated life history for the SFGS, was published by the USFWS in September of 2006 (USFWS, 2006).

8.2 Description

The SFGS is a thin and colorful snake in the *Colubridae* family, which includes most of the species of snakes found in the western U.S. (USFWS, 2007). SFGSs range in length from 46 to 131 cm (18 to 51 inches) (USFWS, 1985 and Woodland Park Zoo). Female SFGS typically weigh about 8 oz. (227 g), whereas, males are usually smaller than females and can be half the length and weight of females (SF Zoo and Woodland Park Zoo). Garter snakes are usually about two inches in girth (Kaplan, 2002). Neonate snakes are 18 to 20 cm in length and disperse immediately after they are born. Juvenile SFGS grow quickly during their first year and spend most of their time feeding. These snakes are typically considered to be mature at two years of age when the males are about 46 cm and the females are about 55 cm; however, some snakes take longer to mature and may not reach maturity until they are three years old. It is estimated that SFGS live between 8 and 15 years (Woodland Park Zoo and Goals Project, 2000).

8.3 Distribution

SFGSs are endemic to the San Francisco Peninsula and San Mateo County and were historically found from San Francisco to Santa Cruz (USFWS, 1985 and 2005), including the San Francisco Peninsula from just north of the San Francisco-San Mateo County line near Lake Merced south along the eastern and western bases of the Santa Cruz Mountains, to the Upper Crystal Springs Reservoir, along the coast south to Ano Nuevo Point, in San Mateo County, and Waddell Creek, in the extreme northern portion of Santa Cruz County (USFWS, 1985, 2006, and 2007). However, the findings of SFGS in Waddell Creek in Santa Cruz County may be questionable (Goals Project, 2000) due to the reported presence of hybrid species in the area.

SFGS populations are thought to have primarily occupied habitat areas in the Buri Buri Ridge along the San Andres Rift Zone from near Pacifica, southeast to the Pulgas Water Temple, and in an arc from the San Georgio-Pescadero highlands west to the coast, and south to Ano Nuevo (USFWS, 2006 and Goals Project, 2000). Red-sided garter snake (RSGS) and SFGS hybrids have been found in eastern San Mateo County (southeast of the Pulgas Water Temple) and in the extreme western part of Santa Clara County (Goals Project, 2000). The hybrids range from the Pulgas region near Upper Crystal Springs Reservoir south to Palo Alto (USFWS, 2006).

The extreme northeastern part of the SFGS's range may have been represented by a population at San Bruno Mountain; however, it is possible that this population has been extirpated (USFWS, 2006). This population may not be natural as individual SFGSs may have been moved here in an attempt to protect them because this area is protected under a Habitat Conservation Plan (HCP) (USFWS, 2006). It is possible that these attempted conservation methods were also used farther south, resulting in the population at Half Moon Bay (USFWS, 2006).

The historic range of the SFGS may have extended as far south as Stanford in Santa Clara County (USFWS, 2006). This assumption is based on observations of hybrids of the SFGS and other garter snake species in this area (USFWS, 2006). The USFWS also believes that areas on the coast west of the Santa Cruz Mountains may be inhabited by the SFGS; however, this cannot be confirmed because this area is privately owned (USFWS, 2006).

Historically, SFGSs were found in sag ponds, small seasonal ponds along the San Andreas Fault in the northern part of the San Francisco Peninsula (USFWS, 1985). Some believe that the purest SFGS populations were found on the coast around Sharp Park in Laguna Salada and along the ridge of the San Francisco Peninsula east of Sharp Park (USFWS, 1985). Habitat areas in the northern and eastern portions of the SFGS's historical range have been destroyed by urbanization and development, including the SFGS population co-located with the sag ponds along the ridge of the San Francisco Peninsula east of Sharp Park (USFWS, 1985).

Although the SFGS's geographical range seems extensive, field surveys performed by the USFWS and the California Department of Fish and Game (CDFG) indicate that their range is limited to and localized within San Mateo County (USFWS, 1985). Six areas are known to contain significant populations of SFGS: 1) Ano Nuevo State Reserve (ANSR), 2) Pescadero Marsh Natural Preserve, 3) San Francisco State Fish and Game Refuge (including both Upper and Lower Crystal Springs Reservoirs), 4) Sharp Park (Laguna Salada), 5) Cascade Ranch, and 6) Milbrae or West of Bayshore (near the San Francisco Airport) (USFWS, 1985).

The current distribution of the SFGS is unknown because most of their historic range is now privately owned; however, it appears that the SFGS can still be found in much of its historic range (USFWS, 2006 and 2007). SFGSs were found in Upper Crystal Springs Reservoir and Mud Dam in 1998 (San Francisco Planning Department, 2001). They were also observed at “San Andreas Reservoir and in a sag pond between San Andreas and Crystal Springs” (San Francisco Planning Department, 2001). Regardless, the number of locations that previously maintained healthy populations of the SFGS has declined and SFGS have been extirpated from individual locations within their historic range (USFWS, 2007). Currently, wild SFGS populations are limited to coastal San Mateo County and other small pockets (USFWS, 2005).

Some sources state that 65 “permanent” reproductive populations ranging from two to over 500 adults were found on the San Francisco Peninsula (Kaplan, 2002 and Goals Project, 2000). The total SFGS population is believed to be around 1500 snakes over one year old (Kaplan, 2002 and Goals Project, 2000). All young under one year old are not included in population counts because the population increases when the young are born and returns to around 1500 the following spring due to insufficient resources (Kaplan, 2002). It is thought that half of the populations are protected to some degree by refuges including preserves and state parks (Goals Project, 2000).

8.4 USFWS Critical Habitat

No critical habitat for the SFGS has been designated by the USFWS (2007) to date.

8.5 Habitat

Successful SFGS breeding populations are typically found in densely vegetated ponds near open hillsides where they can sun themselves, feed, and find shelter in rodent burrows; however, less ideal habitats can also be occupied (USFWS, 2007). These sites usually include emergent vegetation for cover, basking sites, food sources, upland hibernation sites, and corridors which allow for movement between the feeding grounds and the hibernation sites (USFWS, 1985 and 2007). SFGSs prefer shallow marshlands with emergent vegetation and breeding populations of both Pacific tree frogs and California red-legged frogs (CRLF) as well as open grassy uplands (USFWS, 2006). Breeding populations of SFGS are not known to exist where amphibians are not found (USFWS, 2006).

SFGSs are usually observed near standing open water, including ponds, lakes, marshes, slow-moving streams, and sloughs; however, they are also observed at temporary pools including stock ponds, channelized sloughs, and reservoirs (USFWS, 1985 and 2007; NatureServe, 2007; Kaplan, 2002; and Goals Project, 2000). It is speculated that SFGS remain close to open water to retain proximity to anuran species, their preferred prey (USFWS, 2006). These snakes avoid brackish water because their preferred prey, the CRLF, cannot survive in saline water (USFWS, 2007). In addition, Pacific tree frogs and their larvae cannot survive in water with a salinity of 7.0 ppt or greater (USFWS, 2006). However, SFGS may use ditches influenced by the tides as “migration corridors between disconnected areas of freshwater wetland habitat” (Powers, 2003).

Shallow water near the shoreline is required from May to July, to allow the anuran prey to hatch and metamorphose (USFWS, 2006); SFGSs are unable to capture their prey effectively in water that is more than 5 cm deep (USFWS, 2006). Shallow water also exposes rocks, algal mats, and floating vegetation found around the edges of the pond which the SFGSs use as basking sites (USFWS, 2006). These sites may also be used by the anurans and allows the SFGS greater access to their prey (USFWS, 2006).

SFGS prefer emergent vegetation, including cattails, bulrushes, spike rushes, and water plantain, for cover (USFWS, 1985 and 2007); however, they will also seek cover in the water if necessary (USFWS, 1985). If these types of vegetation are not available, SFGSs can be found in aquatic areas surrounded by willow trees as long as there is only a small distance between the overhanging vegetation and the ground (USFWS, 2006). SFGSs sun themselves at the edges of ponds or streams and will also use the area between the aquatic habitat required for their prey and the grasslands where they aestivate (become inactive or dormant) for basking (USFWS, 1985).

Upland grassy hillsides near ponds are also used for basking (USFWS, 1985). It is thought that SFGS may prefer hillsides that face south or west because they receive more sun (USFWS, 2006). Coyote bush, wild oat, wild barley, and other brome species may be found in the SFGS's upland habitat (USFWS, 2006). SFGS "prefer a grassland/shrub matrix with brush densities ranging from 1 averaged sized bush/30 square meters to 1 large bush/20 square meters" (USFWS, 2006). This mix provides both cover from predators and also exposed surfaces to allow the SFGS sun themselves, an important part of their thermoregulation (USFWS, 2006). The preferred brush to grassland ratios are maintained or can be achieved by allowing livestock grazing (USFWS, 2006). Large SFGS populations have been found to coincide with areas of land that are used for cattle grazing (USFWS, 2006). Gopher activity, which moves nitrogen-poor subsoil to the surface, has also been shown to stimulate early successional conditions (open grassland) required by the SFGS (USFWS, 2006). Although grazing appears to have a positive impact on the SFGS, overgrazing can be detrimental to this species as SFGS habitat may no longer be useful if the vegetative cover falls below 20 cm (USFWS, 2006).

Rodent burrows and thick grass mats near the ponds are used for shelter and aestivation when the ponds become dry (USFWS, 1985 and 2007 and NatureServe, 2007). SFGSs may also forage for amphibians in the rodent burrows during the summer (Goals Project, 2000). These burrows are also used for hibernation, since SFGSs found along the coast will hibernate during the winter (USFWS, 2006 and 2007). However, SFGS have been observed emerging from their burrows to bask in the winter indicating that SFGS may not truly hibernate (USFWS, 2006). This could also be due to the relatively warm climate of the San Francisco Bay area (USFWS, 2006). SFGSs that are farther inland are more likely to be active year-round (USFWS, 2007).

Recapture studies have indicated that SFGS have small home ranges that are determined by the availability of food and cover (USFWS, 1985). Most individuals remain within one or two hundred meters of their aquatic and upland habitats (USFWS, 2006). However, some snakes may be able to travel up to two km or more in a short period of time (Goals Project, 2000). Although SFGS typically do not travel far, they may follow their prey to new areas (USFWS, 2006). It is in pursuit of their prey that SFGS may be adversely affected by creek channelization, removal of vegetation, and other flood control measures that are sometimes implemented in riparian areas (USFWS, 2006). Garter snakes are typically found from sea level to 2400 m (8000 feet) (Morey, 2005).

8.6 Diet

Newborn and juvenile SFGS prey almost exclusively on Pacific tree frogs in temporary pools during the spring and early summer (USFWS, 2006 and 2007). Juvenile SFGS may capture metamorphosed Pacific tree frogs in upland habitats; however, they primarily feed on the newly metamorphosed frogs once the temporary pools begin to dry up and the frogs begin to disperse (USFWS, 2006). A laboratory experiment performed using juvenile SFGS showed that Pacific tree frogs elicited the highest response rate out of all of the common prey items that were tested (USFWS, 2006). Observations at one SFGS site have shown that anuran numbers decreased during dry years with a subsequent decrease in the survival of SFGS juveniles (USFWS, 2006). This observation indicates that the SFGS may be so dependent on their anuran prey that they are not able to switch to other available prey sources if necessary to survive (USFWS, 2006). SFGS under 500 mm snout-to-vent length (SVL) require Pacific tree frogs in various stages of metamorphosis, whereas individuals over 500 mm SVL can consume Pacific tree frog, CRLF, and bullfrog tadpoles and adults (USFWS, 2006).

The main diet of adult SFGS consists of CRLF, which are listed as a threatened species (USFWS, 1985 and 2007). Adult SFGSs consume CRLFs in the late summer when they metamorphose (USFWS, 2006). The emergence of the CRLF in the late summer allows the adult SFGS to continue feeding after the Pacific tree frogs have left the drying wetland areas (USFWS, 2006). This observed behavior likely explains the high activity level of SFGSs in the late summer (USFWS, 2006). Adult SFGSs may also feed on juvenile non-native bullfrogs (*Rana catesbeiana*), but are unable to consume the larger adults (USFWS, 2007). Bullfrogs are known to be found in degraded habitats and it is thought that bullfrogs may allow SFGS to colonize areas where Pacific tree frogs or CRLF cannot exist (USFWS, 2006). Although bullfrogs may be consumed by SFGSs, captive SFGS often regurgitate them indicating that they may be undigestable, and that bullfrogs may not be consumed by wild SFGS populations (USFWS, 2006).

Immature California newts (*Taricha torosa*), California toads (*Bufo boreas halophilus*) recently metamorphosed western toads (*Bufo boreas*), threespine stickleback (*Gasterosteus aculeatus*), and non-native mosquito fish (*Gambusia affinis*) are also known to be consumed by SFGS (USFWS, 1985). SFGS are one of the few animals known to eat the California newt without suffering the toxic effects of this organism (USFWS, 2007). Small mammals, reptiles, amphibians, possibly invertebrates, and some fish species may also be consumed by the SFGS if they can be captured in shallow water (USFWS, 1985 and 2006). Captive SFGS have been found to consume earthworms; however, some individuals will starve instead of eating them (USFWS, 2006).

Earthworms may also not be readily available in the wild, further indicating that wild populations of SFGS may not prey on these animals (USFWS, 2006).

8.7 Life History and Reproduction

SFGSs mate in the spring (March and April) and fall (September through November); however, mating is "concentrated in the first few warm days of March" (USFWS, 1985 and 2006 and Goals Project, 2000). The increased mating in the spring is correlated with SFGSs emerging from their burrows and congregating at the aquatic feeding areas (USFWS, 2006). Aggregations of mating adult SFGSs have also been observed on open grassy slopes on warm sunny mornings in late October and early November (USFWS, 1985). It is thought that the female's role in mating is relatively passive. Females release pheromones to attract males, males actively seek out the females primarily using scent, and several males may court the same female simultaneously. These types of behaviors have been identified in other subspecies of the common garter snake (USFWS, 1985 and SF Zoo). Female SFGS can store the male's sperm over the winter and can retain viable sperm for periods ranging from 3 to 53 months (USFWS, 1985 and Goals Project, 2000).

Ovulation in the common garter snake typically occurs in late spring with pregnancy resulting in early summer (USFWS, 1985). The young are typically born about three to four months after successful mating (Woodland Park Zoo). SFGS are ovoviviparous meaning that the eggs hatch within the female's body and the young are born live (USFWS, 1985 and SF Zoo). Female SFGSs give birth from June through September with young typically born in July or August (USFWS, 2007; NatureServe, 2007; and Goals Project, 2000). However, young can be born as late as early September (Goals Project, 2000). The number of young can range from three to 85 but are more typically in the range of 12 to 24 (USFWS, 1985). Most often around 16 young are produced (USFWS, 2007; SF Zoo; and Goals Project, 2000).

The young are typically born in the upland areas near the aquatic feeding habitats. Neonate snakes are 18 to 20 cm in length and disperse immediately after they are born (Woodland Park Zoo and Goals Project, 2000). Juvenile SFGS grow quickly during their first year and spend most of their time feeding (Goals Project, 2000). These snakes are typically considered to be mature at two years of age when the males are about 46 cm and the females are about 55 cm; however, some snakes take longer to mature and may not reach maturity until they are three years old (Woodland Park Zoo and Goals Project, 2000).

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9: SAN JOAQUIN KIT FOX

9.1 Species Listing Status

The San Joaquin kit fox (*Vulpes macrotis mutica*) was listed as endangered on March 11, 1967 (32 FR 4001) by the U.S. Fish and Wildlife Service (USFWS) (USFWS, 1967). A recovery plan for upland species of the San Joaquin Valley was approved by the USFWS on September 30, 1998 (USFWS, 1998).

9.2 Description

The kit fox is the smallest species in North America in the Canidae family, and on average adult males weigh 2.3 kilograms (5 pounds) and adult females weigh 2.1 kilograms (4.6 pounds) (USFWS, 1998).

9.3 Distribution

Historical Range

Prior to 1930, kit foxes inhabited most of the San Joaquin Valley from southern Kern County north to Tracy, San Joaquin County (and possibly as far as Contra Costa County to the west) and near La Grange, Stanislaus County (to the east) (USFWS, 1998 and 2008). By 1930, the kit fox range had been reduced by more than half, with the largest portion remaining in the southern and western parts of the Valley (USFWS, 1998 and 2008).

Current Range

The current distribution of kit foxes in California includes all or portions of Alameda, Contra Costa, Fresno, Kern, Kings, Madera, Merced, Monterey, San Benito, San Joaquin, San Luis Obispo, Santa Barbara, Santa Clara, Stanislaus, Tulare and Ventura counties (SJCOG, 2008). Kit foxes currently inhabit some areas of suitable habitat on the San Joaquin Valley floor and in the surrounding foothills of the coastal ranges, the 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. Kit foxes also occur westward into the interior coastal ranges in Monterey, San Benito, and Santa Clara Counties (Pajaro River watershed), in the Salinas River watershed, Monterey and San Luis Obispo, and in the upper Cuyama River watershed in northern Ventura and Santa Barbara Counties and southeastern San Luis Obispo County. Kit foxes are also known to live within the city limits of the city of Bakersfield in Kern County (USFWS, 1998).

According to the recovery plan (USFWS, 1998):

> "The largest extant populations of kit foxes are in western Kern County on and around the Elk Hills and Buena Vista Valley, Kern County, and in the Carrizo Plain Natural Area, San Luis Obispo County. The kit fox populations of Elk Hills and the City of Bakersfield, Kern County, Carrizo Plain Natural Area, San Luis Obispo County, Ciervo-Panoche Natural Area, Fresno and San Benito Counties, Fort Hunter Liggett, Monterey County, and Camp Roberts, Monterey and San Luis Obispo Counties have been recently, or are currently, the focus of various research projects. Though monitoring has not been continuous in the central and northern portions of the range, populations were recorded in the late 1980s at San Luis Reservoir, Merced County, North Grasslands and Kesterson National Wildlife Refuge area on the Valley floor, Merced County, and in the Los Vaqueros watershed, Contra Costa County in the early 1990s. Smaller populations and isolated sightings of kit foxes are also known from other parts of the San Joaquin Valley floor, including Madera County and eastern Stanislaus County" (p. 124).

The SJKF population is fragmented, particularly in the northern part of the range due to limited suitable habitat (USFWS, 2008). No evidence of recent kit fox occupancy was found in a recent survey in Contra Costa County and Alameda Counties (East Contra Costa County HCP/NCCP, 2006). Although this does not prove an absence of kit fox in these counties, it does suggest that kit fox density is low or their occurrence is periodic in the northern part of the kit fox range (East Contra Costa County HCP/NCCP, 2006).

9.4 USFWS Critical Habitat

No critical habitat for the SJKF has been designated by the USFWS (2008) to date.

9.5 Habitat

The SJKF occurs in a variety of habitats, including grasslands, scrublands (*e.g.*, chenopod scrub and sub-shrub scrub), vernal pool areas, oak woodland, alkali meadows and playas, and an agricultural matrix of row crops, irrigated pastures, orchards, vineyards, and grazed annual grasslands (East Contra Costa County HCP/NCCP, 2006; USFWS, 1998). These habitats are found as relatively small patches in scattered locations, and, in general, do not provide good denning habitat for kit foxes because all have moist or waterlogged clay or clay-like soils. However, where they are interspersed with more suitable kit fox habitats these areas provide food and cover (USFWS, 1998). According to the recovery plan (USFWS, 1998):

> "Kit foxes use some types of agricultural land where uncultivated land is maintained, allowing for denning sites and a suitable prey base. Kit foxes also

> den on small parcels of native habitat surrounded by intensively maintained agricultural lands and adjacent to dryland farms" (p. 129).

Denning sites are used for temperature regulation, shelter from adverse environmental conditions, reproduction, and escape from predators (USFWS, 1998 and 2008). Kit fox dens are found on virtually every soil type, but the kit foxes seem to prefer loose-textured soils. Dens are rarely found in areas with shallow soils because of the proximity to bedrock, high water tables, or impenetrable hardpan layers. Kit foxes dig their own dens, modify and use those already constructed by other animals (ground squirrels, badgers, and coyotes), or use human-made structures (culverts, abandoned pipelines, or banks in sumps or roadbeds) (USFWS, 1998 and 2008).

Although den characteristics vary across the SJKF range, the majority of dens are found in relatively flat terrain or gently sloping hills (with a slope of less than 40 degrees), in washes, drainages, and roadside berms in open areas with grass or grass and scattered brush, and only rarely occur in areas with thick brush (Cal. EPA Dept. of Pesticide Regulation, 2002). Natal and pupping dens are limited to flatter ground with slopes of about 6 degrees (USFWS, 1998).

Kit foxes change dens often and many dens may be used throughout the year likely to avoid potential predation by coyotes (USFWS, 1998 and 2008). Radio-telemetry studies found that foxes (of both sexes) use individual dens for only a median of 2 days (mean of 3.5 days) (USFWS, 1998). More dens are used during the dispersal season than during the breeding or pup-rearing seasons (East Contra Costa County HCP/NCCP, 2006).

9.6 Diet

The diet of the SJKF varies geographically, seasonally and annually, based on variation in abundance of potential prey (USFWS, 1998). According to the recovery plan (USFWS, 1998):

> "In the southern part of the range, one-third of the kit fox diet consists of kangaroo rats (*Dipodomys* spp.), pocket mice (*Perognathus* spp.), white-footed mice (*Peromyscus* spp.) and other nocturnal rodents. Kit foxes in this area also prey on California ground squirrels (*Spermophilus beecheyi*), black-tailed hares (*Lepus californicus*), San Joaquin antelope squirrels (*Ammospermophilus nelsoni*), desert cottontails (*Sylvilagus audubonii*), ground-nesting birds and insects… Vegetation and insects occur frequently in feces. Grass is the most commonly ingested plant material… In the central portion of their geographic range, defined here as Kings, Tulare, Fresno, Madera, San Benito, Merced, Stanislaus, and Monterey Counties, known prey species include white-footed mice, insects, California ground squirrels, kangaroo rats, San Joaquin antelope squirrels, black-tailed hares, and chukar (*Alectoris chukar*), listed in approximate proportion of occurrence in fecal samples… In the northern part of their range, defined here as San Joaquin, Alameda and Contra Costa Counties, kit foxes most

frequently consume California ground squirrels… Cottontails, black-tailed hares, pocket mice, and kangaroo rats are also eaten" (p. 124).

9.7 Life History and Reproduction

Kit foxes are predominantly, although not strictly, nocturnal with most above-ground activities beginning near sunset and continuing sporadically throughout the night (USFWS, 1998). In addition to some populations preying on diurnal ground squirrels, kit foxes are commonly seen during the day during late spring and early summer (USFWS, 1998).

Based on observations at the Elk Hills Naval Petroleum Reserves in California, kit foxes move an average of 9.6 miles nightly during the breeding season which is longer than the average nightly movements during the breeding and pup-rearing seasons (6.5 and 6.3 miles, respectively) (USFWS, 1998).

Kit fox home ranges are generally between 1-3 square miles, but they can be as large as 12 square miles (SJCOG and USFWS, 1998). Home ranges in non-urban areas tend to be larger than those in urban areas (Ralls, 2007). Differences in home range size tend to be related to prey abundance (USFWS, 1998).

Kit foxes reach reproductive age at 1-year, although they may not breed during their first year of adulthood. Breeding pairs remain together in the same home range (although not necessarily the same den) all year. In the fall (Sept. – Oct.) adult females begin to prepare (clean and/or enlarge) pupping dens, selecting those with multiple openings. Breeding takes place between Dec. and March. Gestation is estimated to range from 48 – 52 days and most litters (of 2 – 6 pups) are born between Feb. and late March. While the adult female is lactating, the adult male provides most of the food for the adult female and her pups. Pups emerge from their dens at about 1-month of age and may begin to disperse after 4 – 5 months usually in Aug. or Sept. However, offspring may remain with their parents throughout the following year to help raise a subsequent litter (USFWS, 1998 and 2008). Pups disperse on aver 5 miles (and up to 25 miles) from their pupping dens.

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10: VALLEY ELDERBERRY LONGHORN BEETLE

10.1 Species Listing Status

The valley elderberry longhorn beetle (VELB) (*Desmocerus californicus dimorphus*) was listed as threatened on August 8, 1980 (45 FR 52803) by the U.S. Fish and Wildlife Service (USFWS). A recovery plan for the VELB was approved by the USFWS on June 28, 1984 (USFWS, 1984). A 5-year review, which provides an updated life history for the VELB, was published by the USFWS in September of 2006. The USFWS announced its recommendation to remove the VELB from the endangered species list on October 2, 2006 (USFWS, 2007 a). This recommendation was based on the slowing of the loss of the habitat for this species, the protection of 50,000 acres of riparian (riverside) habitat, and the restoration of 5,100 acres of VELB habitat (USFWS, 2007 a and Environmental Defense, no date).

10.2 Description

Three species of the genus *Desmocerus* occur in North America, “including two species that occur in California” (USFWS, 1984). These species “are moderately-sized, brightly colored, and sexually dichromatic” (USFWS, 1984). All species in the genus *Desmocerus* use various elderberry species as food plants (USFWS, 1984). Two subspecies of *Desmocerus californicus*, *D. c. californicus* (California elderberry longhorn beetle [CELB]) and *D. c. dimorphus* (VELB), have been described (USFWS, 1984).

Longhorn beetles in the family *Cerambycidae* “are characterized by somewhat elongate, cylindrical bodies with long antennae, often more than 2/3 of the body length” (USFWS, 2007 a). Male VELB are usually about 2 cm (13-21 mm) but can “range in length from about ½ to nearly 1 inch (measured from the front of the head to the end of the abdomen) with antennae about as long as their bodies” (USFWS, 2007 a and b and LSA, 2004). Female VELB are broader and “slightly more robust than males, measuring about ¾ to 1 inch, with somewhat shorter antennae” (USFWS, 2007 a and b). Females range in length from 18-25 mm (LSA, 2004).

10.3 Distribution

Historic Range

The VELB is “endemic to the Central Valley of California (USFWS, 2006). “Historically the beetle ranged throughout the Valley” and could be found “in elderberry thickets in moist valley oak woodland along the margins of the Sacramento and San Joaquin Rivers” (California’s Endangered Insects and USFWS, 1980). “Although the precise historical range of the valley elderberry longhorn beetle can never be known, it is presumed that the extensive loss of riparian habitat has reduced its distribution significantly" (USFWS, 1984).

Current Range
The VELB currently occurs in the Central Valley of California "from southern Shasta County to Fresno County in the San Joaquin Valley" (USFWS, 2006 and 2007 a). However, other sources state that the range "extends from Redding (Shasta County) at the northern end of the Central Valley to the Bakersfield area (Kern County) in the south" (Barr, 1991 and 1996; and Jones & Stokes, 2004). Still another source states that the range extends from "a location along the Sacramento River in Shasta County, southward to an area along Caliente Creek in Kern County" (Talley et al., 2006-Biological Opinion).

These differences in range could be due to the fact that "the distribution of VELB based on sightings or collections of typically colored males is" "smaller than that of exit holes" (Talley et al., 2006). "Adults have been taken northward almost to Red Bluff (Tehama County), and as far south as Porterville (Tulare County) and an unknown location in Kern County (museum specimen, not seen)" (Barr, 1991). Although records exist for Kern County," "no specimens or observations of living beetles exist that support the assertion that the species is found there" (USFWS, 2006). A complete description of the VELB's range is discussed in Barr, 1991.

Another source states that the VELB's "range extends throughout California's Central Valley and associated foothills from about the 3,000-foot elevation contour on the east and the watershed of the Central Valley on the west" (USFWS, 1999). This range encompasses all or portions of 31 counties including: "Alameda, Amador, Butte, Calaveras, Colusa, Contra Costa, El Dorado, Fresno, Glenn, Kern, Kings, Lake, Madera, Mariposa, Merced, Napa, Nevada, Placer, Sacramento, San Benito, San Joaquin, San Luis Obispo, Shasta, Solano, Stanislaus, Sutter, Tehama, Tulare, Tuolumne, Yolo, and Yuba" (USFWS, 1999).

"In the foothills of the Sierra Nevada, adult beetles have been found in elevations up to 2,220 feet and exit holes in elevations up to 2,940 feet" (Jones & Stokes, 2004 and Barr, 1991). "Along the Coast Ranges, adult beetles have been found up to 500 feet elevation, and exit holes have been detected up to 730 feet elevation (Jones & Stokes, 2004 and Barr, 1991). About 190 records of VELB have been documented in the Central Valley "mostly based on exit holes" (USFWS, 2007 a).

"To date, no range-wide surveys of VELB have been conducted and therefore the data regarding the range distribution of the species, as well as the local distribution, are incomplete" (Jones&Stokes, 2002). "It is not possible to accurately assess the species' population status" "because the information on VELB population and distribution is limited" (Jones&Stokes, 2002). "However, based on the extent of habitat loss in the Central Valley, it is likely that populations have declined" (Jones&Stokes, 2002).

10.4 USFWS Critical Habitat

Critical habitat was designated for the VELB on August 8, 1980 (45 FR 52803). Two critical habitat areas, the Sacramento Zone and the American River Parkway Zone, were designated because “these areas include the densest known populations of the beetle” (USFWS, 1980, 1991, and 1996). The Putah Creek Zone, “one of the areas proposed as Critical Habitat for the beetle in Solano County,” was not designated as critical habitat due to a lack of information (USFWS, 1980). However, “although not officially designated as critical habitat, portions of Putah Creek and the American River Parkway just west of Nimbus Dam are herein considered essential habitat” (USFWS, 1984 and 1991). “These areas support large numbers of mature elderberry shrubs with extensive evidence of use by the beetle” (USFWS, 1996).

Critical habitat is defined in the ESA as specific areas within the geographic area occupied by a species at the time it is listed, containing physical and biological features necessary for the conservation of the species, and that may require special management to protect the listed species (USFWS, 1980). Critical habitat may also include “specific areas outside the geographical area occupied by the species at the time it is listed” if they are determined to be “essential for the conservation of the species” (USFWS, 1980). The designation of critical habitat is based on habitat areas that provide essential life-cycle needs of the species or areas that contain primary constituent elements (PCEs). PCEs 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 the species (USFWS, 1978).

Critical habitat areas were designated because the PCEs need additional protection or special management to ensure that the areas designated as critical habitat are not adversely modified. The threats that may adversely modify the critical habitat and require special management include (USFWS, 1980):

1) “modification of riparian habitats by river channelization”
2) “construction of buildings, roads, bridges, or parking lots, directly eliminating the beetle’s host plant, elderberry (*Sambucus* sp.).”
3) “human disturbance, such as vandalism or fire, resulting from increased recreational use, which adversely affects the beetle”

VELB Critical Habitat Units

<u>Unit 1: Sacramento Zone:</u>
This area is located in the city of Sacramento and is bounded “on the north by the Route 160 Freeway, on the west and southwest by the Western Pacific railroad tracks, and on the east by Commerce Circle and its extension southward to the railroad tracks” (USFWS, 1980). “The Sacramento Zone is privately owned” and when it was designated as critical habitat, this area consisted of “predominantly riparian woodland” (Talley et al.,

2006). “Today it remains undeveloped with similar vegetation communities and continues to be degraded by homeless encampments, which has been a long-standing problem” (Talley et al., 2006). As a result of the encampments, “this section of Critical Habitat remains somewhat degraded with the threat of continued and more serious degradation (e.g., wild fires, although elderberry often recover from fires)” (Talley et al., 2006).

Unit 2: American River Parkway Zone:
This area of the American River Parkway is located “on the south bank of the American River” and is bordered “on the north by latitude 30°37’30”N, on the west and southwest by Elmanto Drive from its junction with Ambassador Drive to its extension to latitude 38°37’30”N, and on the south and east by Ambassador Drive and its extension north to latitude 38°37’30”N” (USFWS, 1980). This area also includes “Goethe Park, and that portion of the American River Parkway northeast of Goethe Park, west of the Jedediah Smith Memorial Bicycle Trail, and north to a line extended eastward from Palm Drive” (USFWS, 1980). “The American River Parkway Zone remains relatively protected as part of the American River Parkway, so is largely unchanged as far as land use and major vegetation types” (Talley et al., 2006).

10.5 Habitat

“Potential VELB habitat is defined by the presence of mature and immature elderberry shrubs (*Sambucus* spp.)” (Barr, 1991). Elderberries are typically “associated with riparian forests which occur along rivers and streams” in California’s Central Valley “and in the surrounding foothills up to 3,000 feet in elevation in the east and the entire watershed to the west (Jones & Stokes, 2004; and California’s Endangered Insects). “Elderberry is a common component of the remaining riparian forests and adjacent grasslands of the Central Valley” (Barr, 1991). “The beetle occurs most frequently and is most abundant in significant riparian zones” (Talley et al., 2006).

“Studies have found that the beetle is more abundant in dense native plant communities with a mature overstory and a mixed understory” (USFWS, 1999). One study “of Sacramento Valley riparian vegetation” published in 1987, showed that “elderberries were found with VELB emergence holes (7-10mm in diameter) in four types of overstory situations:

- young-growth riparian stands of cottonwoods and willows on the lower terrace;
- stands of mature and senescent cottonwoods on the lower terrace;
- mature riparian stands of mixed tree species, including cottonwood, box elder, northern California walnut, and valley oak on the higher terrace; and
- sites without overstory in both higher and lower terrace areas” (Jones & Stokes, 2002).

Although elderberries are typically associated with riparian habitats, they have also been found "growing in several types of situations" and are "not necessarily restricted to riparian areas" (Barr, 1991). VELB "were also frequently scattered in Elderberry Savannas adjacent to riparian forests, in pastures, and along fencerows" (Barr, 1991). Elderberry "often occurs nearly alone in altered and artificial situations such as along levees, roadside ditches, and in maintained yards and pastures, and is the characteristic woody plant of the Elderberry Savanna" (Barr, 1991).

Although elderberries "can thrive in riparian and low-lying non-riparian areas in the Central Valley," "the VELB has much reduced occupancy rates in non-riparian habitats" (Talley et al., 2006). "VELB are probably more limited by suitable habitat in the non-riparian so tend to stay closer and re-use the same shrubs" (Talley et al., 2006). Riparian habitat was higher quality than non-riparian scrub as evidenced by higher occupancy rates" (Talley et al., 2006).

"The VELB was present in all of the communities in which elderberry grew, but it was more common in riparian woodlands and savannas" (Barr, 1991). "More occupied shrubs than expected" were found in wooded areas whereas "fewer occupied shrubs than expected by chance" were found in open and sparsely wooded areas (Talley et al., 2006).

The VELB is "nearly always found on or close to its host plant, elderberry (*Sambucus* species)" throughout its entire life cycle (USFWS, 2007 a and California's Endangered Insects). "The VELB feeds on from one to four species of elderberry and has been documented as using both blue and red elderberry in the Central Valley" (Talley et al., 2006). In addition, "the limited data indicate that one species is not preferred over the other" by the VELB and that "the beetle inhabits whichever *Sambucus* spp." is available (Barr, 1991).

"The valley elderberry longhorn beetle inhabits *Sambucus* of various sizes, ages, and growth forms, and utilizes an assortment of branch sizes for larval development" (Barr, 1991). However, those plants with exit holes "were most often large, mature plants; young stands were seldom infested" (Barr, 1991). "It generally takes five or more years for elderberry plants to become large enough to support beetles, and it generally takes 25 years or longer for riparian habitats to reach their full value" (USFWS, 1996). However, other studies have shown that "the majority of adults and larvae infest younger elderberry plants with trunk diameters of no more than a few inches" (Barr, 1991).

The elderberry shrubs "must have stems that are 1.0 inch or greater in diameter at ground level" to serve as VELB habitat (USFWS, 2007 a). "VELB exit holes are found on stems or branches of 2.5 cm (1 inch) diameter or more and infrequently in smaller stems (1.3-2 cm)" (Talley et al., 2006). "Full-grown larvae and adults typically are 1.5 to 2.5 cm long" which "may restrict them to larger branches and stems on older elderberries (USFWS, 1984). VELB seem to prefer elderberry trees with a girth of 15 to 65 cm (6-26 inches), and "exit holes were anywhere from 10 cm to 3 m" (0.3-10 feet) above the ground (USFWS, 1984 and 1991).

Elderberries can be “tree-like” or may “form bushy, many-stemmed clumps” (Barr, 1991). Surveys have also shown that VELB exit holes tend to occur more consistently “in clumps of elderberry trees rather than in isolated bushes” (LSA, 2004 and Barr, 1991). “It should be noted that “elderberry shrubs on average are not particularly long-lived” (Talley et al., 2006).

10.6 Diet

The VELB “feeds on at least one species of elderberry (*Sambucus*) and perhaps as many as three elderberry taxa” including *S. glauca*, *S. caerulea*, and *S. mexicana* (USFWS, 1984). In 1982, most specimens collected by one researcher were identified as *S. mexicana*; however, “there appears to be extensive phenotypic variability and possibly hybridization between *S. mexicana* and *S. caerulea*” (USFWS, 1984). VELB adults consume elderberry foliage and possibly also the flowers whereas the “larvae are borers and feed on the soft pith in stems and roots of the elderberry” (USFWS, 1984 and 2007 b; and LSA, 2004). The adults eat from when they emerge in the spring until about June when they begin to mate (California’s Endangered Insects).

10.7 Life History and Reproduction

Adult VELB are actively feeding and mating from March to June (USFWS, 2007 a and LSA, 2004). The adults can sometimes be seen “resting on foliage of the elderberry, or actively flying between the trees” (USFWS, 1984). “Female VELB adults tend to be less active than males, which are more apt to take flight and move between branches, shrubs, or clusters of shrubs” (Talley et al., 2006). “Although adult VELBs can fly, they are considered poor fliers, which suggests that they are not migratory; however, there is no information about seasonal movements of this beetle” (Jones&Stokes, 2002). “The movements of VELB are not well understood, but they probably follow drainage courses where elderberry shrubs are most common” (Jones&Stokes, 2002).

The VELB “appears to be only locally common, i.e., found in population clusters which are not evenly distributed across available elderberry shrubs” (Barr, 1991 and 1996). “Frequently only particular clumps or trees in the study area were found to harbor the beetle” where “other similar ones nearby were unaffected” (Barr, 1991 and 1996).

“Species that are rare have at least one of the following characteristics: limited geographic range, high habitat specificity, or small local populations” (Talley et al., 2006). “The VELB is especially rare, having all three of these characteristics” (Talley et al., 2006). These factors may cause the VELB “to be vulnerable to the negative effects of the isolation of small subpopulations due to habitat fragmentation” (LSA, 2004 and USFWS, 1996). VELB is also assumed to be “a poor disperser” because of the observed minimal spatial distribution of this species (LSA, 2004 and USFWS, 1996). This limited dispersal has conservation implications because “there is little chance that VELB populations would naturally recover following drastic declines or migrate to isolated but suitable habitat" (Talley et al., 2006). "Unoccupied drainages were likely to remain unoccupied and those that experienced extinction were not likely to be recolonized" due to dispersal limitations (Talley et al., 2006). "The dispersal limitation of the VELB along with its low densities" and "loss and fragmentation (isolation) of its habitat" "makes it highly vulnerable to chance events that could lead to local extirpation" (Talley et al., 2006). "Local extinctions tend to cause wider separations and thus further isolation of remaining populations" (Talley et al., 2006). As a result, "non-fragmented stands of elderberries are essential for dispersal corridors for the species and may be necessary to maintain long-term gene-flow over large areas" (LSA, 2004). "Large areas of high habitat quality" are also important "to avoid the creation of population sinks (low quality areas that increase mortality)" (Talley et al., 2006).

The life cycle of the VELB is divided into four stages: "egg, larva, pupa, and adult" and "may require two or more years to complete" (USFWS, 2007 a and LSA, 2004). "The life cycle of the VELB has been assumed to encompass two years, but recent information from rearing experiments suggests that a one year cycle is possible, if not probable" (Barr, 1991). Female VELB lay their eggs "singly or in small groups" on live elderberry leaves, in crevices in the bark, at the stem/trunk junctions, or at the stem/petiole junctions of the elderberry (Barr, 1991, 2006, and 2007 a; California's Endangered Insects; and Talley, no date). The eggs hatch shortly after they are laid and "bright yellow, soft bodied larvae emerge" (Talley et al., 2006). The first instar larvae are exposed on the surface of the shrub anywhere from a few minutes to a day before they "bore to the center of elderberry stems where they create a characteristic feeding gallery in the pith at the center of the stem" (Talley et al., 2006 and Barr, 1991). "The larvae develop for 1 or 2 years feeding on pith" and create frass, a combination of droppings and wood shavings (Talley et al., 2006).

The last larval stage of the VELB before forming their pupae, the fifth instar, chews "through the inner bark, all or most of the way to the surface" to create the exit hole which is then plugged with wood shavings and frass (Talley, no date and 2006; and USFWS, 2006). The larvae then "move back down the feeding gallery to an enlarged pupal chamber packed with frass" (Talley, no date and 2006; and Barr, 1991 and 2006). In the pupal chamber, the larvae metamorphose into their pupae between December and April (Talley et al., 2006). Pupation is thought to take about one month and the adult may remain in the chamber for up to several weeks (Talley et al., 2006). "The adults complete the hole in the outer bark," if necessary, and push "out the plug to emerge from the stem center" (Talley, no date and 2006).

The VELB adults typically emerge "at about the same time the elderberry flowers" "between mid-March and mid-June" (USFWS, 1984 and Talley et al., 2006). The adults live for a few days to a few weeks between mid-March and early-June (Talley, no date and 2006; and USFWS, 1984). However, "most records are for late-April to mid-May" (Talley et al., 2006 and USFWS, 1984). During this period, the adults feed on elderberry leaves and possibly flowers, and reproduce within the canopy (Talley, no date and 2006). The females also lay their eggs during this period (USFWS, 2006). The lifespan of the adult VELB is unknown; however, it is suspected that they die after reproducing (LSA, 2004).

"Egg production per female appears to be highly variable" (Talley et al., 2006). "Records of numbers of eggs per female in captivity vary from several to 180" (Talley et al., 2006). "The causes of differences in egg production are unknown but may include the lifespan and/or health of the female, whether in captivity or not, and site specificity or chance" (Talley et al., 2006). In 2003, one researcher "observed 136 larvae, with an additional 44 eggs that never hatched, all from one female" (Talley et al., 2006). "Hatching success is 50-68% based on two observations" (Talley et al., 2006). "Survival rates of the larvae and subsequent pupae are unknown" (Talley et al., 2006).

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