

*Clarkia franciscana*  
(Presidio clarkia)

**5-Year Review:  
Summary and Evaluation**



Photograph by Jo-Ann Ordano, California Academy of Sciences

**U.S. Fish and Wildlife Service  
Sacramento Fish and Wildlife Office  
Sacramento, California**

**November 2010**

## 5-YEAR REVIEW

*Clarkia franciscana* (Presidio clarkia)

### I. GENERAL INFORMATION

#### Purpose of 5-Year Reviews:

The U.S. Fish and Wildlife Service (Service) is required by section 4(c)(2) of the Endangered Species Act (Act) to conduct a status review of each listed species at least once every 5 years. The purpose of a 5-year review is to evaluate whether or not the species' status has changed since it was listed (or since the most recent 5-year review). Based on the 5-year review, we recommend whether the species should be removed from the list of endangered and threatened species, be changed in status from endangered to threatened, or be changed in status from threatened to endangered. Our original listing of a species as endangered or threatened is based on the existence of threats attributable to one or more of the five threat factors described in section 4(a)(1) of the Act, and we must consider these same five factors in any subsequent consideration of reclassification or delisting of a species. In the 5-year review, we consider the best available scientific and commercial data on the species, and focus on new information available since the species was listed or last reviewed. If we recommend a change in listing status based on the results of the 5-year review, we must propose to do so through a separate rule-making process defined in the Act that includes public review and comment.

#### Species Overview:

As summarized from the Recovery Plan for this species (Service 1998), *Clarkia franciscana* (Presidio clarkia) is a slender, erect, herbaceous annual of the evening-primrose family (Onograceae). It is restricted to serpentine soils in grassland and coastal scrub communities and known from only two locations within highly urbanized areas of the San Francisco Bay Area: 1) the Presidio within the City of San Francisco, California (SF Presidio); and 2) the Oakland Hills within the City of Oakland, Alameda County, California (Oakland Hills) 17 miles to the east of the SF Presidio population (Skinner and Pavlik 1994). There are two extant subpopulations of the *C. franciscana* at the SF Presidio and one experimental subpopulation that was introduced to the Coastal Bluffs at the SF Presidio in fall 2008. All of the subpopulations at the SF Presidio are currently protected on public land owned by the National Park Service (NPS) and co-managed by the Golden Gate National Recreation Area (GGNRA) and the Presidio Trust. There are seven extant subpopulations of the *C. franciscana* that occur within 0.5 mile of each other at the wildland-urban interface and within the adjacent residential Oakland Hills neighborhood; only one of these subpopulations is currently protected on public land owned by the East Bay Regional Park District (EBRPD) at Redwood Regional Park. The *C. franciscana* is thought to be predominately self-pollinated. Small halictid bees (sweat bees), however, have been observed visiting the flowers and could potentially be pollinators for the species (Lewis and Raven 1958). An electrophoretic study shows that the SF Presidio and Oakland Hills populations of *C. franciscana* are genetically distinct; however, consistent with the species' predominate self-pollination, individuals within these populations have restricted genetic variability (Gottlieb and Edwards 1992).

## **Methodology Used to Complete This Review:**

This review was prepared by the Sacramento Fish and Wildlife Office (SFWO), following the Region 8 guidance issued in March 2008. We used information from the *Recovery Plan for Serpentine Soil Species of the San Francisco Bay Area* (Recovery Plan) (Service 1998), environmental impact reports, management plans, monitoring reports, letters from environmental groups, survey information from experts who have been monitoring various localities of this species, and the California Natural Diversity Database (CNDDDB) maintained by the California Department of Fish and Game (CDFG). We received no information from the public in response to our Federal Notice initiating this 5-year review. This 5-year review contains updated information on the species' biology and threats, and an assessment of that information compared to that known at the time of listing or since the last 5-year review. We focus on current threats to the species that are attributable to the Act's five listing factors. The review synthesizes all this information to evaluate the listing status of the species and provide an indication of its progress towards recovery. Finally, based on this synthesis and the threats identified in the five-factor analysis, we recommend a prioritized list of conservation actions to be completed or initiated within the next 5 years.

## **Contact Information:**

**Lead Regional Office:** Larry Rabin, Deputy Division Chief for Listing, Recovery, and Habitat Conservation Planning, Pacific Southwest Region; (916) 414-6464.

**Lead Field Office:** Josh Hull, Sacramento Fish and Wildlife Office; (916) 414-6600.

**Federal Register (FR) Notice Citation Announcing Initiation of This Review:** A notice announcing initiation of the 5-year review of this taxon and the opening of a 60-day period to receive information from the public was published in the Federal Register on March 25, 2009 (74 FR 12878). No information was received.

## **Listing History:**

### **Original Listing**

**FR Notice:** 60 FR 6671

**Date of Final Listing Rule:** February 3, 1995

**Entity Listed:** *Clarkia franciscana*

**Classification:** Endangered

### **State Listing**

*Clarkia franciscana* (*Presidio clarkia*) was listed by the State of California as endangered in November 1978.

**Associated Rulemakings:** None

**Review History:** None

**Species' Recovery Priority Number at Start of 5-Year Review:** The recovery priority number for *Clarkia franciscana* is 5 according to the Service's 2010 Recovery Data Call for the Sacramento Fish and Wildlife Office, based on a 1-18 ranking system where 1 is the highest-ranked recovery priority and 18 is the lowest (Endangered and Threatened Species Listing and Recovery Priority Guidelines, 48 FR 43098, September 21, 1983). This number indicates that the taxon is a species that faces a high degree of threat and has a low potential for recovery.

### **Recovery Plan or Outline**

**Name of Plan or Outline:** Recovery Plan for Serpentine Soil Species of the San Francisco Bay Area

**Date Issued:** September 30, 1998

## **II. REVIEW ANALYSIS**

### **Application of the 1996 Distinct Population Segment (DPS) Policy**

The Endangered Species Act defines "species" as including any subspecies of fish or wildlife or plants, and any distinct population segment (DPS) of any species of vertebrate wildlife. This definition of species under the Act limits listing as distinct population segments to species of vertebrate fish or wildlife. Because the species under review is a plant, the DPS policy is not applicable, and the application of the DPS policy to the species' listing is not addressed further in this review.

### **Information on the Species and its Status**

#### Species Biology and Life History

As summarized from the Recovery Plan for this species (Service 1998), *Clarkia franciscana* (Presidio clarkia) is a slender, erect, herbaceous annual of the evening-primrose family (Onograceae). *C. franciscana* is known from only two locations within highly urbanized areas of the San Francisco Bay Area, California (the Presidio within the City of San Francisco [SF Presidio] and the Oakland Hills within the City of Oakland, Alameda County [Oakland Hills]), where the plant is restricted to serpentine soils in grassland and coastal scrub communities (Skinner and Pavlik 1994). Serpentine soils are formed from weathered volcanic (ultramafic rocks) such as serpentinite, dunite, and peridotite. The *C. franciscana* has adapted to the harsh environments of serpentine soils that limit plant growth: low calcium : magnesium ratios; lack of essential nutrients such as nitrogen, potassium, and phosphorus; and high concentrations of heavy metals (mineral toxicity). The *C. franciscana* is thought to be predominately self-pollinated. However, small halictid bees (sweat bees) have been observed visiting the flowers and could potentially be pollinators for the species (Lewis and Raven 1958). *C. franciscana* flowers develop from erect buds from May through July and set seed in late summer or early fall.

## Spatial Distribution

*Clarkia franciscana* is restricted to serpentine soils in grassland and coastal scrub communities within two highly urbanized locations within the San Francisco Bay Area, California: 1) the Presidio within the City of San Francisco (SF Presidio) and 2) the Oakland Hills within the City of Oakland, Alameda County (Oakland Hills) (Skinner and Pavlik 1994). The two locations are about 17 miles apart and separated by the San Francisco Bay.

The SF Presidio population, first described in 1958 (Lewis and Raven 1958), was the only known population of *Clarkia franciscana* until the discovery of the Oakland Hills population on EBRPD lands at Redwood Regional Park in 1980 (Culligan *in litt.* 1980). Six additional subpopulations of *C. franciscana* were discovered in the Oakland Hills within 0.5 mile of each other in 1988 (Oakland Hills Tennis Club) (Villaseñor *in litt.* 1988b), 1991 (Crestmont Drive and Old Redwood Road sites) (Olson *in litt.* 1991a,c), 2004 (Colgett Drive and Kimberlin Heights Drive sites) (Lowe *in litt.* 2004d,e), and 2006 (median between Skyline Boulevard and Chadbourne Way) (Kanz *in litt.* 2009; EBRPD 2009b).

The location, habitat quality, subpopulation size, and status of current threats and restoration actions are summarized in Tables 1 and 2 below for each of the subpopulations of *C. franciscana* at the SF Presidio and in the Oakland Hills. Figure 1 below shows the distribution of *C. franciscana* within the Redwood Regional Park subpopulation in the Oakland Hills during 2007 (copied from Naumovich 2007, p. 13).

### *San Francisco Presidio*

In 1994, one year prior to the Federal listing of *Clarkia franciscana*, the SF Presidio lands were transferred from the U.S. Army to the National Park Service (NPS) as part of the Golden Gate National Recreation Area (GGNRA). The SF Presidio population of *C. franciscana* continues to be protected within the GGNRA and co-managed by NPS and the Presidio Trust.

At the time of Federal listing of the species in 1995, the SF Presidio location of *Clarkia franciscana* contained one natural subpopulation (Inspiration Point), one reintroduced subpopulation (War Memorial), and one presumed extirpated subpopulation (McDowell Avenue) (CNDDDB 2009; Stringer, pers. comm. 2009a,b; Chassé *et al.* 2009). The Inspiration Point subpopulation (CNDDDB occurrence number 2), the largest within the SF Presidio, occurs on a 15-acre serpentine grassland where the species continues to thrive and benefit from habitat restoration efforts since the transfer of the lands to NPS. The War Memorial subpopulation (CNDDDB occurrence number 1) was artificially seeded in 1972 (Roof 1972), and has persisted there since, with population sizes ranging from tens to hundreds of plants (CNDDDB 2009). The McDowell Avenue subpopulation (CNDDDB occurrence number 3) was last observed in 1908 and has not been seen there since (CNDDDB 2009).

Table 1. Extant, Extirpated, and Introduced Subpopulations of *Clarkia franciscana* at the San Francisco Presidio (data from CNDDDB 2009; Stringer, pers. comm. 2009a,b; Chassé *et al.* 2009; Weiss and Neiderer 2009).

Site Name	Location Description	Habitat Type	Extant/ Extirpated	Native/ Introduced	Habitat Quality	Population Range since 1995	Restoration Actions in Progress	Current Threats
War Memorial (CNDDDB occ# 1)	SF Presidio, near the World War II Memorial	Openings in maritime chaparral	Extant	Seeds planted in 1972 back into native habitat/range	Good	4 - 860	Protective fencing; tree removal; shrub trimming; nonnative grass/forb control	Nonnative trees; native trees planted outside natural range; nonnative grasses/forbs; native shrub encroachment; fog drip; coastal microclimate (cool, wet, fog, wind)
Inspiration Point (CNDDDB occ# 2)	SF Presidio, Inspiration Point, near Arguello Blvd Entrance Gate	Serpentine grassland	Extant	Type locality; native; reseeded in 1972	Good	744 - 54,322	Protective fencing; tree removal; nonnative grass/forb control; reseeded	Nonnative trees; native trees planted outside natural range; nonnative grasses/forbs; fog drip; trail erosion, storm drain runoff, and other hydrologic issues
McDowell Avenue (CNDDDB occ# 3)	SF Presidio, McDowell Ave	Serpentine outcrops	Possibly extirpated (last seen in 1908)	Natural/native occurrence	Poor	0	Weed control at West Crissy Bluff serpentine grassland	Urbanized; nonnative trees; native trees planted outside natural range; nonnative grasses/forbs
Coastal Bluffs	Coastal Bluffs along Pacific Coast on northwest edge of SF Presidio	Serpentine coastal bluffs	Extant	Experimental introduction in fall of 2008	Not known	329	Protective fencing; experimental introduction of 1,000 seeds in fall 2008	Nonnative trees; native trees planted outside natural range; nonnative grasses/forbs; fog drip; coastal microclimate (cool, wet, fog, wind)

Key: CNDDDB occ# = occurrence number in the California Natural Diversity Data Base; SF Presidio = San Francisco Presidio

Table 2. Extant Subpopulations of *Clarkia franciscana* in the Oakland Hills (continues on next two pages) (data from CNDDDB 2009, occurrence #4; Amme, pers. comm. 2009; Legard *in litt.* 2009; Showers *in litt.* 2009; Kanz, pers. comm. 2009).

Site Name	Location Description	Land Owner	Habitat Type	Habitat Quality	Population Range since 2004	Restoration Actions in Progress	Current Threats
Redwood Regional Park	2 - 3 acres of the Serpentine Prairie at EBRPD Redwood Regional Park northeast of Skyline Blvd at the wildland-urban interface in Oakland Hills	EBRPD	Serpentine grassland; serpentine outcrops/roadcuts; restricted to thin soils; usually 10-20% slope; <i>Clarkia franciscana</i> occupied 0.83 acre in 2007	Good	3,500 - 105,420	Serpentine Prairie Restoration Plan (EBRPD 2009a,b) beginning August 2009; protective fencing proposed around 3 acres; tree removal, controlling nonnative grasses/forbs on 6 acres; reseeded; monitoring, adaptive management	Nonnative and planted trees; nonnative grasses, forbs, shrubs; elevated atmospheric nitrogen deposition (air pollution); foot traffic, off-leash dogs; compacted soils from historical equestrian use; vegetation and fire management (mowing); soil development due to nonnative plants and overpopulation of gophers; fire suppression enabling shrub encroachment
Chadbourne Way	500 x 20-foot strip in median between Skyline Blvd and Chadbourne Way	City of Oakland	serpentine grassland with deeper soils yielding largest clarkia plants in Oakland Hills	Fair	548 - 1,600	None	Road maintenance (gravel dumping); vegetation and fire management (mowing before clarkia disperses seeds); nonnative grasses, forbs; elevated atmospheric nitrogen deposition (air pollution)

Key: CNDDDB = California Natural Diversity Database; EBRPD = East Bay Regional Park District

Table 2 (continued). Extant Subpopulations of *Clarkia franciscana* in the Oakland Hills (continues on next page) (data from CNDDDB 2009, occurrence #4; Amme, pers. comm. 2009; Legard *in litt.* 2009; Showers *in litt.* 2009; Kanz, pers. comm. 2009).

Site Name	Location Description	Land Owner	Habitat Type	Habitat Quality	Population Range since 2004	Restoration Actions in Progress	Current Threats
Kimberlin Heights Drive	500-foot long strip along the north side of Kimberlin Heights Drive	Multiple private	Rocky, thin serpentine soils within 2-acre serpentine grassland; open rocky outcrops mixed with areas planted with acacias and pines	Good	<150	None	Vegetation and fire management (mowing before clarkia disperses seeds); invasive exotics (pampas grass and nonnative plants); soil development due to exotic plants; further residential development; elevated atmospheric N deposition
Colgett Drive	600-foot long strip along the north side of Colgett Drive	Multiple private	Primarily found on rock outcrops growing under non-native pines where soil development is minimal	Good	20 - 200	None	Vegetation and fire management (mowing before clarkia disperses seeds); invasive exotics (pampas grass, French broom, nonnative pines, iceplant); further residential development; soil development due to presence of nonnatives; elevated N deposition
Crestmont Drive	500 feet long x 60 to 160 feet wide strip in undeveloped lot on north side of Crestmont Drive at junction with Westfield Way	Private	Third largest subpopulation in Oakland Hills; steep (20-50%) serpentine cutslope, thin soils; flanked by eucalyptus, homes, Monterey pines; 0.5-acre serpentine grassland upslope from most of the clarkia	Good	300 - 1,000	Proposed 0.85-acre conservation easement (City of Oakland 2006b) with fencing, reseeding, controlling exotic invasive plants, and monitoring	Proposed 4-lot residential development on 0.30 acre (City of Oakland 2006b); erosional gullyng from construction of 7 homes upslope; invasive exotics (nonnative annual grasses, pines, French broom, and pampas grass); foot traffic; elevated N deposition

Key: CNDDDB = California Natural Diversity Database; EBRPD = East Bay Regional Park District



Table 2 (continued). Extant Subpopulations of *Clarkia franciscana* in the Oakland Hills (data from CNDDDB 2009, occurrence #4; Amme, pers. comm. 2009; Legard *in litt.* 2009; Showers *in litt.* 2009; Kanz, pers. comm. 2009).

Site Name	Location Description	Land Owner	Habitat Type	Habitat Quality	Population Range since 2004	Restoration Actions in Progress	Current Threats
Oakland Hills Tennis Club/Sunrise Assisted Living Facility (Tennis Club/Sunrise)	2 sites between the Oakland Hills Tennis Club and Sunrise Assisted Living Facility: a 20-foot x 2-foot crack along a steep serpentine cut slope; and a 3,000 square-foot area 75 feet upslope from the other site	Private	One site on top of and one on the face of a serpentine cutslope; sparse coastal scrub and French broom upslope; dense French broom invading on all sides; dense nonnative annual grassland on adjacent slopes.	Fair	39 - 300	Mitigation (controlling invasive exotic plants and monitoring) for construction of the Oakland Hills Tennis Club and Sunrise Assisted Living Facility never implemented	Dense invasive exotic stands of French broom, pampas grass, and nonnative annual grasses; erosional gullying; elevated atmospheric N deposition
Old Redwood Road	16 x 80-foot long strip along northeast side of Old Redwood Road near intersection with Redwood Road	City of Oakland	Toe, face and top of serpentine roadcut; French broom, pampas grass, yellow star thistle invading the toe; wild oat grasses dominates relatively gentle slope above roadcut, although clarkia occurs near edge as well where soils are thinner.	Fair	56 - 300	None	Vegetation and fire management (weed-eating) before clarkia disperses seeds; invasive exotic plants (French broom, pampas grass, yellow starthistle, wild oat grasses); elevated atmospheric N deposition

Key: CNDDDB = California Natural Diversity Database; EBRPD = East Bay Regional Park District

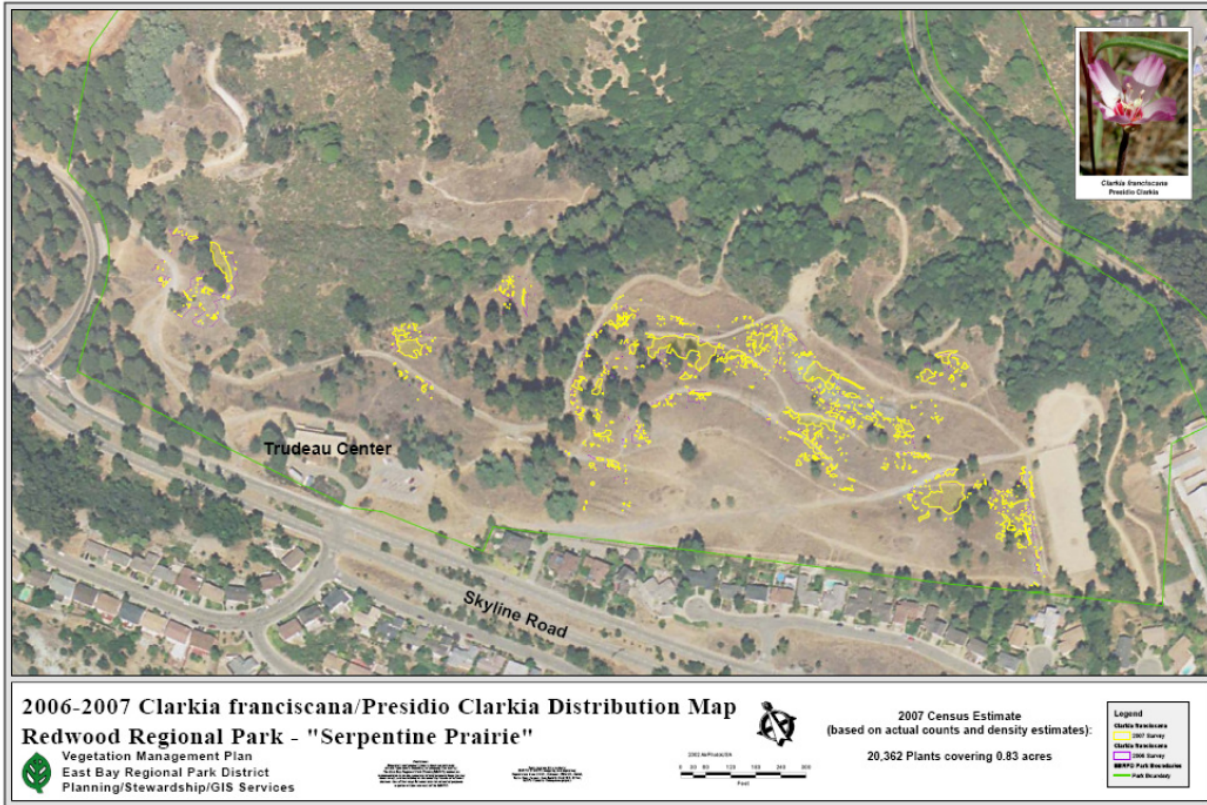


Figure 1. Map of the distribution *Clarkia franciscana* within the Serpentine Prairie at the EBRPD Redwood Regional Park in the Oakland Hills during 2007 (copied from Naumovich 2007, p.13).

As of August 2009, the Inspiration Point and War Memorial subpopulations continue to persist, but no plants have been found within the presumed extirpated McDowell Avenue subpopulation (CNDDDB 2009; Stringer, pers. comm. 2009a,b; Chassé *et al.* 2009; Weiss and Niederer 2009). In fall 2008, an experimental subpopulation of *Clarkia franciscana* (Coastal Bluffs) was introduced by the planting of 1,000 seeds in the serpentine soils along the Coastal Bluffs overlooking the Pacific Ocean along the northwestern edge of the SF Presidio (Stringer, pers. comm. 2009a,b). In late May 2009, 329 individual *C. franciscana* plants were observed at the experimental Coastal Bluff site (Stringer, pers. comm. 2009a,b). It is too soon to tell if a sustainable subpopulation of *C. franciscana* will persist at the experimental Coastal Bluffs site (Stringer, pers. comm. 2009a,b).

### *Oakland Hills*

The Oakland Hills population of *Clarkia franciscana* (CNDDDB occurrence number 4) has been highly fragmented by residential and road development on serpentine soils in the area since the 1950s resulting in seven subpopulations within 0.5 mile of each other (CNDDDB 2009; Kanz *in litt.* 2009). The locations of the seven extant subpopulations of *C. franciscana* within the Oakland Hills are described in Table 2 above.

The Oakland Hills population of *Clarkia franciscana* was first discovered in 1980 by Katherine Culligan who observed less than 1,000 plants on EBRPD lands at the Serpentine Prairie in Redwood Regional Park (Redwood Regional Park subpopulation) (Culligan *in litt.* 1980; Culligan 1982; CNDDDB 2009). In May 1988, a second subpopulation of *C. franciscana* (40-50 plants) was discovered within the Oakland Hills near the Oakland Hills Tennis Club (Tennis Club/Sunrise subpopulation) while conducting a field survey for the environmental impact report for the expansion of the tennis club (Villaseñor *in litt.* 1988b). The site was re-surveyed in 1991, but no *C. franciscana* plants were found (Bigham *in litt.* 1991). The Tennis Club/Sunrise subpopulation was presumed extirpated (Service 1995, 1998) until 1997 when 450 *C. franciscana* plants were found on a serpentine road cut between the Oakland Hills Tennis Club and the proposed Sunrise Assisted Living Facility (Barbic *in litt.* 1997; CNDDDB 2009). The inability to find *C. franciscana* plants near the Oakland Hills Tennis Club during surveys in 1991 was attributed to it being a dry year and the lack of detailed information on the location of the *C. franciscana* plants observed there in 1988 (Kanz, pers. comm. 2009).

In June 1991, two additional subpopulations of *Clarkia franciscana* were discovered in the Oakland Hills: Old Redwood Road and Crestmont Drive subpopulations. The Old Redwood Road subpopulation (184 plants) was discovered within a strip measuring 16 feet by 80 feet on the toe and face of a serpentine roadcut next to Old Redwood Road (Olson *in litt.* 1991a). The Crestmont Drive subpopulation (30 plants) was discovered on a west-facing serpentine cut slope on an undeveloped lot at the junction of Crestmont Drive and Westfield Way (Olson *in litt.* 1991c). The Crestmont Drive subpopulation was flanked by *Eucalyptus* sp. on the north and by homes and Monterey pines (*Pinus radiata*) on the south (Olson *in litt.* 1991c).

In 1995, the final listing rule for the *Clarkia franciscana* (Service 1995) reported that there were three extant subpopulations of *C. franciscana* within the Oakland Hills: Redwood Regional Park, Old Redwood Road, and Crestmont Drive. The fourth subpopulation, Tennis Club/Sunrise, was presumed extirpated at the time (Bigham *in litt.* 1991) until 450 *C. franciscana* plants were observed there in 1997

between the Oakland Hills Tennis Club and the proposed Sunrise Assisted Living Facility (Barbic *in litt.* 1997).

In May 2004, two previously unreported small subpopulations of *Clarkia franciscana* (less than 200 plants each) were found on the uphill slopes of Colgett Drive and Kimberlin Heights Drive in the Oakland Hills (Colgett Drive and Kimberlin Heights Drive subpopulations) (Lowe *in litt.* 2004d,e). In 2006, the second largest subpopulation of *C. franciscana* in the Oakland Hills (1,600 plants) was found on the median between Skyline Boulevard and Chadbourne Way (Chadbourne Way subpopulation) (Kanz *in litt.* 2009; EBRPD 2009b).

Currently, there are seven known subpopulations of *Clarkia franciscana* within the Oakland Hills within 0.5 mile of each other occupying a total of about 3 – 4 acres of serpentine grassland and coastal scrub habitat (Showers *in litt.* 2009; Kanz *in litt.* 2009; CNDDDB 2009; Naumovich 2007, p.13). The seven subpopulations, from north to south, are Redwood Regional Park, Chadbourne Way, Kimberlin Heights Drive, Colgett Drive, Crestmont Drive, Tennis Club/Sunrise, and Old Redwood Road (CNDDDB 2009; Kanz *in litt.* 2009; Culligan *in litt.* 1980; Villaseñor *in litt.* 1988a,b; Olson *in litt.* 1989, 1990, 1991a, c; Barbic *in litt.* 1997; Lowe *in litt.* 2004 a,b,c,d,e,f). The seven subpopulations within the Oakland Hills are described below.

#### Redwood Regional Park

The Redwood Regional Park subpopulation, the largest of the subpopulations in the Oakland Hills, occurs in a patchy distribution (10-14 patches) within about 2 acres of serpentine grassland along the urban-wildland interface of the Oakland Hills north of Skyline Boulevard. In 2007, *Clarkia franciscana* was estimated to occupy about 0.82 acre of serpentine habitat within Redwood Regional Park (see Figure 1 above copied from Naumovich 2007, p. 13). This subpopulation is currently protected from development within Redwood Regional Park on EBRPD lands.

#### Chadbourne Way

The Chadbourne Way subpopulation, the second largest subpopulation in the Oakland Hills, is located within a 500-foot x 20-foot strip on the median between Skyline Boulevard and Chadbourne Way (Kanz, pers. comm. 2009). The median strip is owned and managed by the City of Oakland. The Chadbourne Way subpopulation is located about 500 feet southwest of the larger Redwood Regional Park subpopulation.

#### Kimberlin Heights Drive

The Kimberlin Heights Drive subpopulation is located in undeveloped backyards in a residential neighborhood within a narrow 500-foot long strip of serpentine soil dominated by pines along an uphill slope on the north side of Kimberlin Heights Drive. The Kimberlin Heights subpopulation is located less than 500 feet southwest of the Chadbourne Way subpopulation.

### Colgett Drive

The Colgett Drive subpopulation is located in a residential neighborhood within a narrow 600-foot long strip of serpentine soil dominated by pines along an uphill slope on the north side of Colgett Drive. The subpopulation occurs in the undeveloped backyards of houses on Kimberlin Heights Drive. The Colgett Drive subpopulation is located less than 200 feet southwest of the Kimberlin Heights Drive subpopulation.

### Crestmont Drive

The Crestmont Drive subpopulation, the third largest subpopulation in the Oakland Hills, is located in a residential neighborhood less than 250 feet south-southwest of the Colgett Drive subpopulation. This subpopulation occurs on the north side of Crestmont Drive in a 500 feet long x 60 - 160 feet wide strip in an undeveloped lot on the north side of Crestmont Drive. The Crestmont Drive site is on a west-facing serpentine cut slope and is flanked by *Eucalyptus* sp. on the north and by homes and Monterey pines (*Pinus radiata*) on the south (Olson *in litt.* 1991c). The site is currently undeveloped; however, in 2006, a 4-lot subdivision was approved for development on 0.30 acre of the site (City of Oakland 2006b). The environmental impact review for the project states that a 0.85-acre conservation easement will be established for the *Clarkia franciscana* protecting 0.70 acre of serpentine grassland on-site (City of Oakland 2006a,b). As of August 2009, the construction of the subdivision and the establishment of the conservation easement have yet to occur (Kanz, pers. comm. 2009; Showers, pers. comm.).

### Tennis Club/Sunrise

The Tennis Club/Sunrise subpopulation consists of two sites between the Oakland Hills Tennis Club and the Sunrise Assisted Living Facility located southwest of the intersection of Redwood Road and Skyline Boulevard. The Tennis Club *Clarkia franciscana* site is located within a 20-foot by 2-foot crack along a steep serpentine cut slope near the northern edge of the Oakland Hills Tennis Club building (Kanz, pers. comm. 2009). The Sunrise site is located within a 3,000 square-foot (0.0689 acre) area north and upslope from the Tennis Club *C. franciscana* site (Kanz, pers. comm. 2009; CNDDDB 2009; Lowe *in litt.* 2004f). The Tennis Club/Sunrise subpopulation is located less than 1,500 feet east-southeast of the Crestmont Drive subpopulation and less than 1,500 feet south of the Redwood Regional Park subpopulation.

### Old Redwood Road

The Old Redwood Road subpopulation of *Clarkia franciscana* is located within a 16-foot by 80-foot strip on the toe and face of a steep serpentine roadcut along the northeast side of Old Redwood Road (Olson *in litt.* 1991a; Lowe *in litt.* 2004b). This subpopulation is located about 700 feet south-southwest of the Tennis Club/Sunrise subpopulation, less than 1,500 feet southeast of the Crestmont Drive subpopulation, and less than 2,000 feet south-southwest of the Redwood Regional Park subpopulation. Ralph Kanz theorizes that the Old Redwood Road and Tennis Club/Sunrise subpopulations are the remnants of a larger population of *C. franciscana* along a continuous serpentine ridge that was disturbed in the 1970s and 1980s by grading and cutting activities (Kanz, pers. comm. 2009). The Old Redwood Road subpopulation is located on land that is owned and managed by the City of Oakland.

## Abundance

The number of *Clarkia franciscana* plants observed within the War Memorial and Inspiration Point subpopulations at the SF Presidio and the Redwood Regional Park subpopulation in the Oakland Hills has varied across years. Due to limited data availability and changes in survey techniques and size of the area surveyed, it is not possible to show definitive population estimates and trends of the number of *C. franciscana* plants observed and reported over the past two - three decades. There are scattered population estimates of *C. franciscana* in the 1980s and 1990s. NPS and the Presidio Trust have monitored annually the War Memorial and Inspiration Point subpopulations since the transfer of the SF Presidio lands from the U.S. Army to the GGNRA in 1994 (CNDDDB 2009). EBRPD began annual monitoring of the Redwood Regional Park subpopulation in the Oakland Hills in 2007 (Wilde *in litt.* 2009). There are few population estimates at Redwood Regional Park before 2007 (primarily in 1988 – 1991) (Villaseñor *in litt.* 1988a; Olson *in litt.* 1989, 1990, 1991b). There are only scattered population estimates for the other subpopulations of *C. franciscana* within the Oakland Hills that occur primarily on private lands; these estimates are from local residents, environmental impact reports, and the CNDDDB (Kanz *in litt.* 2009; Lowe *in litt.* 2004a,b,c,d,e,f; City of Oakland 2006a,b; Barbic *in litt.* 1997; CNDDDB 2009). Despite gaps in population data and changes in population surveying methods, the available data suggest increasing abundance of *C. franciscana* at Redwood Regional Park in the Oakland Hills and at Inspiration Point at the SF Presidio but continued low abundance of *C. franciscana* at the War Memorial site at the SF Presidio.

The Federal listing determination for *Clarkia franciscana* (Service 1995) and the Recovery Plan (Service 1998) reported that the upper limit of the total number of *C. franciscana* plants in the 1980s and early 1990s was about 8,000. More recently, GGNRA and EBRPD reported the highest ever known population estimates for *C. franciscana* in 2009 with 54,322 plants within the SF Presidio Inspiration Point subpopulation and 105,420 plants within the Oakland Hills Redwood Regional Park subpopulation (Stringer, pers. comm. 2009a,b; Chassé *et al.* 2009; Wilde *in litt.* 2009). One year prior, however, GGNRA reported during the drought year 2008 one of the lowest recorded population estimates in recent years with 11,595 plants at Inspiration Point and only 4 plants within the War Memorial subpopulation (Stringer, pers. comm. 2009a,b; Chassé *et al.* 2009). EBRPD reported 23,090 *C. franciscana* plants within the Redwood Regional Park subpopulation in 2008 (Wilde *in litt.* 2009).

Similar to other annual herbs, population sizes of *Clarkia franciscana* fluctuate greatly, likely due to interannual variability of precipitation, especially on thin soils where the plants are more water-limited (Kanz, pers. comm. 2009). Other factors that may contribute to population fluctuations include disturbance from vegetation and fire management activities (*e.g.*, Chadbourne Way and Old Redwood Park subpopulations in the Oakland Hills) (Baker *in litt.* 2006; Augustine *in litt.* 2006; Kanz *in litt.* 2009). The factors contributing to the large decline in population at the SF Presidio in 2008 are not fully understood at this time. Summarized below are the population estimates for each of the subpopulations of *C. franciscana*.

## *San Francisco Presidio*

In the 1980s, there were scattered reports of *Clarkia franciscana* population estimates at the SF Presidio ranging from a few hundred to less than 3,000 plants (CNDDDB 2009). Estimates for the War Memorial subpopulation ranged from 12 – 120 plants, and estimates of the Inspiration Point subpopulation ranged from 250 – 2,825 plants in the 1980s (CNDDDB 2009). In 1994, one year prior to the Federal listing of *C. franciscana*, there were 860 plants within the War Memorial subpopulation and 9,714 plants within the Inspiration Point subpopulation (CNDDDB 2009). In 1995, there were 547 plants within the War Memorial subpopulation and 9,098 plants within the Inspiration Point subpopulation (CNDDDB 2009).

In the years immediately following Federal listing, the population of *Clarkia franciscana* declined at Inspiration Point to 3,869 in 1996 and 744 in 1997 (CNDDDB 2009). The War Memorial population increased to 738 plants in 1996 followed by a sharp decline to only 11 plants in 1997, the second lowest reported population estimate for that site (CNDDDB 2009). From 1998 to 2007, the number of *C. franciscana* plants at Inspiration Point steadily increased from 9,061 in 1998 to 48,429 in 2007 (CNDDDB 2009, Stringer, pers. comm. 2009a,b; Chassé *et al.* 2009; Weiss and Neiderer 2009). This increase in the number of *C. franciscana* plants at Inspiration Point was likely due to habitat restoration activities such as invasive grass and tree removal and above-average precipitation (Weiss and Neiderer 2009). The number of plants in the War Memorial subpopulation in 1998 – 2007 ranged from 132 to 967 (CNDDDB 2009).

During dry conditions in 2008, the number of *Clarkia franciscana* plants declined sharply to 11,595 at Inspiration Point and to only 4 plants at the War Memorial site. This was the lowest number of *C. franciscana* plants reported at Inspiration Point since 2002, and the lowest number ever reported at the War Memorial site (CNDDDB 2009, Stringer, pers. comm. 2009a,b; Chassé *et al.* 2009). In 2009, the number of *C. franciscana* plants at Inspiration Point rebounded to 54,322, the highest ever reported (CNDDDB 2009, Stringer, pers. comm. 2009a,b; Chassé *et al.* 2009). At the War Memorial site, however, there were only 29 *C. franciscana* plants in 2009, the fourth lowest number ever reported for that site (CNDDDB 2009, Stringer, pers. comm. 2009a,b; Chassé *et al.* 2009).

In fall 2008, 1,000 *Clarkia franciscana* seeds were planted in an experimental introduction of the species to the serpentine soils of the Coastal Bluffs overlooking the Pacific Ocean along the northwestern edge of the SF Presidio. In late May 2009, there were 329 *C. franciscana* plants observed at the experimental Coastal Bluffs site (Stringer, pers. comm. 2009a,b). At the Coastal Bluffs site, the *C. franciscana* plants are more exposed to the wet and windy conditions and frequent fog coming off the Pacific Ocean; therefore, it is not known if the plants will persist under these microclimatic conditions (Stringer, pers. comm. 2009a,b).

In a comparison of the subpopulations of *Clarkia franciscana* at the War Memorial and Inspiration Point, Chassé *et al.* (2009) explains:

*The two Presidio populations of C. franciscana have followed two very different trajectories since the inception of monitoring in 1994. While the population at Inspiration Point has shown a fairly steady and substantial increase, the World War II Memorial population has fluctuated and remained under 1,000 individuals. One possible explanation is that the more strongly maritime coastal prairie microclimate at the World War II Memorial presents conditions that are,*

compared to the relatively drier grasslands of Inspiration Point, less than ideal for the species (p. 7).

Thus, microclimatic factors associated with the proximity of the War Memorial subpopulation to the ocean may be contributing to the significantly lower number of *Clarkia franciscana* plants at this site. Despite implementation of habitat enhancement measures (protective fencing, tree removal, shrub trimming, and controlling nonnative grasses and forbs), the population of *C. franciscana* at the War Memorial site has never exceeded 1,000 plants; there were only 4 plants at the site in 2008 and only 29 plants in 2009 (CNDDDB 2009; Chassé *et al.* 2009; Chassé, pers. comm. 2009).

### *Oakland Hills*

Species experts report that the *Clarkia franciscana* plants within the SF Presidio population are considerably larger in size than those within the Oakland Hills population (Naumovich, pers. comm. 2009; Kanz, pers. comm. 2009). This difference in the size of *C. franciscana* plants between the two populations is attributed to the generally wetter microclimatic conditions and deeper, organic-rich soils within the SF Presidio compared to the generally thinner, drier, less-developed, organic-poor soils where *C. franciscana* generally occurs in the Oakland Hills (Naumovich, pers. comm. 2009; Kanz, pers. comm. 2009). Additionally, the invasion of nonnative annual grasses, particularly Italian ryegrass (*Lolium multiflorum*), in the serpentine soils of the Oakland Hills appears to restrict *C. franciscana* to thinner soils compared to the SF Presidio population (Naumovich, pers. comm. 2009). Summarized below are the population estimates and characteristics for the seven subpopulations of *C. franciscana* within the Oakland Hills.

### Redwood Regional Park

In 1980, Katherine Culligan found *Clarkia franciscana* (less than 1,000 plants) on EBRPD lands at the Serpentine Prairie in Redwood Regional Park (Culligan *in litt.* 1980; Culligan 1982; CNDDDB 2009). This was the first reported occurrence of *C. franciscana* in the Oakland Hills. The site was not surveyed again until 1988 when about 400 *C. franciscana* plants were observed scattered throughout the area (Villaseñor *in litt.*, 1988a; CNDDDB 2009). The site was re-surveyed in 1989 when about 1,900 *C. franciscana* plants were observed in 10 patches (Olson *in litt.* 1989; CNDDDB 2009). The large increase in the number of *C. franciscana* plants in 1989 compared to the previous year was attributed to higher precipitation in 1989 (Olson *in litt.* 1989). In 1990, 2,301 *C. franciscana* plants were observed in 13 patches at Redwood Regional Park (Olson *in litt.* 1990; CNDDDB 2009). In 1991, 4,254 *C. franciscana* plants were observed in 14 patches at Redwood Regional Park (Olson *in litt.* 1990, 1991b; CNDDDB 2009). The near doubling of the population of *C. franciscana* in 1991 compared to the previous year was attributed to late spring rains; however, other annual herbaceous species surveyed that year showed a decrease in numbers (Olson *in litt.* 1991b).

There are no population estimates of *Clarkia franciscana* at Redwood Regional Park from 1992 to 2003. In 2004, about 3,500 *C. franciscana* plants were observed at Redwood Regional Park in two larger subpopulations with 10 – 12 scattered smaller patches (Lowe *in litt.* 2004c; CNDDDB 2009). Beginning in 2007, EBRPD started annual monitoring of *C. franciscana* at Redwood Regional Park and reported 21,889 plants in 2007, 23,090 in 2008, and 105,420 in 2009 (Wilde *in litt.* 2009).



### Chadbourne Way

The Chadbourne Way subpopulation of *Clarkia franciscana* is the second largest subpopulation within the Oakland Hills. This subpopulation was first discovered in 2006 within a 500-foot by 20-foot strip in the median between Skyline Boulevard and Chadbourne Way. About 1,600 *C. franciscana* plants were observed there in 2006 (EBRPD 2009b; Kanz *in litt.* 2009). In 2008, there were 548 *C. franciscana* plants reported within the Chadbourne Way subpopulation (Kanz *in litt.* 2009). The *C. franciscana* plants within the Chadbourne Way subpopulation are noticeably larger compared to plants in the other Oakland Hills subpopulations likely due to the deeper soils at the Chadbourne Way site (Kanz, pers. comm. 2009).

### Kimberlin Heights Drive

The Kimberlin Heights Drive subpopulation was not discovered until 2004 (Lowe *in litt.* 2004e). In May 2004, the Kimberlin Heights Drive subpopulation contained between 100 – 150 *Clarkia franciscana* plants (Lowe *in litt.* 2004e; CNDDDB 2009). The number of *C. franciscana* plants within the Kimberlin Heights Drive subpopulation has declined since the 2004 survey (Kanz, pers. comm. 2009). Only a few *C. franciscana* plants were observed there in 2007 (Kanz, pers. comm. 2009).

### Colgett Drive

The Colgett Drive subpopulation was not discovered until 2004 (Lowe *in litt.* 2004e). In May 2004, the Colgett Drive subpopulation contained about 200 *Clarkia franciscana* plants (Lowe *in litt.* 2004d; CNDDDB 2009). The number of *C. franciscana* plants within the Colgett Drive subpopulation has declined since the 2004 survey (Kanz, pers. comm. 2009). About 104 *C. franciscana* plants were observed there in 2007, and only 20 plants were observed there in 2008 (Kanz, pers. comm. 2009).

### Crestmont Drive

The Crestmont Drive subpopulation was first discovered in 1991 (Olson *in litt.* 1991c). In June 1991, there were about 30 *Clarkia franciscana* plants in the Crestmont Drive subpopulation (Olson *in litt.* 1991c). The site was not surveyed again until April 2004 when 700 – 1,000 *C. franciscana* plants were observed (Lowe *in litt.* 2004a; City of Oakland 2006a,b; CNDDDB 2009). In May 2006, there were 300 – 400 *C. franciscana* plants within the Crestmont Drive subpopulation (Kanz *in litt.* 2009). The Crestmont Drive subpopulation is the third largest in the Oakland Hills.

### Tennis Club/Sunrise

The Tennis Club/Sunrise subpopulation was first discovered in 1988 when about 50 *Clarkia franciscana* plants were observed just north of the Oakland Hills Tennis Club (Villaseñor *in litt.* 1988b). In 1991, however, no *C. franciscana* plants were found during surveys near the Oakland Hills Tennis Club (Bigham *in litt.* 1991). In the final listing rule (Service 1995), the Tennis Club/Sunrise subpopulation was presumed extirpated; however, 450 *C. franciscana* plants were observed in 1997 on a serpentine road cut between the Oakland Hills Tennis Club and the proposed Sunrise Assisted Living Facility (Barbic *in litt.* 1997; CNDDDB 2009). The site was not surveyed again until May 2004 when 250 - 300 *C. franciscana* plants were observed within a 3,000 square-foot (0.0689 acre) area (Sunrise site) along

the road cut between the Oakland Hills Tennis Club and the Sunrise Assisted Living Facility (Lowe *in litt.* 2004f; CNDDDB 2009). In May 2007, 55 *C. franciscana* plants were observed within a 20-foot by 2-foot crack (Tennis Club site) on a serpentine roadcut within 40 feet north of the Oakland Hills Tennis Club building; another 111 *C. franciscana* plants were observed at the Sunrise site about 75 feet north and upslope from the Tennis Club site (Kanz *in litt.* 2009). In May 2008, 19 *C. franciscana* plants were observed at the Tennis Club site and another 20 *C. franciscana* plants were observed at the Sunrise site (Kanz *in litt.* 2009).

### Old Redwood Road

The Old Redwood Road subpopulation was first discovered in June 1991 when 184 *Clarkia franciscana* plants were observed on the toe and the face of a serpentine road cut within a strip measuring 16 feet by 80 feet (Olson *in litt.* 1991a). The site was not surveyed again until May 2004 when about 300 *C. franciscana* plants were observed primarily on the toe of the road cut (Lowe *in litt.* 2004b; CNDDDB 2009). The 2004 survey reported that many of the *C. franciscana* plants observed within the Old Redwood Road subpopulation were larger in size than most of the *C. franciscana* plants observed at other sites in the Oakland Hills surveyed in 2004 (Lowe *in litt.* 2004b). In May 2007, 205 *C. franciscana* plants were observed at the Old Redwood Road site (Kanz *in litt.* 2009). In May 2008, 56 *C. franciscana* plants were observed at the site; only two plants were observed at the toe of the slope and none were observed above the road cut where scattered plants had been observed in past years (Kanz *in litt.* 2009).

### Habitat or Ecosystem

#### *San Francisco Presidio*

The SF Presidio occupies 1,491 acres in northern San Francisco and is visited annually by over 5 million visitors. The SF Presidio receives an average of 57.7 cm (22.7 inches) of precipitation annually. The average annual minimum temperature is 9.9°C (49.8°F), and the average maximum is 17.6°C (63.7°F) (WestMap 2009); summers there are relatively cool and foggy.

Between the 1880s and the 1940s, trees were planted throughout the SF Presidio converting the original coastal prairies and serpentine grasslands, particularly at Inspiration Point, into Monterey pine (*Pinus radiata*), Monterey cypress (*Cupressus macrocarpa*), redwood (*Sequoia sempervirens*), and bluegum eucalyptus (*Eucalyptus globules*) woodlands and forests (Weiss and Neiderer 2009). The planted forests shaded out the native grasslands at the SF Presidio. The resulting litter and duff layers from the planted forests created thick organic layers that enriched the otherwise nutrient-poor serpentine soils at the SF Presidio allowing for the invasion of nonnative grasses (wild oats (*Avena barbata*) and common velvetgrass (*Holcus lanatus*)), into the few remaining patches of native serpentine grasslands (Weiss and Neiderer 2009). Since the transfer of the SF Presidio lands from the U.S. Army to the NPS in 1994, the serpentine grasslands, particularly at Inspiration Point, have benefited from habitat restoration activities such as nonnative grass and tree removal (Weiss and Neiderer 2009).

## *Oakland Hills*

The Oakland Hills population of *Clarkia franciscana* has been highly fragmented into seven subpopulations occurring within 0.5 mile of each other occupying a total of only 3 - 4 acres of serpentine grassland. *C. franciscana* plants within the Oakland Hills population are generally restricted to thinner, drier, less-developed, organic-poor soils compared to the deeper, wetter, organic-rich soils within the SF Presidio (Naumovich, pers. comm. 2009; Kanz, pers. comm. 2009).

During the last 15 years, many of the trees that were planted at the Serpentine Prairie at Redwood Regional Park in the 1960s developed a closed canopy allowing for the growth of Monterey pine and coast live oak seedlings and saplings, native shrubs, and nonnative annual grasses to fill in under the mature pine canopy (EBRPD 2009a). The shading, buildup of a litter layer, and increase in soil moisture from fog condensation under the trees enabled tall nonnative annual grasses to replace native perennial grasses (Idaho fescue (*Festuca idahoensis*)) at the Serpentine Prairie. Additionally, brush and scrub vegetation almost doubled in the area since the removal of livestock grazing from the western part of the grassland in the 1950s (EBRPD 2009a). Fire suppression and the absence of grazing has further allowed for the replacement of native perennial grasses and wildflowers by nonnative annual grasses throughout the Serpentine Prairie (EBRPD 2009a).

## Genetics

In 1964, James Roof collected seed from the *Clarkia franciscana* plants at the SF Presidio and sowed the seeds at EBRPD's Tilden Botanical Garden in Berkeley, Alameda County, California (Roof 1971). Then, in 1972, James Roof collected seeds from the Tilden Botanical Garden and sowed them at several sites in the SF Presidio (Roof 1972). Roof's actions, however, are thought to have "little or no genetic consequence because *C. franciscana* is nearly monomorphic and probably has been for some time" (Gottlieb and Edwards 1992, p. 6). The genetic analysis used by Gottlieb and Edwards (1992) to come to this conclusion, however, is out-dated and may no longer be valid. The *C. franciscana* plants continue to grow at Tilden Botanical Garden.

The first of the Oakland Hills populations was discovered in 1980 at Redwood Regional Park. The Redwood Regional Park site is 17 miles east of the other known wild population of *Clarkia franciscana* at the SF Presidio and 6.5 miles SSE of Tilden Botanical Garden where the clarkia plants had been cultivated since 1964 from seed that originated from the SF Presidio. Because this discovery occurred so long after the original discovery of the plant in 1958, and because it was relatively far from the previously known population at the SF Presidio, it was suggested that the Oakland Hills population might not be a natural occurrence (Gottlieb and Edwards 1992, Service 1995). It was thought that seed from the SF Presidio might also have been sowed at Redwood Regional Park. However, an electrophoretic comparison of the SF Presidio and Oakland Hills populations showed that "the two populations are fixed at different alleles for five of the 31 genes examined. This result strongly suggests that the Oakland Hills population did not originate by seed transfer from San Francisco, and that it must be regarded as indigenous to its present locality" (Gottlieb and Edwards 1992, p. 1). The study showed that the Oakland Hills population contains at least five gene coding systems that are absent from the SF Presidio population; however, the techniques used for the genetics analysis are now considered to be out-dated and less reliable.

The electrophoretic analysis also showed the lack of genetic variability within the Oakland Hills and SF Presidio populations. All plants sampled from the Oakland Hills population (ten plants each from each of ten widely spaced patches at Redwood Regional Park) proved to have identical electrophoretic mobility for each isozyme, and there was no polymorphism (Gottlieb and Edwards 1992). Similarly, all of the plants sampled from the SF Presidio population (seeds collected from the Tilden Botanical Garden and from plants collected by Gottlieb at the SF Presidio in August 1971) also exhibited identical electrophoretic mobility for each isozyme. Gottlieb and Edwards (1992) explain that the lack of genetic variability found within the Oakland Hills and SF Presidio populations of *Clarkia franciscana* is “consistent with its predominate self-pollination” (Gottlieb and Edwards 1992, p.1). The genetic analysis, however, sampled only one of the seven subpopulations of *C. franciscana* within the Oakland Hills. A sampling of all of the subpopulations of *C. franciscana* may find greater genetic variability. The seven subpopulations of *C. franciscana* within the Oakland Hills, however, are thought to be part of a larger population that was only recently (beginning in the 1950s) fragmented by residential development and roads into the seven subpopulations (Kanz, pers. comm. 2009).

Low genetic diversity within the two populations of *Clarkia franciscana* combined with its highly restricted distribution makes the species vulnerable to local extirpation or even extinction. Populations that are low in genetic variation are more vulnerable to diseases and parasites (Burdon and Marshall 1981) and to chance events, including environmental fluctuations, catastrophes, and genetic drift (Menges 1991). The small size of many of the Oakland Hills subpopulations (*e.g.*, Colgett Drive, Kimberlin Heights Drive, Crestmont Drive, Old Redwood Road, and Tennis Club/Sunrise) may result in low viability caused by harmful genetic changes resulting from inbreeding in small populations (Barrett and Kohn 1991, Ellstrand and Elam 1993). Additionally, the recent decrease in pollinators worldwide (Department of Pesticide Regulation 2006, Keith 2006, Nielsen 2006, National Research Council 2006) could cause an increase in self-pollination by *C. franciscana* resulting in even lower genetic diversity.

The genetic distinctiveness and viability of the Oakland Hills population of *Clarkia franciscana* may also be threatened by genetic swamping and the loss of local genetic types caused by the introduction of plants originating from the SF Presidio population and cultivated for over 40 years into areas containing the Oakland Hills population. The threats from genetic swamping and the loss of local genetic types are discussed under Factor E.

#### Species-specific Research and/or Grant-supported Activities

##### *Effectiveness of Controlling Nonnative Species at Inspiration Point*

Since the transfer of the SF Presidio lands from the U.S. Army to NPS in 1994, NPS and the Presidio Trust have been annually monitoring population trends of the *Clarkia franciscana* at the Inspiration Point and War Memorial sites (Chassé *et al.* 2009). NPS and the Presidio Trust have also evaluated the effectiveness of various habitat enhancement techniques in increasing the survival of *C. franciscana* including tree removal and reducing the cover of nonnative annual grasses (discussed below) (Chassé *et al.* 2009, Weiss and Neiderer 2009).

A recent study of site conditions at Inspiration Point (Weiss and Neiderer 2009) found that *Clarkia franciscana* occupies a wide range of soil depth and solar insolation environments on the site. Neither of these environmental factors appears severely limiting within open grasslands at Inspiration Point. *C.*

*franciscana* densities on the deepest soils at Inspiration Point (greater than 80 cm), were indistinguishable from shallower soils. However, *C. franciscana*, did not grow directly under tree canopies (Weiss and Neiderer 2009).

The study by Weiss and Neiderer (2009) also evaluated the effectiveness of eight experimental habitat enhancement treatments at Inspiration Point on increasing *Clarkia franciscana* survivorship and decreasing the cover of nonnative annual grasses. The eight treatments were spring mowing with thatch reduction, spring mowing without thatch reduction, scraping (removal of 3 inches of topsoil), spring burning, fall burning (before the rainy season and germination), fall flaming (post-germination), and fall tarping (Lumite weed barrier) with late seeding. The study found that scraping, fall tarping, and fall flaming (post-germination) were successful in significantly reducing the cover of nonnative annual grass and enhancing survivorship of seeded *C. franciscana* (Weiss and Neiderer 2009). The study also evaluated the effectiveness of the habitat enhancement treatments on *C. franciscana* survivorship with and without active seeding of *C. franciscana*. Where active seeding did not occur, scraping, fall tarping, and fall burning (pre-germination) increased *C. franciscana* survivorship only where it had been initially present. Where active seeding did occur, scraping, fall tarping, and fall flaming (post-germination) increased *C. franciscana* survivorship whether it had been present initially or not. Thus, the study concluded that to expand *C. franciscana* into unoccupied areas, the areas should be treated and actively seeded (Weiss and Neiderer 2009). Seeding where *C. franciscana* was already present did increase the numbers of *C. franciscana* plants, however, making it appropriate in occupied areas as well (Weiss and Neiderer 2009). A previous reseeding study by Bode (2000) showed that *C. franciscana* did well on deep, rich soils when competitors were removed by scraping.

Weiss and Neiderer (2009) concluded:

*The wide tolerance of [Presidio] clarkia to both soil depth and insolation suggests that as areas are opened up, and the forest soils appropriately treated, that Presidio clarkia can occupy the new grassland areas, regardless of local aspect and slope, or distance to forest edge. While additional tree removal is not required to improve the light environment for clarkia, it does provide biochemical benefits not addressed in this study, such as litter reduction and soil enrichment (Weiss and Neiderer 2009, p. 38).*

Based on the results of their study, Weiss and Neiderer (2009) provided the following recommendations for managing *Clarkia franciscana*: 1) create a mosaic of rotational treatments on a 25 meter scale; 2) the edges of sparsely populated *C. franciscana* patches should be identified, and the adjacent areas of about 5 meters by 5 meters should be scraped, tarped, and flamed after fall germination; 3) *C. franciscana* seeds from the site should be sown; 4) in subsequent years, adjacent areas should be treated, creating a patch dynamic pattern in which *C. franciscana* colonies are allowed to expand; 5) managers should treat no more than 10 percent of the total area inhabited by *C. franciscana* in any given year; 6) densely occupied *C. franciscana* patches should be avoided, but treatment does not need to be limited to areas where *C. franciscana* is absent; 7) other site improvements, such as tree removal, weed control, and native plantings should continue; 8) evaluate an effective return interval for treatment; and 9) management of *C. franciscana* should be undertaken with the adaptive management model using existing information, assessing results through monitoring, and incorporating information gained through each phase of management into future management in order to achieve stated goals and objectives (Weiss and Neiderer 2009, p. 39).

## *Effectiveness of Controlling Nonnative Species at Redwood Regional Park*

EBRPD began annual monitoring of *Clarkia franciscana* at Redwood Regional Park in 2007.

In 2008, EBRPD initiated a study at the Serpentine Prairie at Redwood Regional Park to evaluate the effectiveness of various habitat enhancement measures in increasing the population and survival of *C. franciscana* and reducing the cover of nonnative annual grasses (e.g., spring mowing, thatch raking, prescribed burning, and tree removal) (Appendix B in EBRPD 2010). In August 2009, EBRPD began removing trees (Monterey pines, acacias, and small pine seedlings and hardwoods coming up in the understory) and duff throughout a 3-acre area to open up the serpentine grassland for *C. franciscana* (EBRPD 2009a,b,c; EBRPD 2010). EBRPD also plans to evaluate the effectiveness of fencing off portions of the serpentine grassland in increasing the survival rate of *C. franciscana* (EBRPD 2009c).

In the study initiated in 2008, EBRPD established thirty-two 10 meter by 10 meter experimental plots within a 100 meter by 300 meter macroplot at the Serpentine Prairie at Redwood Regional Park (Appendix B in EBRPD 2010). The abundance of *Clarkia franciscana* in each of the 32 plots was counted in May 2008 (baseline conditions) and May 2009 (after treatment). Each of the 32 experimental plots received one of the following treatments:

1. Control: Eight permanent control plots receiving no treatment were established in areas known to have the *Clarkia franciscana* to allow for determining the effect of environmental conditions on the annual variability of the species' abundance.
2. Spring mowing: Spring mowing with a handheld gas trimmer was applied in April 2008 and April 2009 to eight permanent treatment plots where *Clarkia franciscana* had not been observed to avoid disturbance of the species. Spring mowing was anticipated to reduce cover of nonnative annual grass, which has been shown to outcompete annual forbs such as *C. franciscana*.
3. Fall raking and thatch removal: The fall raking and thatch removal treatment was applied with a metal gardening rake to eight permanent treatment plots in September 2008 and September 2009 where *Clarkia franciscana* was present in low concentrations. Raking was expected to reduce thatch which has been shown to inhibit the germination of forbs such as *C. franciscana*.
4. Tree removal: Tree removal plots were located underneath pines; these areas were not expected to have *Clarkia franciscana* due to a thick duff layer. Trees were not removed from the plots until August/September 2009 after data collection in May 2009; therefore, the report does not yet evaluate the effects of tree removal on *C. franciscana* abundance. Tree removal is expected to benefit *C. franciscana* by reducing shading and thatch which are detrimental to open grassland forbs such as the clarkia.

The results of the study are shown in Table 3 below.

Table 3. Total *Clarkia franciscana* individuals per treatment (Appendix B in EBRPD 2010).

Treatment	2008 (Baseline) <sup>1</sup>	2009 (Post Treatment) <sup>2</sup>
Control	1229	3030
Spring Mow	0	24
Fall Rake	1238	3254
Tree Removal <sup>3</sup>	15	184 <sup>3</sup>

<sup>1</sup> Baseline data was collected during the May 2008 census after the first spring mow treatment in April 2008 but prior to the fall rake treatment in September 2008 and the tree removal treatment in August/September 2009. Spring mow treatment plots were purposely located in areas with *Clarkia franciscana* absent to avoid disturbing *Clarkia franciscana* individuals.

<sup>2</sup> May 2009 census data was collected after applying two spring mow treatments (April 2008 and 2009) and one fall rake treatment (September 2008) but prior to the tree removal treatment in August/September 2009.

<sup>3</sup> Tree removal did not occur until August/September 2009 after the May 2009 census; therefore, increases in *Clarkia franciscana* abundance in 2009 are due to climate rather than treatment.

All of the experimental treatments showed a statistically significant increase in *Clarkia franciscana* abundance from 2008 to 2009 likely due to an increase in spring precipitation in 2009 (Table 3). However, none of the increases in *C. franciscana* abundance in the treated plots were statistically significant from the control plots (Appendix B in EBRPD 2010). The abundance of *C. franciscana* increased by 2.5 times in the 2009 control and fall rake treatment plots compared to baseline conditions in 2008. Spring mow plots, where no *C. franciscana* were observed in early May of 2008, had 24 individuals in 2009 (23 in one plot and 1 in another plot). These individuals were observed after the second year of treatment. The tree removal treatment was not applied to the experimental plots until August/September 2009 after the May 2009 census. Therefore, the 12-fold increase in the abundance of *C. franciscana* in the tree removal plots shown in Table 3 in 2009 was not due to tree removal but due to an increase in spring precipitation in 2009 (EBRPD 2010). EBRPD will begin to evaluate the effectiveness of the tree removal treatments on the abundance of *C. franciscana* at Redwood Regional Park in 2010. Tree removal has been shown to be effective in increasing the abundance of *C. franciscana* at the SF Presidio especially when combined with reseeding of the *C. franciscana* plants (Chassé *et al.* 2009, Weiss and Neiderer 2009). Also in 2010, EBRPD will be able to begin analyzing the effectiveness of the installation of protective fencing at the Serpentine Prairie at Redwood Regional Park for the protection of *C. franciscana*.

The fall rake treatment resulted in a significant increase in bare ground and decreased thatch; native forbs increased, but not significantly. The results from a second year of fall rake treatment are required to evaluate the effectiveness of raking for improving native plant cover (EBRPD 2010).

The spring mow treatment significantly reduced non-native annual grasses and thatch and increased total native vegetation, native annual forbs, and bare ground. Baseline data showed that the spring mow treatment plots had significantly higher non-native annual grasses and fewer native forbs and overall native cover compared to the control plots. After one year of treatment, the amount on non-native annual grasses, native forbs, and overall cover of native forbs was not significantly different between the spring mow plots and control plots (EBRPD 2010). The increase in *Clarkia franciscana* abundance after the 2009 spring mowing treatment shows that individual *C. franciscana* plants could survive and flower after two years of early season mowing.

Spring mowing has not been shown to significantly reduce the cover of nonnative annual grasses at the SF Presidio possibly because the stronger coastal influence, increased moisture and longer growing period at that site may make it more difficult to successfully use a single mowing treatment (EBRPD 2010). Instead, post germination treatments of flaming, tarping, and scraping have been very successful in reducing the cover of annual grasses at the SF Presidio (Neiderer and Weiss 2009). However, due to differences in site conditions between the SF Presidio and Redwood Regional Park, the delay in tree removal and fence building and the initial success of the spring mowing treatment Redwood Regional Park, EBRPD is currently not recommending the use of the post germination treatments at Redwood Regional Park, although there may be in the future (EBRPD 2010).

Based on the apparent lack of seedbank response in unoccupied areas, EBRPD is highly recommending collecting *Clarkia franciscana* onsite for reseeding due to the positive response observed at the SF Presidio from active seed dispersal resulting in dense concentrations and robust clarkia individuals there. EBRPD recommends collecting seeds at different times in the season throughout the serpentine grassland, from large and small individuals, to capture a range of genetic diversity (EBRPD 2010). To avoid over-collecting, EBRPD recommends that seed collection be limited to less than 1 percent of the seedset in the first year while efficacy is being tested (EBRPD 2010). EBRPD recommends seeding areas that have bare ground and low annual grass cover such as the Hunt Field area at Redwood Regional Park.

### **Five-Factor Analysis**

The following five-factor analysis describes and evaluates the threats attributable to one or more of the five listing factors outlined in section 4(a)(1) of the Act.

#### **FACTOR A: Present or Threatened Destruction, Modification, or Curtailment of Habitat or Range**

The final listing rule for the *Clarkia franciscana* (Service 1995) identified the following threats that destroy, modify, or curtail the habitat or range of the species: pedestrian and mountain bicycle traffic, roadside maintenance and mowing, potential residential development, habitat fragmentation, competition from nonnative plants, and shade from native and introduced shrubs and trees. The current status of the threats to the *C. franciscana* from pedestrian and mountain bicycle traffic, roadside maintenance and mowing, and potential residential development are discussed for the SF Presidio and Oakland Hills populations below. The status of threats to the species from habitat fragmentation, competition from nonnative grasses, forbs, and shrubs, and shading from nonnative trees and native trees planted outside their natural range is discussed under Factor E.

#### Pedestrian and Mountain Bicycle Traffic

##### *San Francisco Presidio*

The final listing rule (Service 1995) identified habitat degradation from pedestrian and mountain bicycle traffic on and near casually established “social trails” as a threat to *Clarkia franciscana* at the SF Presidio. The listing rule stated:



*The Presidio, which contains one of the two populations of C. franciscana, represents a significant natural and cultural resource within San Francisco city limits, and is expected to be heavily used by visitors since its transfer to the National Park Service (T. Thomas, pers. comm., 1992). The heavy use will increase the negative impact of traffic on C. franciscana (Service 1995, p. 6681).*

However, in 1995, one year after the transfer of the SF Presidio lands from the U.S. Army to NPS, NPS and the Presidio Trust placed protective fencing around the Inspiration Point and War Memorial subpopulations of *Clarkia franciscana* which has virtually eliminated the threats from pedestrian and mountain bicycle traffic (Adams 1996; Stringer, pers. comm. 2009a,b; GGNRA 2008; Chassé, pers. comm. 2009). According to Laura Baker of the East Bay Chapter of the California Native Plant Society (EBCNPS), however, the split rail fencing at Inspiration Point in the SF Presidio does not prevent dogs from entering the site and potentially disturbing the *C. franciscana* by digging up the serpentine grassland (Baker, pers. comm. 2009). The recently introduced Coastal Bluffs subpopulation of *C. franciscana* also has protective fencing, but pedestrians frequently hop over the fence to access the beach (Chassé, pers. comm. 2009). However, NPS introduced the *C. franciscana* to an area along the Coastal Bluffs away from established “social trails” used for accessing the beach (Chassé, pers. comm. 2009). Thus, foot traffic is not thought to be a major threat to the Coastal Bluffs subpopulation or any of the other subpopulations of *C. franciscana* at the SF Presidio.

### *Oakland Hills*

Pedestrian traffic continues to threaten *Clarkia franciscana* in some areas at Redwood Regional Park from a proliferation of trails through the Serpentine Prairie. Since the moving of the EBRPD main headquarters from the Serpentine Prairie in the 1990s, the original headquarters parking lot has become more available for the public to access the serpentine grasslands to hike, view the wildflower displays, and walk their dogs (EBRPD 2009a). As a result, in the last five years especially, the relatively flat summit area of Hunt Field within the Serpentine Prairie has become severely compacted and degraded largely due to frequent off-leash dog use of the site (EBRPD 2009a).

In November 2009, EBRPD completed installation of a protective fence around 3 acres of the most heavily impacted area of serpentine grassland containing *Clarkia franciscana* at Redwood Regional Park. EBRPD states in the *Serpentine Prairie Restoration Plan* (EBRPD 2009b, 2010):

*A permanent resource protection fence would be installed around the perimeter of the most heavily impacted area of Hunt Field. Additionally, if the unfenced areas adjacent to the Dunn Trail are shown to be negatively impacted, either by increases in dog use, trampling and social trails, or significant decreases in Presidio clarkia when compared to fenced plots (e.g., a decrease of twenty-five percent or greater), then additional fencing would be installed to protect the lower field within the central portion of the prairie. Retention or removal of the protective fencing would be determined as the success of the site’s restoration is determined as part of the adaptive management process (EBRPD 2009b, p. 11).*

Thus, if the fences are found to significantly increase the survival of *Clarkia franciscana*, then EBRPD could install additional fences for the protection of the species (EBRPD 2009a,b,c; Yamamoto 2009; Zamora 2007; Cuff 2009).

Pedestrian traffic continues to threaten the other subpopulations of *Clarkia franciscana* within the residential neighborhood in the Oakland Hills (Center for Biological Diversity 2007, Kay 2007). On June 25, 2007, Ralph Kanz, a member of the environmental group Friends of Oakland's Endangered Species, documented surveyors working on the proposed 4-lot residential development for the Crestmont Project apparently disturbing habitat for the *C. franciscana* at the site by "trampling the territory of the Presidio clarkia . . . walking around the site, carrying equipment and digging stake holes" (Kay 2007, Center for Biological Diversity 2007). The sponsor of the proposed 4-lot residential development for the Crestmont Project proposes to establish a 0.85-acre conservation easement on-site and install protective fencing between the residences and the preserved area for the protection of the *C. franciscana* (City of Oakland 2006a,b). However, as of August 2009, the residential development has not been constructed and the conservation easement has yet to be established (Kanz, pers. comm. 2009; Showers, pers. comm. 2009).

#### Road Maintenance and Vegetation and Fire Management (Mowing)

##### *San Francisco Presidio*

Road maintenance and vegetation management (mowing) were identified as threats to the *Clarkia franciscana* at the SF Presidio in the final listing rule for the species (Service 1995). Currently, the threats from road maintenance and vegetation management at the SF Presidio have been virtually eliminated (Chassé, pers. comm. 2009). In 2001, NPS and the Presidio Trust finalized the *Vegetation Management Plan and Environmental Assessment for the Presidio of San Francisco* (NPS and the Presidio Trust 2001) which established special vegetation management zones for the protection of the *C. franciscana* and other rare plant species. NPS and the Presidio Trust also educate their maintenance crews in how to avoid impacts to the *C. franciscana* and other rare plant species (Chassé, pers. comm. 2009).

##### *Oakland Hills*

Road maintenance and vegetation and fire management (mowing, weed-whacking, and weed-eating) continue to be one of the primary threats to six of the seven subpopulations of *Clarkia franciscana* in the Oakland Hills: Redwood Regional Park, Chadbourne Way, Kimberlin Heights Drive, Colgett Drive, Crestmont Drive, and Old Redwood Road. Fuel reduction is a primary management concern for reducing the fire hazard at the wildland-urban interface within the highly urbanized Oakland Hills.

In 2001, the Service issued a biological opinion to FEMA and EBRPD for the impacts of vegetation and fire management activities within Redwood Regional Park on the *Clarkia franciscana* (Service 2001). The biological opinion included conservation measures to minimize the effects of those activities on *C. franciscana* at Redwood Regional Park. In 2009, FEMA and EBRPD reinitiated formal consultation of the 2001 biological opinion for additional treatments at Redwood Regional Park for the protection of the *C. franciscana* (e.g., installation of protective fencing, tree removal, prescribed burn, and seasonal grazing) (EBRPD 2009d). On August 14, 2009, the Service concluded that the *C. franciscana* is likely to benefit from the proposed tree removal, protective fencing, and efforts to control nonnative grasses

and forbs. The Service further concluded that any temporary adverse effects would be minimized by implementation of the proposed conservation measures and EBRPD's commitment to not disturb the *C. franciscana* plants until after they have released and distributed their seeds. Lec Naumovich of EBCNPS, however, states that *C. franciscana* plants that occur within 200 feet of existing buildings at Redwood Regional Park are within "maintenance areas" that are likely to be impacted by fire management activities (Naumovich, pers. comm. 2009).

*Clarkia franciscana* within the Chadbourne Way, Kimberlin Heights Drive, Colgett Drive, Crestmont Drive, and Old Redwood Road subpopulations continue to be threatened by road maintenance and vegetation and fire management activities implemented by the City of Oakland before the clarkia plants have released and dispersed their seeds (Kanz *in litt.* 2006; Augustine *in litt.* 2006; Baker *in litt.* 2009; Baker, pers. comm. 2009; Kanz, pers. comm. 2009; Naumovich, pers. comm. 2009).

On May 16, 2006, the Center for Biological Diversity sent a letter to the City of Oakland Fire Department regarding vegetation management activities that continue to harm the *Clarkia franciscana* and other listed plant species (Augustine *in litt.* 2006). The City of Oakland Fire Department (2006) responded by proposing to address the negative effects of its vegetation management activities on the *C. franciscana* through developing a Vegetation Management Plan. The plan would include a Resource Inventory/Critical Habitat Mapping, Wildfire Hazard Reduction/ Resource Management Plan, and a Draft Environmental Impact Review/ Environmental Impact Statement "which addresses the potential individual and cumulative environmental impacts of fuels management projects identified in the Plan, potential measures to avoid, minimize or mitigate negative environmental impacts and help to identify a Federal partner to collaborate with." The City of Oakland Fire Department (2006) stated that the plan and associated deliverables would be completed in 12 – 24 months. However, as of August 2009, the plan has yet to be developed and has not undergone a CEQA review (Baker, pers. comm. 2009; Kanz, pers. comm. 2009; Naumovich, pers. comm. 2009). Without a finalized Vegetation Management Plan to minimize the effects of road maintenance and fire management activities on the *C. franciscana*, the species continues to be threatened by vegetation management activities conducted by the City of Oakland.

For six consecutive years between 2004 and 2009, the Old Redwood Road subpopulation was reportedly weed-whacked before the *Clarkia franciscana* plants had released and dispersed their seeds (Kanz, pers. comm. 2009). The decline in the number of *C. franciscana* plants at the toe and top of the roadcut on Old Redwood Road since 2004 is attributed to weed-whacking on the toe and top of the roadcut but not the face of the roadcut (Kanz, pers. comm., 2009; Kanz *in litt.* 2009). Currently, the plants at the toe of the roadcut are in poor condition (Kanz, pers. comm., 2009). The Colgett Drive, Kimberlin Heights Drive, and Crestmont Drive subpopulations of *C. franciscana* were also reportedly weed-whacked in 2005 and 2006 before the plants had released and dispersed their seeds (Kanz *in litt.* 2006 in City of Oakland 2006b).

EBCNPS has been working with the City of Oakland to try to minimize the negative effects of vegetation and fire management activities that disturb *Clarkia franciscana* plants before they have released and distributed their seeds. Laura Baker of EBCNPS met with a subcommittee of the Wildfire Assessment District over a six month period with the specific purpose of devising ways to ensure the safety of the *C. franciscana* population (as well as that of Tiburon buckwheat (*Eriogonum luteolum* var. *caninum*), pallid manzanita (*Arctostaphylos pallida*), and most beautiful jewel-flower (*Streptanthus*

*albidus* ssp. *peramoenus*)). During these meetings, Laura Baker made recommendations and discussed in detail “alerting potential contractors to the presence of the species, teaching them to recognize various life stages of the plant, and waiting to cut until a botanist had inspected the area. The area was also supposed to be flagged and signed” (Baker *in litt.* 2009).

Despite EBCNPS efforts to work with the City of Oakland, in early July 2009, the Chadbourne Way subpopulation of *C. franciscana* was weed-whacked by the contractor hired by the City of Oakland to perform fuels abatement (Baker *in litt.* 2009). It is not known if the contractor in question was briefed on any of the recommendations that EBCNPS had provided to the Wildfire Assessment District (Baker *in litt.* 2009). According to Camille Rogers, Fire Inspector for the City of Oakland, the contractor was not given the go-ahead to start weed-whacking, but he allegedly “wanted to get a jump-start on the job” (Baker *in litt.* 2009). The Chadbourne Way subpopulation of *C. franciscana* had also been disturbed the previous winter by road maintenance workers dumping gravel and then grading a section of the median containing *C. franciscana* plants (Baker *in litt.* 2009).

### Residential Development

Residential development continues to threaten four of the subpopulations of *Clarkia franciscana* (Kimberlin Heights Drive, Colgett Drive, Crestmont Drive, and Tennis Club/Sunrise) (City of Oakland 2006a,b; Barbic *in litt.* 1997; National Realtors Association 2009; Lowe *in litt.* 2004 a,d,e). The impacts of residential developments in *C. franciscana* habitat since the Federal listing of the species are discussed for the Crestmont Drive, Colgett Drive, and Tennis/Club Sunrise subpopulations below.

#### *Crestmont Drive and Colgett Drive*

Beginning in 1988, prior to the Federal listing of the *Clarkia franciscana*, the City of Oakland approved the subdivision of Lot “A” allowing for additional residential development in *C. franciscana* habitat in the Crestmont neighborhood in the Oakland Hills (Kanz *in litt.* 2009). In 1991, 30 *C. franciscana* plants were discovered within an undeveloped section of Lot “A” between Colgett Drive and Crestmont Drive near the intersection of Crestmont Drive and Westfield Way (Olson *in litt.* 1991c). After the Federal listing of the *C. franciscana*, between 1995 – 2003, eight single family homes were constructed on Crestmont Drive and Colgett Drive adjacent to and upslope from the undeveloped lot on Crestmont Drive where *C. franciscana* was discovered in 1991 (National Realtors Association 2009; City of Oakland 2004, 2006b, 2009). Seven of these homes are across the street from the Colgett Drive subpopulation of *C. franciscana* discovered north of Colgett Drive in 2004 (Lowe *in litt.* 2004d).

It is not known at this time if there was an environmental review for any of these housing developments or if any compensation measures were provided for impacts to the *Clarkia franciscana*; however, no measures have been enforced (Kanz *in litt.* 2009; Center for Biological Diversity 2007). If the CNDDDB had been consulted during the environmental review, then the discovery of *C. franciscana* on the adjacent undeveloped lot at Crestmont Drive (Olson *in litt.* 1991c) would have been disclosed and botanical surveys would have been conducted (Kanz *in litt.* 2009). The eight homes range in size from 1,619 square feet (0.0371 acre) to 6,191 square feet (0.142 acre) on lots ranging in size from 7,009 square ft (0.161 acre) to 170,944 square feet (3.924 acres). The eight houses combined cover a total of 34,106 square feet (0.783 acre) on lots covering a combined total of 254,400 square feet (5.840 acres) (National Realtors Association 2009). Since we do not know if any botanical surveys were conducted

prior to the construction of these eight houses, we do not know if any *C. franciscana* occurred within these lots. However, a local resident reported observing *C. franciscana* on private property in this area in 2006 (Kanz *in litt.* 2006 in City of Oakland 2006b).

The construction of eight single family homes along the edges of and upslope from the Crestmont Drive subpopulation and across the street from the Colgett Drive subpopulation of *Clarkia franciscana* has likely had negative impacts on the species from accelerated erosion, altered hydrology, increased foot traffic, and invasion of non-native plant species. A local resident reported, “Observations of the site [Crestmont Drive] indicate the impacts of water from uphill properties [on Colgett Drive] may be causing rilling and erosion” (Kanz *in litt.* 2006 in City of Oakland 2006b). Thus, the Crestmont Drive subpopulation may continue to be impacted by altered hydrology and erosion from the construction of the eight single family homes uphill on Colgett Drive. The impacts of erosion and altered hydrology are further discussed under Factor E.

In October 2006, the City of Oakland completed an environmental impact review for the construction of four 3,800-square-foot (0.087-acre) houses on Crestmont Drive (Crestmont Project) within the serpentine grassland containing the Crestmont Drive subpopulation of *Clarkia franciscana* (City of Oakland 2006a,b; Chang 2007). A total of about 700 – 1,000 *C. franciscana* plants were observed within the 1.28-acre site in 2004 (Lowe *in litt.* 2004a). The four houses are proposed to be constructed on a total of 0.30 acre containing *C. franciscana*. Based on botanical surveys in 2004, it was estimated that the residential developments would result in the permanent loss of 7 – 10 percent of the Crestmont Drive subpopulation of *C. franciscana* (City of Oakland 2006b). However, a local resident commented in the Final Environmental Impact Review for the residential development (City of Oakland 2006b) that “population counts from an individual year are not an accurate way to assess the importance of a site to annual special status plant species . . . . Brad Olson [*C. franciscana* expert with EBCNPS] stated ‘I’ve found that five continuous years is truly necessary to capture the range of variability’” (Kanz *in litt.* 2006 in City of Oakland 2006b). In 2006, 300 - 400 *C. franciscana* plants were observed at the Crestmont Drive site with about 80 *C.* plants (20 – 27 percent of the subpopulation) occurring within the footprint of the proposed residential development (Kanz *in litt.* 2009).

The developer proposes to compensate for impacts to the *Clarkia franciscana* from the proposed 4-lot Crestmont residential development by establishing a 0.85-acre conservation easement on-site for the protection of the *C. franciscana* (City of Oakland 2006b). The conservation easement would contain 0.70 acre of serpentine grassland which is habitat for the species. The developer proposes to enhance the habitat quality for the *C. franciscana* within the easement by installing protective fencing, controlling nonnative grasses, removing nonnative and introduced trees, re-seeding with seeds obtained from *C. franciscana* plants within the construction area, and regular monitoring of the health of the *C. franciscana* subpopulation. CDFG approved the residential development project on April 30, 2009. EBCNPS, however, questions the adequacy of the proposed conservation easement in mitigating the effects of the proposed development on the *C. franciscana*. According to Lec Naumovich of EBCNPS, the conservation easement would be placed on deeper soils at the site; the thinner soils where the development is proposed are likely to have more *C. franciscana* plants (Naumovich, pers. comm. 2009). As of August 2009, the 4-lot residential development had not been constructed and the conservation easement had yet to be established (Showers, pers. comm. 2009; Kanz, pers. comm. 2009). Therefore, it is not known at this time if the 4-lot residential development will be constructed and the conservation easement established for the protection of the *C. franciscana*.

A local resident and member of the Friends of Oakland's Endangered Species commented in the Final Environmental Impact Review for the Crestmont Project that the proposed conservation easement lacked adequate buffers for the protection of the *Clarkia franciscana* (Kanz *in litt.* 2006 in City of Oakland 2006b). The environmental consulting firm preparing the environmental impact review, WRA, responded that the conservation easement will have "adequate buffers" because the conservation easement is "contiguous on its north and south sides with undeveloped and undevelopable serpentine slopes identical to the subject site . . . these adjacent areas approximating two acres in size . . . provide additional habitat buffers" (City of Oakland 2006b, p. 53).

The City of Oakland disclosed in the cumulative effects analysis for the Crestmont Project (City of Oakland 2006b) that since 2003 additional residential developments have been or are in the process of being constructed within serpentine grassland habitat about 450 - 700 feet east-southeast of the Crestmont Drive subpopulation of *Clarkia franciscana* (City of Oakland 2006b). A 4,400-square-foot (0.101-acre) single family home is currently proposed to be constructed on known serpentine soil about 450 feet east-southeast of the Crestmont Drive subpopulation of *C. franciscana* (City of Oakland 2004; 2006b, p. 54). Surveys of the site have not found *C. franciscana* (City of Oakland 2006b, p.54).

Alta Villa, a 21-unit residential development, was completed in 2003 on land that borders Via Rialto and Redwood Road about 650 feet east-southeast of the Crestmont Drive subpopulation. The City of Oakland (2006b, p. 54) states that "while there may have been serpentinite soils present on part of this project, whether or not it supported any of the special status species involved in this case [*Clarkia franciscana*] is unknown."

A 10-unit town-home project on a site below and contiguous with the Alta Vista development has been under construction since 2001. This project was administratively approved by the City of Oakland on September 13, 2006, and a revised/corrected environmental determination was issued on September 21, 2006. After it was discovered that the property contained serpentine soils, the City of Oakland required that the applicant provide a biological report. The report concluded that this site did not contain special status plant species or suitable habitat for special status plant species (City of Oakland 2006, p. 55).

#### *Tennis Club/Sunrise*

On May 23, 1988, a small population of *Clarkia franciscana* (40-50 plants) was discovered within a 25-foot x 100-foot strip of rocky serpentine soil at the Oakland Hills Tennis Club while conducting a field survey for the environmental impact review for the expansion of the club (Villaseñor *in litt.* 1988b). On August 10, 1988, the Oakland Planning Commission approved the expansion of the tennis club requiring that a biological monitor be on-site during construction, and "the project sponsor shall develop a management plan for the on-going protection of the plant population and its potential habitat. The plan shall be reviewed by the State Department of Fish and Game [CDFG], and shall be approved by the Director of City Planning prior to issuance a certificate of occupancy. The plan shall include monitoring of the plant population for a five year period following issuance of the certificate of occupancy" (cited in Kanz *in litt.* 2009 and Center for Biological Diversity 2007). According to the Center for Biological Diversity (2007), "no management plan was ever prepared; some of the land with potential habitat was sold, and homes have since been constructed on it." The subpopulation was thought to have been extirpated when no *C. franciscana* plants were found during surveys in 1991 (Bigam *in litt.* 1991,

Service 1995). Subsequently, 450 *C. franciscana* plants were observed between the Oakland Hills Tennis Club and the proposed Sunrise Assisted Living Facility in 1997 (Barbic *in litt.* 1997).

In 1997, the City of Oakland approved the construction of the Sunrise Assisted Living Facility on the site of an existing shopping center at the corner of Redwood Road and Skyline Boulevard. Project surveys found 450 *Clarkia franciscana* plants (mentioned above) and 500 San Francisco popcornflower (*Plagiobothrys diffusus*) plants, listed as endangered by the State of California, on serpentine outcrops and serpentine derived soils along the southern border of the property, downslope from the existing development (Barbic *in litt.* 1997). A Mitigated Negative Declaration was prepared under the California Environmental Quality Act for the project stating that the endangered plants occur at the extreme edge of the property and would not be disturbed by the construction of the project or ongoing use of the site. The Mitigated Negative Declaration stated that a dense stand of invasive French broom that, if left unattended, would colonize the native grasslands, eliminate habitat for the *C. franciscana*, and present a fire hazard to the development. Thus, the Mitigated Negative Declaration included the following mitigation measures to reduce the fire hazard and the threat to the *C. franciscana* from the invasive French broom (cited in Kanz *in litt.* 2009):

- 14.1 *The project sponsor shall remove French broom from the site using a technique(s) approved by the City. Typical techniques for removing French broom include (1) mechanical mowing or removal, (2) hand cutting or removal, (3) controlled burn, and (4) painted or direct spraying of herbicides. The project sponsor shall consult with the City and California Department of Fish and Game (CDFG) staff as appropriate to draft a French broom removal plan. The plan should include grounds and maintenance worker education and training concerning the listed species and responsibilities under the State and Federal Endangered Species Acts. The plan shall be submitted and approved by CDFG and the City prior to the issuance of any grading or other building-related permits for the project. The removal plan shall be accompanied by a revegetation and monitoring plan approved by the City and CDFG. The area should be revegetated with native shrubs and grasses such as coyote brush, California sage, and purple needlegrass. Annual monitoring and maintenance should be conducted on an ongoing basis as stipulated by the CDFG or in the plan, to prevent the recolonization of the area with French broom or other non-native, invasive species. Grounds and maintenance worker education and training shall also be incorporated into the project's regular maintenance plan and grounds and maintenance worker training as provided for in the plan.*
  
- 14.2 *The project sponsor shall prepare a training plan for construction, grounds and maintenance workers that details the steps to be taken to ensure the continued survival and well-being of the endangered species found on the site and any habitat factors important to them. The plan should include but not necessarily be limited to details of the general area in which the endangered species are known to occur; any other portions of the site where they might potentially occur; and measures that shall be taken to ensure that the endangered plant species and their habitat will not be disturbed by construction or ongoing operations on the site. The measures in the plan should include but not be limited to the construction and maintenance of physical barriers to prevent unauthorized access to the plants or their habitat; measures to be taken to ensure that maintenance of site landscaping (including irrigation, the application of chemical fertilizers, herbicides*

*or other pesticides, or any other measures to be taken) does not harm the plants or their habitat; and any the measures to be taken, in addition to those required by Mitigation Measure 14.1, to ensure that exotic invasive plants found on the site do not intrude into the habitat of the endangered plant species. The plan shall be submitted to the California Department of Fish and Game (CDFG) and the Zoning Manager for review prior to the issuance of any grading or building permit and no such grading or building permits shall be issued until both the CDFG and the Zoning Manager have approved the plan.*

14.3 *The applicant shall obtain any required permits from the CDFG, USFWS, and any other regulatory body with jurisdiction over listed species prior to the issuance of any grading permits by the City.*

*Implementation of these mitigation measures would reduce impacts on endangered plant species to a less than significant level.*

However, the project files for the Sunrise Assisted Living Facility project reportedly do not include any plans or record of contact with CDFG or the Service (Kanz *in litt.* 2009). According to the Center for Biological Diversity (2007), “the [French] broom was never removed, continued to grow and thrive, and today both threatens the endangered species and creates a serious fire hazard.” Additional reports verify that the site is still threatened by dense stands of French broom (Lowe *in litt.* 2004f, Kanz *in litt.* 2009). The threats to the *Clarkia franciscana* from French broom and other nonnative grasses, forbs, and shrubs are discussed under Factor E. The threats to the *C. franciscana* from non-compliance with and lack of enforcement of State laws protecting the species (*e.g.*, the California Endangered Species Act and the California Environmental Quality Act) are further discussed under Factor D.

### Summary

At the time of the Federal listing of the *Clarkia franciscana* in 1995, there were two extant subpopulations of the species at the SF Presidio (Inspiration Point and War Memorial) and three known extant subpopulations within the Oakland Hills (Redwood Regional Park, Old Redwood Road, and Crestmont Drive). A fourth subpopulation (Tennis Club/Sunrise) within the Oakland Hills was presumed extirpated when *C. franciscana* plants were not found there during surveys in 1991 (Service 1995, Bigham *in litt.* 1991). Since the Federal listing of the species, three additional small subpopulations of *C. franciscana* were found within the Oakland Hills (Chadbourne Way, Kimberlin Heights Drive, and Colgett Drive), and *C. franciscana* plants were found within the presumed extirpated Tennis Club/Sunrise subpopulation (Barbic *in litt.* 1997).

In the fall of 2008, NPS introduced *C. franciscana* to the Coastal Bluffs site within the SF Presidio, but it is too soon to tell if a sustainable subpopulation will persist at this site due to coastal microclimatic conditions that are thought not to be conducive to the growth and the survival of the species (Chassé *et al.* 2009; Chassé, pers. comm. 2009; Stringer, pers. comm. 2009a,b). All three of the subpopulations of *C. franciscana* within the SF Presidio are currently protected on Federal lands owned by NPS and co-managed by GGNRA and the Presidio Trust. However, only one of the seven subpopulations of *C. franciscana* within the Oakland Hills (Redwood Regional Park, the largest subpopulation) is currently protected on public lands owned and managed by EBRPD.



The final listing rule for the *Clarkia franciscana* (Service 1995) identified the following threats to the habitat or range of the species: pedestrian and mountain bicycle traffic, roadside maintenance and mowing, potential residential development, habitat fragmentation, competition from nonnative plants, and shade from native and introduced shrubs and trees. Since the transfer of the SF Presidio lands from the U.S. Army to the NPS in 1994, NPS and the Presidio Trust have installed protective fencing, removed native and introduced trees, and experimented with various measures to reduce the cover of nonnative annual grasses and increase the survival of the *C. franciscana*. As of August 2009, the threats from foot and mountain bicycle traffic and roadside maintenance and mowing at the SF Presidio have been virtually eliminated. The threats from nonnative plants and shading from nonnative and introduced trees continue but have been somewhat reduced by restoration activities at the SF Presidio (the status of these threats are discussed further under Factor E).

Within the Oakland Hills, however, the threats to the *Clarkia franciscana* from residential development, roadside maintenance, vegetation and fire management (mowing), foot traffic, habitat fragmentation, competition from nonnative plant species, and shade from native and introduced shrubs and trees remain. Only the Redwood Regional Park subpopulation is currently protected from residential development. Even since the Federal listing of the species in 1995, residential development on private lands within the Oakland Hills has degraded, modified, or disturbed the serpentine habitat of the *C. franciscana* in many cases without environmental review or mitigation (Center for Biological Diversity 2007; Kanz *in litt.* 2009; City of Oakland 2006b) (the inadequacy of existing State laws [California Endangered Species Act and California Environmental Quality Act] in protecting the *C. franciscana* is discussed under Factor D). Only one residential development project, the 4-lot Crestmont Project, proposes to compensate for the permanent loss of 0.30 acre of *C. franciscana* habitat (Crestmont Drive subpopulation) by establishing a 0.85-acre conservation easement on-site (City of Oakland 2006a,b); however, at this time, the project has not been constructed and a conservation easement has not been established.

Roadside maintenance and vegetation and fire management (mowing and weed-whacking) currently threatens six of the seven subpopulations within the Oakland Hills and are the greatest threats to the Chadbourne Way, Kimberlin Heights Drive, Colgett Drive, and Old Redwood Road subpopulations. Despite efforts by EBCNPS to work with the City of Oakland, the *Clarkia franciscana* plants within the Old Redwood Road and Chadbourne Way subpopulations continue to be mowed before the plants have released and distributed their seeds by road maintenance and vegetation management crews hired by the City of Oakland (Augustine *in litt.* 2006; Baker *in litt.* 2009; Kanz *in litt.* 2009; Kanz, pers. comm., 2009; Center for Biological Diversity 2007).

In August 2009, EBRPD began implementing the Serpentine Prairie Restoration Plan (EBRPD 2009a,b) which would reduce the threats to the *Clarkia franciscana* at Redwood Regional Park from foot and mountain bicycle traffic, shade from trees, and competition with nonnative plants. Additionally, EBRPD and FEMA have consulted with the Service to minimize and mitigate for the impacts of proposed vegetation and fire management activities at Redwood Regional Park (Service 2001; Service *in litt.* 2008). However, there are no biological opinions or habitat conservation plans in place to protect the six other subpopulations of *C. franciscana* in the Oakland Hills from vegetation and fire management activities.

## **FACTOR B: Overutilization for Commercial, Recreational, Scientific, or Educational Purposes**

Overutilization for commercial purposes was not known to be a threat to the *Clarkia franciscana* in the 1995 final listing rule (60 FR 6671). In 2005, however, Bob Case, a plant fancier from Concord, California, acquired a seed from a *C. franciscana* plant at EBRPD's Tilden Botanical Garden in Berkeley, California (Oakland Tribune 2007). *C. franciscana* plants had been growing at the Tilden Botanical Garden since seeds from the SF Presidio were planted there in 1964 (Roof 1971). Bob Case then planted the seed in his backyard where the plants reportedly rapidly grew (Oakland Tribune 2007). Bob Case then took samples of the *C. franciscana* to a plant sale where he provided samples to a garden in El Sobrante, Contra Costa County, on the Bringing Back the Natives Tour (Jensen *in litt.* 2009).

Some of the *Clarkia franciscana* plants from Bob Case's collection ended up at Annie's Annuals & Perennials, a popular grower in Richmond, California. Annie's Annuals & Perennials then featured the *C. franciscana* as the "Plant of the Month" in December (Oakland Tribune 2007). That led to the company being contacted by CDFG for sales of a State-listed endangered species (Showers, pers. comm. 2009; Oakland Tribune 2007). Then, at the request of Mary Ann Showers of CDFG, Annie's Annuals & Perennials destroyed the remaining crop of *C. franciscana* plants; however, a few *C. franciscana* plants remain in home gardens in the cities of Richmond and San Pablo in Contra Costa County (Jensen *in litt.* 2009). Ani Jensen, propagator for Annie's Annuals & Perennials, stated that she knows that seven *C. franciscana* plants were sold by mail order (Jensen *in litt.* 2009). However, due to the store's retail set-up, she is not able to track the number of *C. franciscana* plants that were sold on-site (Jensen *in litt.* 2009). A review of the plant distributor's website shows that *C. franciscana* is no longer listed as for sale by Annie's Annuals & Perennials (Annie's Annuals & Perennials 2009).

In summary, since the listing of *Clarkia franciscana*, there have been several reported incidents of sales of *C. franciscana* plants traced back to the collection of seed from plants at the Tilden Botanical Garden. Since intervention by CDFG, the sales have reportedly ceased; therefore, the overutilization of the *C. franciscana* for commercial purposes is not thought to be a major threat to this endangered species. Instead, the greater potential threat to the *C. franciscana* from the propagation and sale of *C.* plants that germinated from seed acquired from the Tilden Botanical Garden (which originated from the SF Presidio population) is from genetic swamping of and the loss of local genetic types within the Oakland Hills population if those cultivated plants were planted in areas of the Oakland Hills that contain the native wild *C. franciscana*. This potential threat is discussed under Factor E.

## **FACTOR C: Disease or Predation**

Neither disease nor predation was identified in the 1995 final listing rule (60 FR 6671) as a threat to *Clarkia franciscana*. At this time, there are still no known threats to the *C. franciscana* from disease or predation.

## **FACTOR D: Inadequacy of Existing Regulatory Mechanisms**

The 1995 final listing rule (60 FR 6671) for the *Clarkia franciscana* identified three State laws that contribute to the conservation of the species: the California Endangered Species Act (CESA), Native Plant Protection Act (NPPA), and California Environmental Quality Act (CEQA). In addition, the following regulatory mechanisms were considered during the current review: 1) National Park Service

(NPS) Organic Act; 2) Natural Community Conservation Planning Act; and 3) the Federal Endangered Species Act in those cases where *C. franciscana* occurs and is incidentally protected in habitat occupied by the listed species. These regulatory mechanisms appear to remain currently valid. There are several State and Federal laws and regulations that are pertinent to federally listed species, each of which may contribute in varying degrees to the conservation of federally listed and non-listed species. These laws, most of which have been enacted in the past 30 to 40 years, have greatly reduced the threat of wholesale habitat destruction. The Endangered Species Act is the primary Federal law that provides protection for this species since its listing as endangered in 1992. Other Federal and State regulatory mechanisms provide discretionary protections for the species based on current management direction, but do not guarantee protection for the species absent its status under the Act. Therefore, we continue to believe other laws and regulations have limited ability to protect the species in absence of the Endangered Species Act.

The following list includes a brief summary of laws and regulations that were evaluated for this 5-year review.

California Endangered Species Act (CESA) and Native Plant Protection Act (NPPA): The CESA (California Fish and Game Code, section 2080 *et seq.*) prohibits the unauthorized take of State-listed threatened or endangered species. The NPPA (Division 2, Chapter 10, section 1908) prohibits the unauthorized take of State-listed threatened or endangered plant species. The CESA requires State agencies to consult with CDFG on activities that may affect a State-listed species and mitigate for any adverse impacts to the species or its habitat. Pursuant to CESA, it is unlawful to import or export, take, possess, purchase, or sell any species or part or product of any species listed as endangered or threatened. The State may authorize permits for scientific, educational, or management purposes, and to allow take that is incidental to otherwise lawful activities. The *Clarkia franciscana* was listed as endangered under CESA in November 1978.

Furthermore, with regard to prohibitions of unauthorized take under NPPA, landowners are exempt from this prohibition for plants to be taken in the process of habitat modification. Where landowners have been notified by the State that a rare or endangered plant is growing on their land, the landowners are required to notify CDFG 10 days in advance of changing land use in order to allow salvage of listed plants. However, salvaging of *Clarkia franciscana* plants may not be beneficial to the species as there is no evidence that the plants would survive being transplanted. Recent research, however, shows that the salvaging of *C. franciscana* seeds may be successful. Preliminary research at the SF Presidio (Weiss and Neiderer 2009) suggests that the salvage of *C. franciscana* seeds may be successful if the seeds are planted in suitable nearby habitat (whether presently occupied by the species or not) when combined with measures to reduce the cover of nonnative annual grasses (scraping of top soil, fall tarping, and fall flaming post-germination). However, it is not known at this time if the salvage and planting of *C. franciscana* seeds would be successful in establishing sustainable populations. Those areas would have to continue to be properly managed and treated to ensure that nonnative annual grasses and forbs did not return. Under CESA and NPPA, CDFG would be able to salvage the seeds from *C. franciscana* plants in areas threatened by habitat modification only if the landowner happened to notify CDFG during the time when the *C.* plants had produced seeds that could be salvaged.

Despite the listing of the *Clarkia franciscana* as endangered under CESA in 1978, the species continues to be threatened due to emergency exemptions for fire management activities, differences in

interpretation of the law, alleged violations of the law, and lack of enforcement. Environmental groups (EBCNPS, Center for Biological Diversity, and Friends of Oakland's Endangered Species) have reported in many instances the apparent violation of CESA by the City of Oakland with respect to the *C. franciscana*.

NPS Organic Act: The NPS Organic Act of 1916 (39 Stat. 535, 16 U.S.C. 1, as amended), states that the NPS “shall promote and regulate the use of the Federal areas known as national parks, monuments, and reservations ... to conserve the scenery and the national and historic objects and the wildlife therein and to provide for the enjoyment of the same in such manner and by such means as will leave them unimpaired for the enjoyment of future generations.” The NPS Management Policies indicate that the Park Service will “meet its obligations under the National Park Service Organic Act and the Endangered Species Act to both pro-actively conserve listed species and prevent detrimental effects on these species.” This includes working with the Service and undertaking active management programs to inventory, monitor, restore, and maintain listed species habitats, among other actions.

In 1994, the SF Presidio lands were transferred from the U.S. Army to the NPS as part of the GGNRA. Since then, NPS and the Presidio Trust have been annually monitoring the SF Presidio population of the *Clarkia franciscana* and implementing habitat enhancement measures for the protection of the species (e.g., nonnative tree removal, installing protective fencing, controlling nonnative annual grasses and forbs, and experimental introductions) (Weiss and Neiderer 2009; Chassé *et al.* 2009; Stringer, pers. comm. 2009a,b).

Natural Community Conservation Planning Act: The Natural Community Conservation Program is a cooperative effort to protect regional habitats and species. The program helps identify and provide for area wide protection of plants, animals, and their habitats while allowing compatible and appropriate economic activity. Many Natural Community Conservation Plans (NCCPs) are developed in conjunction with Habitat Conservation Plans (HCPs) prepared pursuant to the Federal Endangered Species Act. At this time, there are no NCCPs or HCPs that have been approved or are currently being developed that protect the *Clarkia franciscana*.

In 1996, the City of Oakland approved the *Open Space, Conservation and Recreation (OSCAR) Element of the Oakland General Plan* which mandates the preparation of a long-term multi-species HCP for the East Bay Hills (including *Clarkia franciscana* in the Oakland Hills) (OSCAR CO-9.1.3) (City of Oakland 1996). However, 13 years later, still no such HCP or NCCP exists. Justin Augustine of the Center for Biological Diversity writes, “Until it [East Bay Hills HCP] does [exist], Oakland’s imperiled plant communities will not be adequately managed and protected” (Augustine *in litt.* 2006, p. 3).

Endangered Species Act of 1973, as amended (Act): The Act is the primary Federal law providing protection for this species. The Service’s responsibilities include administering the Act, including sections 7, 9, and 10 that address take. Since listing, the Service has analyzed the potential effects of Federal projects under section 7(a)(2), which requires Federal agencies to consult with the Service prior to authorizing, funding, or carrying out activities that may affect listed species. A jeopardy determination is made for a project that is reasonably expected, either directly or indirectly, to appreciably reduce the likelihood of both the survival and recovery of a listed species in the wild by reducing its reproduction, numbers, or distribution (50 CFR 402.02). A non-jeopardy opinion may

include reasonable and prudent measures that minimize the amount or extent of incidental take of listed species associated with a project.

Section 9 prohibits the taking of any federally listed endangered or threatened species. Section 3(18) defines “take” to mean “to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect, or to attempt to engage in any such conduct.” Service regulations (50 CFR 17.3) define “harm” to include significant habitat modification or degradation which actually kills or injures wildlife by significantly impairing essential behavioral patterns, including breeding, feeding or sheltering. Harassment is defined by the Service as an intentional or negligent action that creates the likelihood of injury to wildlife by annoying it to such an extent as to significantly disrupt normal behavioral patterns which include, but are not limited to, breeding, feeding, or sheltering. The Act provides for civil and criminal penalties for the unlawful taking of listed species. Incidental take refers to taking of listed species that results from, but is not the purpose of, carrying out an otherwise lawful activity by a Federal agency or applicant (50 CFR 402.02). For projects without a Federal nexus that would likely result in incidental take of listed species, the Service may issue incidental take permits to non-Federal applicants pursuant to section 10(a)(1)(B). To qualify for an incidental take permit, applicants must develop, fund, and implement a Service-approved Habitat Conservation Plan (HCP) that details measures to minimize and mitigate the project’s adverse impacts to listed species. Regional HCPs in some areas now provide an additional layer of regulatory protection for covered species, and many of these HCPs are coordinated with California’s related Natural Community Conservation Planning program.

With regard to federally listed plant species, section 7(a)(2) requires Federal agencies to consult with the Service to ensure any project they fund, authorize, or carry out does not jeopardize a listed plant species. Section 9 of the Act and Federal regulations pursuant to section 4(d) of the Act prohibit the “take” of federally endangered wildlife; however, the take prohibition does not apply to plants. Instead, plants are protected from harm in two particular circumstances. Section 9 prohibits (1) the removal and reduction to possession (i.e., collection) of endangered plants from lands under Federal jurisdiction, and (2) the removal, cutting, digging, damage, or destruction of endangered plants on any other area in knowing violation of a state law or regulation or in the course of any violation of a state criminal trespass law. Federally listed plants may be incidentally protected if they co-occur with federally listed wildlife species.

The *Clarkia franciscana* has a highly restricted distribution. Only three of the nine known subpopulations of *C. franciscana* co-occur with other federally-listed species: 1) the federally-listed as threatened Alameda whipsnake (*Masticophis lateralis* ssp. *euryxanthus*) at Redwood Regional Park (CNDDDB 2009, EBRPD 2009b); 2) the federally-listed as threatened Marin dwarf-flax (*Hesperolinon congestum*) at the SF Presidio War Memorial site (CNDDDB 2009, occurrence # 1); and 3) the federally-listed as endangered Presidio manzanita (*Arctostaphylos hookeri* ssp. *ravenii*) at an undisclosed location. However, conservation measures developed under formal consultation for the Alameda whipsnake, the Presidio manzanita, and Marin dwarf-flax would not necessarily adequately protect the *C. franciscana* at either of the three sites.

In summary, the Endangered Species Act is the primary Federal law that provides protection for this species since its listing as endangered in 1995. Other Federal and State regulatory mechanisms provide discretionary protections for the species based on current management direction, but do not guarantee protection for the species absent its status under the Act. Therefore, we continue to believe other laws

and regulations have limited ability to protect the species in absence of the Endangered Species Act.

### **FACTOR E: Other Natural or Manmade Factors Affecting Its Continued Existence**

The final listing rule for the *Clarkia franciscana* (Service 1995) identified the following natural and manmade factors affecting the continued existence of the *C. franciscana* at the SF Presidio and in the Oakland Hills: 1) pedestrian and off-road vehicle traffic, 2) hiking and bicycle trails, 3) unauthorized dumping, 4) invasion of nonnative annual grasses and forbs, 5) nonnative trees and native trees planted outside their natural range, 6) low genetic variability, 7) road construction, 8) urbanization, 9) habitat fragmentation, 10) inbreeding in small populations, and 11) road maintenance and mowing. The threats from pedestrian and off-road vehicle traffic, hiking and bicycle trails, unauthorized dumping, and road maintenance and mowing are discussed under Factor A. The threats from nonnative trees and native trees planted outside their natural range; nonnative grasses, forbs, and shrubs; road construction and habitat fragmentation; and low genetic variability and inbreeding in small populations are discussed below.

The following new threats have been identified since the Federal listing of the *Clarkia franciscana* in 1995: (1) erosion and altered hydrology; (2) elevated atmospheric nitrogen deposition from air pollution; (3) an overpopulation of gophers resulting in soil development; (4) loss of pollinators; (5) genetic swamping and the loss of local genetic types; and (6) climate change. These new threats are also discussed below.

#### Nonnative Trees, Native Trees Planted Outside their Natural Range, and Native Shrub Encroachment

##### *San Francisco Presidio*

Between the 1880s and the 1940s, the U.S. Army planted nonnative trees and native trees outside their natural range throughout the SF Presidio converting the original coastal prairies and serpentine grasslands, particularly at Inspiration Point, into Monterey pine, Monterey cypress, redwood, and bluegum eucalyptus woodlands and forests (NPS and the Presidio Trust 2001, Weiss and Neiderer 2009). The planted forests shaded out the native grasslands at the SF Presidio. The resulting litter and duff layers from the planted forests created thick organic layers that enriched the otherwise nutrient-poor serpentine soils at the SF Presidio allowing for the invasion of nonnative grasses (wild oats and common velvetgrass) into the few remaining patches of native serpentine grassland (Weiss 1999; Weiss and Neiderer 2009; Neiss *et al.* 2002).

Prior to the Federal listing of the *Clarkia franciscana*, in the 1980s, the U.S. Army removed some trees from the War Memorial site for the protection of another federally-listed plant species. Since the transfer of the SF Presidio lands from the U.S. Army to NPS in 1994, the serpentine grasslands, particularly at Inspiration Point, have benefited from additional habitat restoration activities such as nonnative grass and tree removal (Adams 1996; Weiss and Neiderer 2009; Chassé *et al.* 2009; Golden Gate National Parks Conservancy *et al.* 2003, 2004). The removal of nonnative tree species (and native trees planted outside their natural range) such as blue gum eucalyptus, Monterey pine, and Monterey cypress during the past decade has greatly reduced the direct threats to the subpopulation of *C. franciscana* at Inspiration Point. However, leaf litter, fog drip, and shade continue to limit the potential for continued expansion of *C. franciscana* at that site (Adams 1996, Baye 2002, Chassé *et al.* 2009, Weiss and Neiderer 2009).

Neiss *et al.* (2002) analyzed the influences of nonnative trees (and native trees planted outside their natural range) on serpentine grassland soil ecology at the SF Presidio by comparing soil geochemical properties of two field sites at Inspiration Point (open serpentine grassland and an adjacent forest canopy). The study compared the calcium/magnesium ratio, exchangeable cations, pH, available nutrients, and total heavy metal content of soils at the two sites. An analysis of variance of the results shows significant differences ( $p < 0.05$ ) between the calcium/magnesium ratios, pH, extractable chromium, and total heavy metal concentrations at the two sites. Thus, the authors concluded, “As a result of past land management practices, substantial changes in serpentinite soil characteristics exist which may inhibit future habitat restoration and endangered plant revegetation projects at the site” (Neiss *et al.* 2002, p. A-25).

In 1996 and 2001, trees were removed from the relict East Grassland site at Inspiration Point for the benefit of the *Clarkia franciscana* (Chassé, pers. comm. 2009). In 2001, NPS and the Presidio Trust finalized the *Vegetation Management Plan and Environmental Assessment for the Presidio of San Francisco* (NPS and the Presidio Trust 2001) which includes measures for restoring habitat for the *C. franciscana* by removing trees, controlling nonnative annual grasses and forbs, and planting native serpentine grassland species. In compliance with the Vegetation Management Plan (NPS and the Presidio Trust 2001), beginning in 2001, NPS and the Presidio Trust initiated the Inspiration Point Viewshed Enhancement Project which included removing trees and planting native grasses and wildflowers on about 2.5 acres near Inspiration Point and restoring the site to native serpentine grassland (Golden Gate National Parks Conservancy *et al.* 2003). In the fall of 2004, NPS and the Presidio Trust funded the removal of a dozen trees near Inspiration Point to promote the growth of *C. franciscana* by decreasing fog drip, shade, and leaf litter (Golden Gate National Parks Conservancy *et al.* 2004). From 2006 – 2009, 20 additional trees were removed each year from the West Grassland site at Inspiration Point (Chassé, pers. comm. 2009). In 2006, two Monterey pines were removed from the War Memorial site (Chassé, pers. comm. 2009).

Weiss and Neiderer (2009) evaluated the distribution of *Clarkia franciscana* within the serpentine grassland at Inspiration Point. The authors found that *C. franciscana* occupies a wide range of soil depth and solar insolation environments on the site. Neither of these environmental factors appears severely limiting within open grasslands at Inspiration Point. *C. franciscana* densities on the deepest soils at Inspiration Point (greater than 80 cm), were indistinguishable from shallower soils. However, *C. franciscana* did not grow directly under tree canopies (Weiss and Neiderer 2009). Weiss and Neiderer (2009) concluded:

*The wide tolerance of [Presidio] clarkia to both soil depth and insolation suggests that as areas are opened up, and the forest soils appropriately treated, that Presidio clarkia can occupy the new grassland areas, regardless of local aspect and slope, or distance to forest edge. While additional tree removal is not required to improve the light environment for clarkia [at Inspiration Point], it does provide biochemical benefits not addressed in this study, such as litter reduction and soil enrichment (Weiss and Neiderer 2009, p. 38).*

Thus, as demonstrated by the large increase in the number of *Clarkia franciscana* plants at Inspiration Point since 2002 (with the exception of the drought year 2008), the species has benefited from the removal of trees near the remnant 10-acre serpentine grassland when combined with measures to control

nonnative annual grasses and forbs. The species would likely further benefit from litter reduction if additional trees were removed near the site.

The War Memorial subpopulation continues to be threatened by the encroachment of native shrubs (primarily *Ceanothus* sp.) into *Clarkia franciscana* habitat (Chassé, pers. comm. 2009). NPS is reducing the threat from shrub encroachment at the War Memorial site by trimming the shrubs as they grow into habitat occupied by *C. franciscana* and the federally-listed as threatened Marin dwarf-flax (*Hesperolinon congestum*) (Chassé, pers. comm. 2009). Shrub encroachment is no longer considered to be a threat at the Inspiration Point site (Chassé, pers. comm. 2009).

### *Oakland Hills*

Nonnative trees and the planting of native trees outside their natural range, such as Monterey pine, continue to threaten four of the seven subpopulations of *Clarkia franciscana* in the Oakland Hills: Redwood Regional Park, Kimberlin Heights Drive, Colgett Drive, and Crestmont Drive. Acacias, nonnative pines, and/or eucalyptus threaten the four subpopulations by shading out *C. franciscana* (Olson *in litt.* 1990, 1991c; Lowe *in litt.* 2004a,c,d,e). Also, the roots and the litter from the trees cause physical and geochemical changes in the soil resulting in soil development and the invasion of nonnative annual grasses (Lowe *in litt.* 2004d, e; Weiss 1999; Weiss and Neiderer 2009; Neiss *et al.* 2002).

In 2001, a large stand of 20 eucalyptus trees and some Monterey pines was removed near the Crestmont Drive subpopulation of *Clarkia franciscana* (City of Oakland 2006b, pp. 53-4). Three years later, in 2004, 700 – 1,000 *C. franciscana* plants were observed at the site compared to only 30 plants in 1991 (Lowe *in litt.* 2004a; Olson *in litt.* 1991c). The City of Oakland attributed the observed increase in *C. franciscana* within the Crestmont Drive subpopulation to the removal of the trees (City of Oakland 2006b).

At Redwood Regional Park, Monterey pines, acacias, and eucalyptus were planted at the Serpentine Prairie beginning in the 1960s. In the last 45 years, shading, litter layer development, and increasing moisture from fog condensation under the pines have altered the Serpentine Prairie soils, suppressing the native bunchgrasses and supporting the growth of hundreds of Monterey pine and hardwood coast live oak seedlings and saplings, some of which are now small trees (EBRPD 2009a). The tree canopy also allowed for the growth of an understory of scattered shrubs (coyote brush (*Baccharis pilularis*), poison oak (*Toxicodendron diversilobum*), *etc.*) and the replacement of native bunchgrasses by a dense growth of nonnative annual grasses (EBRPD 2009a). Fire suppression and the cessation of livestock grazing has also allowed for native shrub encroachment and the invasion of nonnative annual grasses into the serpentine grasslands at Redwood Regional Park (EBRPD 2009a).

In August 2009, EBRPD began implementation of the Serpentine Prairie Restoration Plan which includes the removal of trees and shrubs and controlling nonnative grasses on 6 acres of the Serpentine Prairie to increase the survival of *Clarkia franciscana* at Redwood Regional Park (EBRPD 2009a,b,c). Approximately 73 large pine and acacia trees and 51 smaller trees and shrubs were removed from the Serpentine Prairie in August 2009, and the areas were seeded with local serpentine adapted native perennial grasses (meadow barley and California brome) (EBRPD 2010). The stumps were then treated with Pathfinder II herbicide to prevent resprouting of hardwood brush and small trees (EBRPD 2010).



EBRPD employees also removed the thick duff that had developed in the acacia stands and some of the pine stands (EBRPD 2010).

The proposed tree removal at Redwood Regional Park is part of a broader vegetation and fire management effort to reduce the fire hazard within the East Bay Hills (EBRPD 2009d). EBRPD and FEMA reinitiated formal consultation with the Service for the potential effects of vegetation and fire management activities and proposed restoration activities on the *Clarkia franciscana* at Redwood Regional Park. The tree removal plan included the following conservation measures to reduce the temporary impacts of the project on the *C. franciscana*: (1) tree roots would be left in the soil to decompose naturally and maintain an undisturbed soil profile; (2) tree removal is not anticipated to disturb more than 5 percent of the soil surface in the area where the trees removal take place, and all work will take place after the plants have dispersed their seeds; (3) no broadcast spray of herbicides will be employed; (4) to minimize the impacts on the *C. franciscana*, trees would be felled away from the direction of the *C. franciscana* and then removed to a processing area where they will be chipped and removed off site; (5) after tree removal, a crew of laborers will pick up and remove branches and other tree debris and rake up excess organic material; and (6) erosion remediation measures will be promptly implemented to avoid impacts due to accelerated soil erosion. The Service concluded that the proposed project would not jeopardize the *C. franciscana*, and the species may benefit from the removal of nonnative trees and nonnative annual grasses (Service 2009).

In summary, nonnative trees and the planting of native trees outside their natural range continues to threaten all of the subpopulations of *Clarkia franciscana* at the SF Presidio and four of the seven subpopulations in the Oakland Hills. Tree removal at Inspiration Point, the War Memorial, Crestmont Drive, and Redwood Regional Park has reduced the threats at these sites (Weiss and Niederer 2009, Chassé *et al.* 2009, City of Oakland 2006b; Chassé, pers. comm. 2009; EBRPD 2010), but long-term changes in the soil physical and geochemical properties resulting from litter production may limit the success of efforts to restore *C. franciscana* to these sites even after tree removal (Neiss *et al.* 2002). NPS is reducing the threats from shrub encroachment at the War Memorial site in the SF Presidio by trimming shrubs as they grow into *C. franciscana* habitat (Chassé, pers. comm. 2009). In August 2009, EBRPD began restoration of a 6-acre site within the Serpentine Prairie at Redwood Regional Park in the Oakland Hills by removing trees and shrubs and the duff layer and planting with local serpentine adapted native perennial grasses (EBRPD 2010).

### Nonnative Grasses, Forbs, and Shrubs

Competition with nonnative grasses, forbs, and shrubs continues to be one of the primary threats to all of the subpopulations of the *Clarkia franciscana* at the SF Presidio and in the Oakland Hills. Since the transfer of the SF Presidio lands to the NPS in 1994, NPS and the Presidio Trust have been monitoring the effectiveness of various methods for reducing the cover of nonnative annual grasses at Inspiration Point (*e.g.*, hand removal, scraping off the topsoil, tarping, thatch removal, and prescribed burn) and adaptively managing to increase the survival of *C. franciscana* (Weiss and Niederer 2009; Chassé *et al.* 2009; Golden Gate National Parks Conservancy *et al.* 2003, 2004). Similarly, in August 2009, EBRPD began implementation of the Serpentine Prairie Restoration Plan to monitor the effectiveness of various measures for controlling nonnative annual grasses at Redwood Regional Park (*e.g.*, spring mowing, fall raking and thatch removal, scraping off the topsoil, tarping, prescribed burn, and seasonal sheep grazing) (EBRPD 2009a,b,d, 2010). The status of current threats to the *C. franciscana* from nonnative grasses,

forbs, and shrubs, and the implementation of measures to reduce those threats are further discussed for the SF Presidio and Oakland Hills below.

### *San Francisco Presidio*

Competition from nonnative annual grasses and forbs continues to threaten the survival of all the subpopulations of *Clarkia franciscana* at the SF Presidio. Since the transfer of the SF Presidio lands to the NPS in 1994, NPS and the Presidio Trust have been experimenting with, implementing, and monitoring various measures to control nonnative annual grasses and forbs within and adjacent to *C. franciscana* subpopulations. Ten years ago, NPS reduced the threat to the War Memorial subpopulation from larger weeds such as cape ivy (*Delairea odorata*), but the threats from nonnative annual and perennial grasses and smaller nonnative forbs remains (Chassé, pers. comm. 2009). Currently, NPS uses hand removal techniques to control nonnative plants at the War Memorial site and targets the removal of the nonnative perennial herb sourgrass (*Oxalis pes-caprae*) (Chassé, pers. comm. 2009).

In 2001, NPS and the Presidio Trust finalized the *Vegetation Management Plan and Environmental Assessment for the Presidio of San Francisco* (NPS and the Presidio Trust 2001) which includes measures for restoring habitat for the *Clarkia franciscana* by removing trees, controlling nonnative annual grasses and forbs, and revegetating serpentine grasslands with appropriate native grass species. In compliance with the Vegetation Management Plan (NPS and the Presidio Trust 2001), beginning in 2001, NPS and the Presidio Trust initiated the Inspiration Point Viewshed Enhancement Project restoring over 2.5 acres of serpentine grassland adjacent to the remnant 10-acre serpentine grassland at Inspiration Point (Golden Gate National Parks Conservancy *et al.* 2003). Following tree removal, the upper 2 acres of the restoration site were planted with about 30,000 native grasses and wildflowers during the winter 2001-2002 and winter 2002-2003 (Golden Gate National Parks Conservancy *et al.* 2003). In 2004, an additional 16,000 native grasses and wildflowers were planted at Inspiration Point, and nonnative plants species were removed (Golden Gate National Parks Conservancy *et al.* 2004). The survival of planted grasses and wildflowers and composition of the new plant community are being monitored to evaluate the effectiveness of the restoration project and learn how to best restore similar plant communities at the SF Presidio and throughout the GGNRA (Golden Gate National Parks Conservancy *et al.* 2003).

In 2004, the Presidio Stewards Guild was established to encourage long-term volunteer commitment to particular restoration projects or areas at the SF Presidio including protecting the *Clarkia franciscana* at Inspiration Point (Golden Gate National Parks Conservancy *et al.* 2004). Through the Presidio Stewards Guild, NPS and the Presidio Trust employ staff and experienced volunteers and interns to remove invasive plant species adjacent to and occasionally within subpopulations of *C. franciscana* in a sensitive manner (Chassé *et al.* 2009). Within *C. franciscana* subpopulations, activities are limited to hand removal and target nonnative species such as poison hemlock (*Conium maculatum*), French broom, common velvetgrass, wild lettuce (*Lactuca* spp.), narrowleaf plantain (*Plantago lanceolata*), wild radish (*Raphanus sativus*), and common sheep sorrel (*Rumex acetosella*) (Chassé *et al.* 2009). In an effort to expand habitat for *C. franciscana*, additional methods are used to control nonnative grasses and forbs adjacent to occupied *C. franciscana* habitat. Weed-eaters and brush mowers are used to control nonnative annual grasses, particularly Italian ryegrass (Chassé *et al.* 2009). Hand tools such as hoes and McLeods are used where appropriate (Chassé *et al.* 2009). Areas with close to 100 percent cover of nonnative plant species are covered with landscape fabric (tarping) (Chassé *et al.* 2009).

NPS and the Presidio Trust use additional methods to control the spread of nonnative annual grasses and forbs throughout the SF Presidio. Continued threats from nonnative grasses, such as Italian ryegrass and common velvetgrass are addressed through adaptive management. Buffer plantings have been placed along the edges of roads, trails, and parking areas that are potential entry points for invasive species (Chassé *et al.* 2009). Where appropriate, strategic revegetation is used in areas where the native vegetation has been lost or severely impacted (Chassé *et al.* 2009). In 2008, NPS and the Presidio Trust planted about 1,500 native plants, including purple needlegrass (*Nassella pulchra*), meadow barley (*Hordeum brachyantherum*), purple sanicle (*Sanicula bipinnatifida*) and other species appropriate to serpentine grassland habitat (Chassé *et al.* 2009). The Presidio Trust is also controlling nonnative plant species within the serpentine grassland at West Crissy Bluff near the site of the extirpated McDowell Avenue subpopulation of *Clarkia franciscana* (Chassé, pers. comm. 2009).

Weiss and Neiderer (2009) evaluated the effectiveness of eight experimental habitat enhancement treatments at Inspiration Point on increasing *Clarkia franciscana* survivorship and decreasing the cover of nonnative annual grasses.

Weiss and Neiderer (2009) evaluated the effectiveness of eight experimental habitat enhancement treatments at Inspiration Point on increasing *Clarkia franciscana* survivorship and decreasing the cover of nonnative annual grasses. The eight treatments were spring mowing with thatch reduction, spring mowing without thatch reduction, scraping (removal of 3 inches of topsoil), spring burning, fall burning (before the rainy season and germination), fall flaming (post-germination), and fall tarping (Lumite weed barrier) with late seeding. The study found that scraping, fall tarping, and fall flaming (post-germination) were successful in significantly reducing the cover of nonnative annual grass and enhancing survivorship of seeded *C. franciscana* (Weiss and Neiderer 2009). The study also evaluated the effectiveness of the habitat enhancement treatments on *C. franciscana* survivorship with and without active seeding of *C. franciscana*. Where active seeding did not occur, scraping, fall tarping, and fall burning (pre-germination) increased *C. franciscana* survivorship only where it had been initially present. Where active seeding did occur, scraping, fall tarping, and fall flaming (post-germination) increased *C. franciscana* survivorship whether it had been present initially or not. Thus, the study concluded that to expand *C. franciscana* into unoccupied areas, the areas should be treated and actively seeded (Weiss and Neiderer 2009). Seeding where *C. franciscana* was already present did increase the numbers of *C. franciscana* plants, however, making it appropriate in occupied areas as well (Weiss and Neiderer 2009). A previous reseeding study by Bode (2000) showed that *C. franciscana* did well on deep, rich soils when competitors were removed by scraping.

Based on the results of their study, Weiss and Neiderer (2009) recommended that the *Clarkia franciscana* be expanded into adjacent areas of unoccupied suitable habitat by removing nonnative grasses (scraping, tarping, and/or flaming post-germination in the fall) and active seeding with *C. franciscana*. Weiss and Neiderer (2009) stated that management of *C. franciscana* should be undertaken with the adaptive management model using existing information, assessing results through monitoring, and incorporating information gained through each phase of management into future management in order to achieve stated goals and objectives

#### *Oakland Hills*

Nonnative grasses, forbs, and shrubs (*e.g.*, Italian rye grass, wild oat grasses, pampas grass, rip-gut brome, and French broom) continue to threaten *Clarkia franciscana* and are one of the primary threats to

all seven of the subpopulations of *C. franciscana* in the Oakland Hills (Lowe *in litt.* 2004a,b,c,d,e,f; CNDDDB 2009; EBRPD 2009a,b; City of Oakland 2006a,b; Center for Biological Diversity 2007).

### Redwood Regional Park

Since the 1930s, the Serpentine Prairie at Redwood Regional Park has been highly disturbed, altered, compacted, and degraded by equestrian use, horse competitions and construction of obstacle courses, livestock grazing, trail construction, grading and dirt mound construction, fire suppression, planting of native and nonnative trees, encroachment of shrubs and nonnative annual grasses, foot traffic and off-leash dog walking. Since the planting of Monterey pines, acacias, and eucalyptus in the 1960s, a closed tree canopy has developed at the Serpentine Prairie. Shading, litter production, and increased soil moisture under the tree canopy has allowed for the replacement of native bunchgrasses by a dense growth of nonnative annual grasses and shrubs at the Serpentine Prairie. Fire suppression, cessation of livestock grazing, and elevated inputs of atmospheric nitrogen deposition from air pollution (further discussed below under “New Threats”) have further accelerated the encroachment of native shrubs and nonnative shrubs (French broom) and nonnative grasses and forbs (milk thistle (*Silybum marianum*), pampas grass common oats (*Avena barbata*), Mediterranean barley (*Hordeum leporinum*), and ripgut brome (*Bromus diandrus*)) into *Clarkia franciscana* habitat at Redwood Regional Park (EBRPD 2009a,b; Olson *in litt.* 1990; Lowe *in litt.* 2004c). In recent years, the density of invasive Italian ryegrass has especially increased throughout the Serpentine Prairie (Lowe *in litt.* 2004c).

In August 2009, EBRPD began implementation of the *Serpentine Prairie Restoration Plan, Redwood Regional Park* (EBRPD 2009a,b) which combines measures for reducing the cover of nonnative annual grasses, forbs, and shrubs within and adjacent to *Clarkia franciscana* habitat at Redwood Regional Park with other restoration actions to enhance habitat for the survival of the species (*e.g.*, tree removal; installation of protective fencing; revegetation and removal of dirt mounds originally constructed for the equestrian course; soil decompaction; and decommissioning, realigning and repairing existing recreation trails within the restoration area). Currently, EBRPD is evaluating the effectiveness of spring mowing, fall raking and thatch removal, and tree removal in reducing the cover of nonnative plant cover and increasing the survival and abundance of *C. franciscana* at the Serpentine Prairie at Redwood Regional Park (EBRPD 2010). Based on preliminary results, EBRPD is currently recommending the use of spring mowing to control the dense growth of nonnative grasses at the Serpentine Prairie combined with active seeding of *C. franciscana* to expand populations into adjacent areas of unoccupied habitat (Appendix B in EBRPD 2010). EBRPD will continue to monitor the effectiveness of the various habitat enhancement measures in controlling nonnative grasses and forbs and adaptively manage to increase the survival and abundance of *C. franciscana* at Redwood Regional Park.

### Kimberlin Heights Drive and Colgett Drive

The Kimberlin Heights Drive subpopulation is threatened by nonnative pines and pampas grass and the resulting soil development from the presence of these species (Lowe *in litt.* 2004e). The Colgett Drive subpopulation is threatened by nonnative pines, pampas grass, French broom, and iceplant (*Mesembryanthemum crystallinum*) (Lowe *in litt.* 2004d).

### Crestmont Drive

The Crestmont Drive subpopulation of *Clarkia franciscana* is threatened by nonnative annual grasses, French broom, and pampas grass (Lowe *in litt.* 2004a). The developer of a proposed 4-lot residential development on Crestmont Drive proposes to mitigate for impacts to the *C. franciscana* by the establishment of a 0.85-acre conservation easement to include protective fencing, controlling nonnative plant species, reseeding with *C. franciscana*, and monitoring (City of Oakland 2006a,b). However, as of August 2009, the proposed residential development has not been constructed and the conservation easement has yet to be established (Kanz, pers. comm. 2009; Showers, pers. comm. 2009).

### Oakland Hills Tennis Club/Sunrise Assisted Living Facility

The Tennis Club/Sunrise subpopulation of *Clarkia franciscana* continues to be threatened by a dense growth of French broom and nonnative grasses (pampas grass) (Barbic *in litt.* 1997; Lowe *in litt.* 2004f). The site originally supported native grassland and coyote brush scrub vegetation (Barbic *in litt.* 1997). However, the scrub community has been invaded and suppressed by French broom, and native grasses have been replaced by non-native annual species on non-serpentine soils on site (Barbic *in litt.* 1997). A site survey in 2004 reported, “Site conditions appear to be trending away from those conducive to persistence of clarkia (*i.e.*, invasion of non-native species and grass density)” (Lowe *in litt.* 2004f).

In 1997, the City of Oakland approved the construction of the Sunrise Assisted Living Facility upslope from the Tennis Club/Sunrise subpopulation of *Clarkia franciscana* (Barbic *in litt.* 1997). A Mitigated Negative Declaration was prepared under CEQA for the project stating that the endangered plants occur at the extreme edge of the property and would not be disturbed by the construction of the project or ongoing use of the site. The Mitigated Negative Declaration also stated that a dense stand of invasive French broom that, if left unattended, would colonize the native grasslands, eliminating habitat for the *C. franciscana*, and would present a fire hazard to the development. Thus, the Mitigated Negative Declaration included the following mitigation measures to reduce the fire hazard and the threat to the *C. franciscana* from the invasive French broom (cited in Kanz *in litt.* 2009): 1) consult with CDFG on developing a plan for the removal of French broom and a revegetation and monitoring plan; 2) the training of grounds and maintenance workers in minimizing the disturbance of special-status plant species while landscaping and removing invasive plant species; and 3) the construction of physical barriers to prevent unauthorized access to areas with special-status plant species. However, the project files reportedly do not contain any management plans or record of contact with CDFG or the Service (Kanz *in litt.* 2009). According to the Center for Biological Diversity (2007), “the [French] broom was never removed, continued to grow and thrive, and today both threatens the endangered species and creates a serious fire hazard.” Additional reports verify that the site is still threatened by dense stands of French broom (Lowe *in litt.* 2004f, Kanz *in litt.* 2009).

### Old Redwood Road

The Old Redwood Road subpopulation of *Clarkia franciscana* is currently threatened by nonnative shrubs, grasses, and forbs. Nonnative French broom, pampas grass, yellow star thistle (*Centaurea solstitialis*) are invading the toe of the roadcut (Lowe *in litt.* 2004b). Nonnative wild oat grasses (*Avena* sp.) dominate the relatively gentle slope above the roadcut restricting the *C. franciscana* to the edge where soils are thinner (Lowe *in litt.* 2004b).

## Habitat Fragmentation and Small Populations

The final listing rule for the *Clarkia franciscana* (Service 1995) reports that edaphic specialists (plants restricted to a certain soil type) with small populations such as the *C. franciscana* may have low genetic variability (Menges 1991). As a result, populations that become subdivided by alterations in habitat from road construction and urbanization or from natural catastrophes such as disease, fire, or drought, may be at high risk of genetic changes that decrease the ability of the populations to survive (Menges 1991). Low viability caused by harmful genetic changes may result from inbreeding in small populations (Barrett and Kohn 1991).

A study by Gottlieb and Edwards (1992) verified the low genetic variability within the SF Presidio population and the Oakland Hills population (Redwood Regional Park) of *Clarkia franciscana* as is expected for a species that is predominately self-pollinated. The genetic variability of the *C. franciscana* may be further threatened by the recent worldwide decrease in pollinators (Nielsen 2006, National Research Council 2006). Although the species is thought to be primarily self-pollinated, small halictid bees (sweat bees) have been observed visiting the flowers and could potentially be pollinators for the *C. franciscana* (Lewis and Raven 1958). The potential threat from loss of pollinators is further discussed below under “New Threats”.

Urbanization, road construction, and the conversion of the open serpentine grasslands into woodlands have fragmented the SF Presidio population of *Clarkia franciscana* into two extant subpopulations. Only the Inspiration Point subpopulation has more than 2,000 individuals. The War Memorial subpopulation has never exceeded 1,000 plants and contained only 4 plants in 2008 and 24 plants in 2009 (CNDDDB 2009; Chassé *et al.* 2009).

The Oakland Hills population has been highly fragmented by urbanization and road development since the 1950s resulting in seven smaller subpopulations occurring within 0.5 mile of each other within a highly residential neighborhood (Figure 1). Only the Redwood Regional Park subpopulation has more than 2,000 individuals (CNDDDB 2009; Kanz *in litt.* 2009; Legard *in litt.* 2009). The Chadbourne Way subpopulation had 1,600 plants in 2006 but only 548 plants in 2008 (Kanz *in litt.* 2009). The number of *Clarkia franciscana* plants within the Crestmont Drive subpopulation increased from 30 plants in 1991 to 700 - 1,000 plants in 2004 due to tree removal efforts in 2001 but decreased to 300 - 400 plants in 2006 (Kanz *in litt.* 2009; Lowe *in litt.* 2004a; City of Oakland 2006a,b). The Kimberlin Heights Drive subpopulation had less than 150 *C. franciscana* plants in 2004 and only a few plants in more recent years (Kanz, pers. comm. 2009; Lowe *in litt.* 2004e). The Colgett Drive subpopulation had less than 200 plants in 2004 and only 20 plants in 2008 (Kanz, pers. comm. 2009; Lowe *in litt.* 2004e). The Tennis Club/Sunrise subpopulation had 350 - 400 plants in 1997 but decreased to 250 - 300 plants in 2004, 111 in 2007, and only 20 plants in 2008 (Barbic *in litt.* 1997; Lowe *in litt.* 2004f; Kanz *in litt.* 2009). The Old Redwood Road subpopulation had 300 plants in 2004, 205 plants in 2007, and only 56 plants in 2008 (Lowe *in litt.* 2004b; Kanz *in litt.* 2009).

The Recovery Plan (Service 1998) recommends securing populations containing a minimum of 2,000 plants each (but preferably more). The probability of population persistence over the long-term is expected to be higher for larger populations because large size decreases the likelihood of reduced viability or population extirpations due to random demographic or genetic events (Barrett and Kohn

1991, Ellstrand and Elam 1993). Currently, only two of the nine subpopulations of *Clarkia franciscana* (Inspiration Point and Redwood Regional Park) exceed the criteria for containing a minimum of 2,000 plants. Thus, the *C. franciscana* continues to be threatened by habitat fragmentation, a small number of populations, and the small size of most of the subpopulations.

### New Threats

The following new threats to the *Clarkia franciscana* have been identified since the Federal listing of the species in 1995.

#### *Erosion and Altered Hydrology*

In 1978, the Ecology Trail was routed through a then unknown subpopulation of *Clarkia franciscana* at Inspiration Point (Geary 1978). Since then, the trail has been fenced off but the Inspiration Point subpopulation of *C. franciscana* at the SF Presidio continues to be threatened by trail erosion, storm drain runoff, and other hydrologic issues (Chassé *et al.* 2009). A storm drain flows directly into the Inspiration Point site (Chassé, pers. comm. 2009; Chassé *et al.* 2009). This is thought to potentially threaten the *C. franciscana* because, as observed at the War Memorial site, the species does not do well under wetter conditions (Chassé, pers. comm. 2009; Chassé *et al.* 2009).

In the Oakland Hills, most of the subpopulations of *Clarkia franciscana* occur on very steep, highly erosive serpentine roadcuts, and, therefore, are vulnerable to altered hydrology and accelerated erosion resulting from human disturbance (CNDDDB 2009; Lowe *in litt.* 2004a,b,c,d,e,f; Olson *in litt.* 1989). The *C. franciscana* has become restricted to areas with steeper slopes and thinner soils in the Oakland Hills due to the invasion of nonnative annual grasses onto the deeper serpentine soils (Naumovich, pers. comm. 2009). The lower Tennis Club site within the Tennis Club/Sunrise subpopulation is highly vulnerable to altered hydrology and erosion due to its location in a steep gully between the Sunrise Assisted Living Facility and the Oakland Hills Tennis Club (Kanz, pers. comm. 2009). Only the Chadbourne Way subpopulation and some patches of the Redwood Regional Park subpopulation are not currently threatened by erosion and altered hydrology due to their locations on more gentle slopes (Kanz, pers. comm. 2009; Olson *in litt.* 1989).

Until recently, concerns about landslides slowed residential development on some of the steeper serpentine slopes in the Oakland Hills where *Clarkia franciscana* occurs. However, since the Federal listing of the species, many residential developments have been constructed on steep serpentine soils that may or may not have had *C. franciscana* (City of Oakland 2006b; National Association of Realtors 2009; Center for Biological Diversity 2007). In some cases, these residential developments proceeded without environmental review (Kanz *in litt.* 2009; Center for Biological Diversity 2007).

The Crestmont Drive subpopulation of *Clarkia franciscana* may be threatened by altered hydrology and erosional gullying due to the construction of seven single family homes immediately upslope on Colgett Drive between 1998 – 2003 (Lowe *in litt.* 2004a; Kanz *in litt.* 2006 in City of Oakland 2006b; National Association of Realtors 2009; City of Oakland 2009). A local resident and member of Friends of Oakland's Endangered Species reports "observations of the site [Crestmont Drive] indicate the impacts of water from uphill properties [on Colgett Drive] may be causing rilling and erosion" (Kanz *in litt.* 2006 in City of Oakland 2006b).

### *Atmospheric Nitrogen Deposition from Air Pollution*

Elevated atmospheric nitrogen deposition from air pollution is particularly harmful to the nutrient-poor serpentine grasslands where the *Clarkia franciscana* occurs because nitrogen is the primary limiting nutrient for plant growth on serpentine soils (Weiss 1999). The use of catalytic converters on vehicles has increased the availability of nitrogen in a form that is directly absorbed by plants (EBRPD 2009a). The excess nitrogen deposited leads to increases in nonnative annual grasses which outcompete the native flora (Fenn *et al.* 2003, Weiss 1999).

Weiss (1999) found that the dry deposition of 10 – 15 kilograms nitrogen per hectare per year from smog has enabled the invasion of nonnative annual grasses into native grasslands on nutrient-poor, serpentine soils in South San Jose, California, resulting in the loss of habitat for the federally-threatened bay checkerspot butterfly (*Euphydryas editha bayensis*). Similarly, the displacement of *Clarkia franciscana* and native bunchgrasses from serpentine soils in the Oakland Hills is attributed to the dry deposition of 10 – 15 kilograms nitrogen per hectare per year from smog allowing for the invasion of nonnative annual grasses, especially Italian ryegrass at Redwood Regional Park (EBRPD 2009a, Tonnesen *et al.* 2007). The amount of nitrogen loading at the Serpentine Prairie at Redwood Regional Park is thought to have been augmented by the condensation of fog underneath the canopy of nonnative trees (and native trees planted outside their natural range) since the 1960s (Naumovich, pers. comm. 2009). Thus, *Clarkia franciscana* in the serpentine grasslands in the Oakland Hills continues to be threatened by elevated atmospheric nitrogen deposition from air pollution enabling the invasion of nonnative annual grasses into otherwise nutrient-poor soils.

Comparatively, Weiss (1999) found on the San Francisco Peninsula (including the SF Presidio), where nitrogen deposition from smog is only 4 – 6 kilograms nitrogen per hectare per year, ungrazed serpentine grasslands have largely resisted the invasion of nonnative annual grasses. Thus, *Clarkia franciscana* on serpentine grasslands at the SF Presidio are less threatened due to the relatively cleaner air and lower inputs of atmospheric nitrogen deposition from air pollution there.

Other researchers found that increased levels of soil nitrogen from elevated atmospheric nitrogen deposition in the Mojave Desert could increase the dominance of nonnative annual grasses and thereby raise the frequency of fire (Brooks 1999, 2003; Brooks and Pyke 2001). However, it is not known at this time what effect increasing fire frequency would have on the *Clarkia franciscana* or whether the results from the research in the Mojave Desert are transferable to the San Francisco Bay Area. In fact, fire suppression at Redwood Regional Park has allowed for the encroachment of shrubs into the serpentine grassland habitat of the *C. franciscana* (EBRPD 2009a,b).

Other potential effects of elevated atmospheric nitrogen deposition on plants in nitrogen-limited ecosystems (Wolkowski *et al.* 2008), such as that in which the *Clarkia franciscana* grows, include decreased diversity of mycorrhizal communities (Egerton-Warburton and Allen 2000, Sigüenza 2000). Mycorrhiza form a mutualistic relationship with plants including annual forbs in which the mycorrhiza increase nutrient uptake of water and mineral from the soil, and increase the plants resistance to disease in exchange for carbohydrates from the plant (Campbell *et al.* 1999). Increased nitrogen deposition can also predispose plants to other environmental stresses such as elevated concentrations of ozone, drought, frost, or insect attacks (Bytnerowicz 2002; Jones *et al.* 2004). It is not known at this time if elevated atmospheric nitrogen deposition from air pollution impact *C. franciscana* mycorrhiza.



### *Overpopulation of Gophers*

The Redwood Regional Park subpopulation of *Clarkia franciscana* in the Oakland Hills is reportedly threatened by an overpopulation of gophers that disturbs the soils where the *C.* occurs resulting in soil development and the creation of top soil (Lowe *in litt.* 2004c). Gophers create fresh mounds of bare soil that are colonized by seeds from adjacent stands of plants (including nonnative annual grasses) (EBRPD 2009a; Hobbs and Mooney 1995). Gopher disturbance rates can be on the order of 10 - 25 percent of an area per year (EBRPD 2009a; Hobbs and Mooney 1995). The development and enrichment of the soils by the gophers' activities is thought to allow the invasion of nonnative annual grasses onto the otherwise thinner and nutrient-poor serpentine soils where the *C. franciscana* occurs (Lowe *in litt.* 2004c; EBRPD 2009a). Hobbs and Mooney (1995) found that exclusion of gophers from a serpentine grassland at Jasper Ridge Biological Preserve in the eastern foothills of the Santa Cruz Mountains of northern California increased the abundance of native perennial plant species greatly in the years following exclosure. However, it is not known at this time if the exclusion of gophers would benefit *C. franciscana* in the Serpentine Prairie at Redwood Regional Park.

### *Loss of Pollinators*

The *Clarkia franciscana* is thought to reproduce primarily through self-pollination. However, small halictid bees (sweat bees) have been observed visiting the flowers and could potentially be pollinators for the species (Lewis and Raven 1958). Thus, the use of pollinators by the *C. franciscana* could be important for increasing gene flow among populations and maintaining the genetic variability of the species. A study by Gottlieb and Edwards (1992) verified the low intrapopulation genetic variability within the SF Presidio population and the Oakland Hills population (Redwood Regional Park) as is expected for a species that is predominately self-pollinated (Stebbins 1978). Species with small populations and low genetic variability, such as the *C. franciscana*, are at greater risk of extirpation from natural catastrophic events (disease, fire, and drought) (Menges 1991).

The reproduction and genetic variability of the *Clarkia franciscana* could be threatened by the recent worldwide decrease in pollinators. Pollinators are threatened by the use of both regulated (*e.g.*, malathion) and unregulated pesticides (*e.g.*, pyrethroids) (Department of Pesticide Regulation 2006, Keith 2006, Service 2000). More recently, the decline in pollinators observed across North America has been attributed to introduced parasites, in particular the varroa mite (*Varroa jacobsoni*), which affects the honey bee (*Apis mellifera*) (Nielsen 2006, National Research Council 2006). The potential effects of introduced parasites on *C. franciscana* pollinators are not known. Hafernik (2009), however, reported a rich diversity of bees at the SF Presidio, including 56 species representing 23 genera. The diversity and abundance of bees and other pollinators in the Oakland Hills is not known at this time.

### *Genetic Swamping and Loss of Local Genetic Types*

The SF Presidio and Oakland Hills populations of the *Clarkia franciscana* are separated by 17 miles and the San Francisco Bay resulting in two genetically distinct populations (Gottlieb and Edwards 1992). However, the genetic distinctiveness of the Oakland Hills population of *C. franciscana* could potentially be threatened by genetic swamping from *C. franciscana* plants of SF Presidio genetic stock (which had been cultivated for 40 years at Tilden Botanical Garden) planted by residents within the Oakland Hills.

In 2005, Bob Case, a plant fancier from Concord, California, acquired a seed from a *Clarkia franciscana* plant at the EBRPD's Tilden Botanical Garden in Berkeley, California (Oakland Tribune 2007). *C. franciscana* plants had been growing at the Tilden Botanical Garden since seeds from the SF Presidio were planted there in 1964 (Roof 1971). Bob Case then planted the seed in his backyard where the *C. franciscana* plants rapidly grew (Oakland Tribune 2007). Bob Case then took samples of the *C. franciscana* to a plant sale where he provided samples to a garden in El Sobrante, Contra Costa County, on the Bringing Back the Natives Tour (Jensen *in litt.* 2009).

Some of the *Clarkia franciscana* plants ended up at Annie's Annuals & Perennials, a popular grower in Richmond, California. Annie's Annuals & Perennials then featured the *C. franciscana* as the "Plant of the Month" in December promoting sales of the *C. franciscana* (Oakland Tribune 2007). That led to the company being contacted by CDFG for sales of an endangered species in violation of CESA (Showers, pers. comm. 2009; Oakland Tribune 2007). Then, at the request of Mary Ann Showers (CDFG), Annie's Annuals & Perennials destroyed the remaining crop of *C. franciscana* plants (Jensen *in litt.* 2009). A review of the plant distributor's website shows that *C. franciscana* is no longer listed as for sale by Annie's Annuals & Perennials (Annie's Annuals & Perennials 2009).

The primary threat to the *Clarkia franciscana* due to the propagation and sale of *C.* plants that germinated from seed acquired from the Tilden Botanical Garden (of SF Presidio genetic type) is from genetic swamping and loss of local genetic types if the acquired seeds were planted in the Oakland Hills near native wild *C. franciscana* plants within the Oakland Hills population. On February 1, 2007, a newspaper article in the *Oakland Tribune* (Oakland Tribune 2007) promoted the conservation of *C. franciscana* by suggesting that residents in the Oakland Hills should purchase plants from Annie's Annuals & Perennials and plant them in their yards. If residents had followed the newspaper article's suggestion, then *C. franciscana* plants that had originated from seed from the SF Presidio population (that was then cultivated at the Tilden Botanical Garden for over 40 years) would have been introduced into areas within the genetically distinct wild Oakland Hills population (Showers, pers. comm. 2009). The two populations of *C. franciscana* are separated by 17 miles resulting in two genetically distinct populations (Gottlieb and Edwards 1992). If residents of the Oakland Hills had purchased *C. franciscana* plants from Bob Case or Annie's Annuals & Perennials and planted them in their yards, then the plants could have hybridized with the *C. franciscana* plants of the Oakland Hills population resulting in outbreeding depression and loss of local genetic distinction (Showers, pers. comm. 2009). Insects or the wind could carry pollen from the cultivated *C. franciscana* plants in home gardens to the wild *C.* plants within the Oakland Hills resulting in the genetic swamping of the Oakland Hills population by the SF Presidio genetic type and loss of the local Oakland Hills genetic type (Oakland Tribune 2007).

Ani Jensen, propagator for Annie's Annuals & Perennials, stated that she knows that seven *Clarkia franciscana* plants were sold by mail order, and none of them to residents in the Oakland Hills (Jensen *in litt.* 2009). However, due to the store's retail set-up, she is not able to track the number of *C. franciscana* plants that were sold on-site or if these plants were sold to residents within the Oakland Hills (Jensen *in litt.* 2009). The store's on-site retail set-up tracks plants sales only by price and not by species (Jensen *in litt.* 2009). Ani Jensen stated that the store's remaining crop of *C. franciscana* was destroyed as requested by Mary Ann Showers (CDFG), but she knows of a few *C. franciscana* plants remaining in home gardens in Richmond and San Pablo in Contra Costa County (Jensen *in litt.* 2009).

## *Climate Change*

Current climate change predictions for terrestrial areas in the Northern Hemisphere indicate warmer air temperatures, more intense precipitation events, and increased summer continental drying (Field *et al.* 1999, Cayan *et al.* 2005, Intergovernmental Panel on Climate Change 2007). However, predictions of climatic conditions for smaller sub-regions such as California remain uncertain. It is unknown at this time if climate change in California will result in a warmer trend with localized drying, higher precipitation events, or other effects. While we recognize that climate change is an important issue with potential effects to listed species and their habitats, we lack adequate information to make accurate predictions regarding its effects to particular species at this time.

The *Clarkia franciscana* has evolved to adapt to the highly specific soil, environmental, and microclimatic conditions that are unique to the two locations where it occurs in the San Francisco Bay Area: the SF Presidio and the Oakland Hills. Observations at the War Memorial site demonstrate that the *C. franciscana* is not very tolerant of certain microclimatic conditions associated with this coastal location (cooler, wetter, and greater exposure to wind and fog) (Chassé *et al.* 2009). Thus, due to the highly restrictive soil, environmental, and microclimatic conditions under which the *C. franciscana* can grow, the species may be vulnerable to even small changes in climate.

## Summary

Competition with nonnative grasses, forbs, and shrubs continues to be the primary threat to all subpopulations of *Clarkia franciscana* at the SF Presidio and in the Oakland Hills. This threat from invasive plants is exacerbated by the presence of nonnative trees (and native trees planted outside their native range) at both locations, elevated atmospheric nitrogen deposition from air pollution in the Oakland Hills, fire suppression and an overpopulation of gophers at Redwood Regional Park, climate change, and human disturbance all of which promote the invasion of nonnative plants into the naturally nutrient-limited serpentine grassland habitat of the *C. franciscana*.

Since the transfer of the SF Presidio lands to NPS in 1994, NPS and the Presidio Trust have been experimenting with and implementing various techniques for controlling nonnative plants within and adjacent to *Clarkia franciscana* habitat at the SF Presidio (*e.g.*, hand removal, scraping off the top soil, tarping, prescribed burning, tree removal and revegetation, and reseeded) (Weiss and Neiderer 2009, Chassé *et al.* 2009). Tree removal when combined with measures to control nonnative grasses has been successful in increasing the number of *C. franciscana* plants at Inspiration Point (Weiss and Neiderer 2009, Chassé *et al.* 2009). However, these efforts have been less effective at the War Memorial site where unfavorable microclimatic factors associated with the site's proximity to the ocean (*e.g.*, cooler, wetter, and greater exposure to wind and fog) are thought to limit the growth and survival of the *C. franciscana* (Chassé *et al.* 2009; Chassé, pers. comm. 2009; Stringer, pers. comm. 2009a,b). Similarly, microclimatic factors may limit the sustainability of the recently introduced experimental Coastal Bluffs subpopulation along the northwestern edge of the SF Presidio (Chassé, pers. comm. 2009; Stringer, pers. comm. 2009a,b).

In August 2009 in the Oakland Hills, EBRPD began removing trees and shrubs and controlling nonnative annual grasses on 6 acres of the Serpentine Prairie at Redwood Regional Park to restore habitat for the *Clarkia franciscana* (EBRPD 2010). The City of Oakland recently approved the

establishment of a 0.85-acre conservation easement for the protection of the Crestmont Drive subpopulation as mitigation for the construction of a 4-lot residential development on 0.30 acre of *C. franciscana* habitat at the site (City of Oakland 2006a,b). The proposed conservation easement would include protective fencing, controlling nonnative plant species, reseeding with *C. franciscana*, and monitoring; however, at this time, the proposed residential development has not been constructed and the conservation easement has yet to be established (Showers, pers. comm. 2009; Kanz, pers. comm. 2009).

The *Clarkia franciscana* continues to be threatened by habitat fragmentation, low number of populations, small population sizes, and low genetic variability within both the SF Presidio and in the Oakland Hills. Only two subpopulations, Inspiration Point at the SF Presidio and Redwood Regional Park in the Oakland Hills, have greater than 2,000 plants. Five of the remaining nine extant subpopulations (War Memorial, Kimberlin Heights Drive, Colgett Drive, Tennis Club/Sunrise, and Old Redwood Road) had less than 200 plants each in recent years.

The following new threats have been identified since the Federal listing of the *Clarkia franciscana* in 1995: erosion and altered hydrology; elevated atmospheric nitrogen deposition from air pollution; an overpopulation of gophers resulting in soil development; loss of pollinators; genetic swamping and the loss of local genetic types; and climate change.

### **III. RECOVERY CRITERIA**

Recovery plans provide guidance to the Service, States, and other partners and interested parties on ways to minimize threats to listed species, and establish criteria that may be used to determine when recovery goals are achieved. There are many paths to accomplishing the recovery of a species and recovery may be achieved without fully meeting all recovery plan criteria. For example, one or more criteria may have been exceeded while other criteria may not have been accomplished. In that instance, we may determine that, over all, the threats have been minimized sufficiently, and the species is robust enough, to downlist or delist the species. In other cases, new recovery approaches and/or opportunities unknown at the time the recovery plan was finalized may be more appropriate ways to achieve recovery. Likewise, new information may change the extent that criteria need to be met for recognizing recovery of the species. Overall, recovery is a dynamic process requiring adaptive management, and assessing a species' degree of recovery is likewise an adaptive process that may, or may not, fully follow the guidance provided in a recovery plan. We focus our evaluation of species status in this 5-year review on progress that has been made toward recovery since the species was listed (or since the most recent 5-year review) by eliminating or reducing the threats discussed in the five-factor analysis. In that context, progress towards fulfilling recovery criteria serves to indicate the extent to which threat factors have been reduced or eliminated.

#### Downlisting Criteria

The Recovery Plan (Service 1998) states that *Clarkia franciscana* should be evaluated for downlisting to threatened if the five known occurrences of the species at that time (the Inspiration Point, War Memorial, Redwood Regional Park, Crestmont Drive, and Old Redwood Road subpopulations) are:

1. Fully protected and managed with the primary intention of preserving the populations in perpetuity;
2. Shown to be stable or increasing over a minimum of 20 years that includes the normal precipitation cycle (or longer if suggested by the results of demographic monitoring);

3. Seed collected from the remaining natural populations representing both the SF Presidio and the Oakland Hills is stored at a minimum of two Center for Plant Conservation certified botanic gardens;
4. Reliable seed germination and propagation techniques for the species are understood; and
5. Until research shows otherwise, recovery should target securing populations containing a minimum of 2,000 plants each (but preferably more). The probability of population persistence over the long-term is expected to be higher for larger populations because large size decreases the likelihood of reduced viability or population extirpations due to random demographic or genetic events (Barrett and Kohn 1991, Ellstrand and Elam 1993).

Each of the above downlisting criteria addresses listing factors A and E by protecting populations from habitat destruction/modification and from man-made and natural factors. The criteria also ensure population sizes are large enough to reduce the likelihood of extinction from catastrophic events.

At the time of Federal listing of the *Clarkia franciscana* and the writing of the Recovery Plan, there were only five known extant occurrences of the species: the Inspiration Point and War Memorial subpopulations at the SF Presidio and the Redwood Regional Park, Crestmont Drive, and Old Redwood Road subpopulations within the Oakland Hills (Service 1995, 1998). The Tennis Club/Sunrise subpopulation was presumed extirpated since plants were not found there during surveys in 1991 (Bigham *in litt.* 1991). Since the writing of the Recovery Plan, *C. franciscana* plants were found at the presumed extirpated Tennis Club/Sunrise site (Barbic *in litt.* 1997) and three additional subpopulations of *C. franciscana* were discovered within the Oakland Hills: Chadbourne Way, Kimberlin Heights Drive, and Colgett Drive (Lowe *in litt.* 2004d,e; EBRPD 2009b; Kanz *in litt.* 2009). The recently discovered Chadbourne Way subpopulation is the second largest subpopulation within the Oakland Hills. Therefore, the downlisting criteria should be revised to take into consideration the protection of the four additional subpopulations found within the Oakland Hills. The criteria relevant to the species' current threats are currently up-to-date.

Downlisting Criterion #1 Protection and Management: The downlisting criterion requires that all of the known occurrences of the species (only five occurrences were known during the writing of the Recovery Plan) be fully protected and managed with the primary intention of preserving the populations in perpetuity. The War Memorial and Inspiration Point subpopulations have been fully protected and managed with the primary intention of preserving the populations in perpetuity since the SF Presidio lands were transferred from the U.S. Army to NPS in 1994. NPS is also protecting and managing the experimental introduction of *Clarkia franciscana* at the Coastal Bluffs site at the SF Presidio. In the Oakland Hills, however, only the Redwood Regional Park subpopulation is currently protected and managed by EBRPD with the primary intention of preserving the populations in perpetuity. The remaining six subpopulations in the Oakland Hills are currently unprotected on private residential lands or on public lands adjacent to roads managed by the City of Oakland. In summary, only three of the nine known extant subpopulations of the *C. franciscana* (and one experimental subpopulation) are currently protected and managed with the primary intention of preserving the populations in perpetuity. Therefore, the downlisting criterion has not been met.

Downlisting Criterion #2 Population Stability for 20 Years: The downlisting criterion requires that demographic monitoring show that all of the known occurrences of the species (only five occurrences were known during the writing of the Recovery Plan) are stable or increasing over a minimum of 20 years that includes the normal precipitation cycle (or longer if suggested by the results of demographic

monitoring). The Inspiration Point and War Memorial subpopulations have been monitored annually since 1994 for a total of 16 years. At Inspiration Point, the number of *Clarkia franciscana* plants declined between 1994 and 1997 (from 9,714 to 744), was steady between 1998 and 2002 (ranging between 9,061 - 12,578), and increased between 2003 and 2009 (from 20,956 to 54,322) with the exception of the drought year 2008 when the number of *C. franciscana* plants declined to 11,595. At the War Memorial site, the number of *C. franciscana* plants has never exceeded 1,000 plants and declined to only 11 plants in 1997, 4 plants in 2008, and 29 plants in 2009. In the Oakland Hills, annual monitoring beginning in 2007 at Redwood Regional Park shows an increase in recent years; however, there is only scattered population data available at Redwood Regional Park prior to 2007. Annual monitoring has yet to be implemented for the six other subpopulations in the Oakland Hills; recent population data shows a decline in the number of *C. franciscana* plants within some of these subpopulations. In summary, none of the subpopulations of *C. franciscana* have met the criterion for population stability over a 20 year period. Only the Inspiration Point subpopulation comes close to achieving population stability over a 20 year period. Therefore, the downlisting criterion has not been met.

Downlisting Criterion #3 Seed Storage at Two Center for Plant Conservation Certified Botanical Gardens: The downlisting criterion requires that seed collected from the remaining natural populations representing both the SF Presidio and the Oakland Hills be stored at a minimum of two Center for Plant Conservation certified botanic gardens. Currently, only one Center for Plant Conservation certified botanical garden (the University of California Botanic Garden in Berkeley) has seed collected from the SF Presidio and Oakland Hills populations of the *Clarkia franciscana*. In 1981, *C. franciscana* seeds were acquired from the SF Presidio population and stored at the University of California Botanic Garden in Berkeley (University of California Botanic Garden 2009). In 2004, 2005, and 2008, as requested by CDFG, about 4,900 *C. franciscana* seeds were collected from the Oakland Hills population of *C. franciscana* and are being stored at the University of California Botanic Garden in Berkeley (Forbes, pers. comm. 2009). Michael Wall, Seed Program Manager at Rancho Santa Ana Botanic Garden, stated that the Center for Plant Conservation certified Rancho Santa Ana Botanic Garden never acquired *C. franciscana* seeds (Wall, pers. comm. 2009). Therefore, the downlisting criterion has not been met.

Downlisting Criterion #4 Reliable Seed Germination and Propagation Techniques Understood: The downlisting criterion requires that reliable seed germination and propagation techniques for the species are understood. In 1964, James Roof collected seed from *Clarkia franciscana* plants at the SF Presidio and sowed the seeds at EBRPD's Tilden Botanical Garden in Berkeley, Alameda County, California (Roof 1971). The EBRPD Tilden Botanical Garden has been germinating and propagating *C. franciscana* there since. NPS is currently experimenting with seed germination and propagation at the experimental Coastal Bluffs site. NPS planted 1,000 *C. franciscana* seeds at the site in fall 2008, and 329 plants emerged there in May 2009 (Stringer, pers. comm. 2009a,b). Thus, due to 45 years of experience in successful seed germination and propagation at the Tilden Botanical Garden and the apparent preliminary success of introduction of *C. franciscana* at the Coastal Bluffs site, the downlisting criterion has been met.

Downlisting Criterion #5 Securing Populations Containing a Minimum of 2,000 Plants: The downlisting criterion requires that until research shows otherwise, recovery should target securing populations containing a minimum of 2,000 plants each (but preferably more). Currently, only two of the nine known extant subpopulations of the *Clarkia franciscana* contain a minimum of 2,000 plants each: Inspiration Point and Redwood Regional Park. Thus, the downlisting criterion has not been met.

## Delisting Criteria

The Recovery Plan states that available data suggest that *Clarkia franciscana* should not be considered for delisting. The species is known from only two locations in an area that is extensively urbanized. Only one possible repatriation site is known. In the unlikely event that (1) a significant number of new populations are discovered and/or (2) research shows habitat within the species range is available and introductions are likely to be successful, development of delisting criteria could be considered.

Since the writing of the Recovery Plan, three additional subpopulations of *Clarkia franciscana* have been discovered within the Oakland Hills population (Chadbourne Way, Kimberlin Heights Drive, and Colgett Drive), and *C. franciscana* plants were found within the presumed extirpated Tennis Club/Sunrise subpopulation. However, no new populations have been discovered outside of the SF Presidio and Oakland Hills populations. In fall 2008, an experimental subpopulation of *C. franciscana* (Coastal Bluffs) was introduced by the planting of 1,000 seeds in the serpentine soils along the Coastal Bluffs overlooking the Pacific Ocean along the northwestern edge of the SF Presidio (Stringer, pers. comm. 2009a,b). In late May 2009, 329 individual *C. franciscana* plants were observed at the experimental Coastal Bluff site (Stringer, pers. comm. 2009a,b). However, it is too soon to tell if a sustainable subpopulation of *C. franciscana* will persist at the experimental Coastal Bluffs site due to microclimatic conditions (wetter and cooler with greater exposure to wind and fog) that are less conducive to the growth of the species (Stringer, pers. comm. 2009a,b; Chassé *et al.* 2009; Chassé, pers. comm. 2009). The serpentine grassland at the West Crissy Bluffs site, near the extirpated McDowell Avenue site, has also been identified as a possible repatriation site at the SF Presidio (Chassé *et al.* 2009); the Presidio Trust is currently controlling nonnative plant species at this site. In summary, due to the failure to meet four of the five downlisting criterion, the lack of finding additional populations of *C. franciscana* outside of the SF Presidio and Oakland Hills, and the currently unknown success of recent introduction efforts, we believe that the Recovery Plan is up-to-date and relevant to both the species' current status and current threats in stating that *C. franciscana* should not be considered for delisting.

## **IV. SYNTHESIS**

At the time of Federal listing of the species in 1995, there were a total of five known extant subpopulations of *Clarkia franciscana* occurring within two highly urbanized locations within the San Francisco Bay Area (two subpopulations at the SF Presidio and three in the Oakland Hills). Currently, there are a total of nine known extant subpopulations (two at the SF Presidio and seven in the Oakland Hills) and one experimental introduction (Coastal Bluffs at the SF Presidio). However, only two of the subpopulations (Inspiration Point and Redwood Regional Park) have more than 2,000 *C. franciscana* plants.

Since the transfer of the SF Presidio lands to NPS in 1994, NPS and the Presidio Trust have installed protective fencing and implemented a vegetation management plan that has eliminated the threats from pedestrian traffic, road maintenance, and mowing at the SF Presidio. NPS and the Presidio Trust have also reduced the threats from shading by nonnative trees (and native trees planted outside their natural range) by removing trees adjacent to *Clarkia franciscana* habitat, but long-term changes in soil physical and geochemical properties from litter production may limit the ability of the *C. franciscana* to recolonize these sites. NPS and the Presidio Trust have also experimented with and monitored the

effectiveness of various techniques in controlling nonnative grasses and forbs that threaten the *C. franciscana*. The restoration efforts at the SF Presidio have been successful in increasing the number of *C. franciscana* plants at Inspiration Point from about 9,000 in 1995 to over 54,000 in 2009 (except during the drought year in 2008 when the site had less than 12,000 plants). Restoration efforts at the War Memorial site, however, have been less successful likely due to microclimatic conditions associated with the site's proximity to the ocean (wetter, cooler, and greater exposure to wind and fog) that are thought to limit the growth and survival of the species. The War Memorial subpopulation has never exceeded 1,000 plants and decreased to only 4 plants in 2008 and 29 plants in 2009.

In the Oakland Hills, the *Clarkia franciscana* continues to be threatened by residential development; pedestrian traffic; road maintenance; vegetation and fire management (mowing and weed-whacking); shading from nonnative and introduced trees; habitat fragmentation; small population size; low genetic variability; genetic swamping and loss of local genetic types; erosion and altered hydrology; and competition with nonnative grasses, forbs and shrubs. Only the Redwood Regional Park subpopulation is currently protected from residential development. One of the primary threats to the species, competition with invasive grasses, forbs, and shrubs, is exacerbated by the presence of nonnative trees (and native trees planted outside their native range), elevated atmospheric nitrogen deposition from air pollution, fire suppression enabling shrub encroachment, soil development from an overpopulation of gophers at Redwood Regional Park, climate change, and human disturbance all of which promote the invasion of nonnative plants into the naturally nutrient-limited serpentine grassland habitat of the *C. franciscana*. Restoration efforts at Redwood Regional Park have increased the number of *C. franciscana* plants there from 3,500 in 2004 to over 105,000 plants in 2009. In August 2009, EBRPD began implementation of the Serpentine Prairie Restoration Plan which proposes to restore 6 acres of serpentine grassland for the protection of *C. franciscana* at Redwood Regional Park through installation of protective fencing, removal of nonnative and introduced trees, and controlling nonnative annual grasses. However, no restoration has been implemented for the six other subpopulations of *C. franciscana* in the Oakland Hills.

Despite the discovery of new subpopulations in the Oakland Hills and implementation of restoration activities at the SF Presidio and Redwood Regional Park, the status of the species remains endangered due to population instability, low number of populations, small size of the populations, low genetic variability, and continued threats from invasive plants, residential development, road maintenance, and vegetation and fire management activities. Therefore, we believe *Clarkia franciscana* still meets the definition of endangered, and recommend no status change at this time.



## V. RESULTS

### Recommended Listing Action:

- Downlist to Threatened
- Uplist to Endangered
- Delist (indicate reason for delisting according to 50 CFR 424.11):
  - Extinction*
  - Recovery*
  - Original data for classification in error*
- No Change

### New Recovery Priority Number and Brief Rationale: 5C (change)

We recommend a change in the recovery priority number for *Clarkia franciscana* from 5 to 5C based on a 1-18 ranking system where 1 is the highest-ranked recovery priority and 18 is the lowest (Endangered and Threatened Species Listing and Recovery Priority Guidelines, 48 FR 43098, September 21, 1983). The recovery priority number (5) indicates that the species has a high degree of threat but a low potential for recovery. The “C” indicates conflict with residential development and vegetation and fire management activities in the Oakland Hills.

## VI. RECOMMENDATIONS FOR ACTIONS OVER THE NEXT 5 YEARS

1. Implement and evaluate the effectiveness of the habitat enhancement recommendations suggested by Weiss and Neiderer (2009) and EBRPD (Appendix B in EBRPD 2010) (e.g., tree removal, reseeding, scraping, fall tarping, fall flaming (post-germination), spring mowing, and installation of protective fencing), for increasing the survivorship of *Clarkia franciscana*, controlling nonnative annual grasses, and expanding *C. franciscana* populations into adjacent areas .
  - a. The effectiveness of various habitat enhancement measures may vary dependent on site-specific conditions as observed in the different results obtained in studies of the SF Presidio (Weiss and Neiderer 2009) and Oakland Hills (EBRPD 2010) populations. Monitor the results, determine the best treatment intervals, and adaptively manage.
  - b. Expand *Clarkia franciscana* plants into adjacent areas of suitable habitat by collecting clarkia seeds from nearby plants and actively seeding in areas of bare ground and low cover of nonnative annual grasses. Collect seeds at different times in the season from *C. franciscana* plants throughout the adjacent areas, from large and small individuals, to capture a range of genetic diversity (Appendix B in EBRPD 2010). To avoid over-collecting, seed collection should be limited to less than 1 percent of the seedset in the first year while efficacy is being tested (EBRPD 2010).
  - c. Persuade private landowners in the Oakland Hills (e.g., Oakland Hills Tennis Club, Sunrise Assisted Living Facility, and the proposed Crestmont development) to monitor the *Clarkia franciscana* subpopulations on their lands and control invasive species as required under their management plans that were developed during the CEQA process (e.g., Center for Biological Diversity 2007; Kanz *in litt.* 2009; EBRPD 2009b; City of Oakland 2006b).

- d. Persuade the City of Oakland and private landowners in the Oakland Hills (*e.g.*, Colgett Drive, Kimberlin Heights Drive, and Crestmont Drive) to remove trees where they have been planted in suitable *Clarkia franciscana* habitat as is being done at Redwood Regional Park and the SF Presidio.
2. Reintroduce *Clarkia franciscana* to suitable habitat at the SF Presidio (restored site at the West Crissy serpentine grassland near McDowell Avenue; historic location for the species) (Chassé *et al.* 2009).
3. Address storm drain runoff and erosion issues at Inspiration Point in the SF Presidio and at Crestmont Drive in the Oakland Hills.
4. Increase education of City of Oakland road maintenance and vegetation and fire management teams in how to avoid and minimize impacts to the *Clarkia franciscana* including delaying their activities (*e.g.*, mowing and weed-whacking) in areas with *C. franciscana* (Chadbourne Way, Old Redwood Road, and Redwood Regional Park subpopulations) until after the clarkia have set seed (late summer, early fall).
5. Analyze the genetic diversity among the seven subpopulations of *Clarkia franciscana* within the Oakland Hills. Store seeds representing the genetic diversity within the Oakland Hills population at the University of California Botanical Garden, Berkeley, California, and the Rancho Santa Ana Botanic Gardens, Claremont, California. Also collect seeds from the SF Presidio population of *C. franciscana* for storage at the Rancho Santa Ana Botanic Gardens, Claremont, California.

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U.S. FISH AND WILDLIFE SERVICE  
5-YEAR REVIEW

*Clarkia franciscana* (Presidio clarkia)

Current Classification: Endangered

Recommendation Resulting from the 5-Year Review:

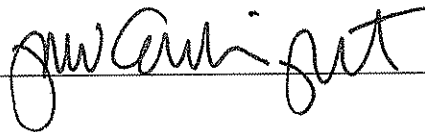
- Downlist to Threatened
- Uplist to Endangered
- Delist
- No change needed

Appropriate Listing/Reclassification Priority Number: 5C (change)

Review Conducted By: Joseph Terry

FIELD OFFICE APPROVAL:

 Lead Field Supervisor, U.S. Fish and Wildlife Service

Approve  Date 11-19-00