Clarkia imbricata
(Vine Hill Clarkia)

5-Year Review:
Summary and Evaluation

Photo credit: Josh Hull, USFWS

U.S. Fish and Wildlife Service
Sacramento Fish & Wildlife Office
Sacramento, CA

September 2011

5-YEAR REVIEW

Clarkia imbricata (Vine Hill 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 status of the species 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:

Clarkia imbricata is an annual herb endemic to grasslands on acidic sandy soils in Sonoma County in the area of Vine Hill Road between the cities of Forestville and Santa Rosa, adjacent to Pitkin Ranch on a dry slope in the vicinity of Pitkin marsh. Only three original native populations were known and all three are thought to be extirpated: 1) 6230 Vine Hill Road (now located between 4570 and 4800 Vine Hill Road, hereafter referred to as the "Lewis-type locality"); 2) 4965 Vine Hill Road including a portion of 6443 Sequoia Circle Road (hereafter the "Sequoia Circle locality") and the "Pitkin Ranch locality", where *C. imbricata* grew along a path to Pitkin Marsh and on a dry slope bordering Pitkin Marsh. The Lewis-type locality was probably extirpated before 1974, after which no plants were found during repeated surveys. The Pitkin Ranch locality was likely extirpated sometime between 1981 and 1984 after land use conversion to a Christmas tree farm around 1976; searches in 1984, 1986 and 1987 for *Clarkia imbricata* were unsuccessful in locating individuals. Finally, the habitat of the Sequoia Circle locality was on private property with restricted access, and plants have not been surveyed since the listing rule in 1997.

In 1974, a population was introduced to the Vine Hill Preserve from seeds collected from the Sequoia Circle population (from the 4965 Vine Hill Road portion of the population). At this time, the Vine Hill Preserve population is the only known extant population. Surveys of the Vine Hill Preserve counted 8,781 plants in 2010. In 2009 there were 7,341 plants, no surveys were conducted in 2008, and in 2007 there were 3,357 plants. Annual plants can vary in number from year to year, but the trend over 2007 through 2010 is best described as increasing or stable.

No quantitative surveys have been conducted in 2011; however numbers appear to have declined.

The primary threats to *Clarkia imbricata* are habitat loss through community succession and competition with non native species and risk of extinction through stochastic events associated with small populations (such as a fire). Secondary threats include inadequacy of existing regulatory mechanisms, habitat loss through land use conversion on the unprotected portions of the Vine Hill Preserve population, and overcollecting or damage associated with trespassing on the Vine Hill Preserve.

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. There is no final approved Recovery Plan. We used survey information from experts who have been monitoring various localities of this species, and the California Natural Diversity Database (CNDDB) maintained by the California Department of Fish and Game. Personal communications with experts were our primary sources of information used to update the status of the species and threats. 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. We focus on *Clarkia imbricata* 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 Environmental Contaminants, Pacific Southwest Region (916) 414-6464.

Lead Field Office: Josh Hull, Recovery Division Chief, 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 21, 2010 (75 FR 28636 28642). We did not receive any comments specific to *Clarkia imbricata*.

Listing History

Original Listing
FR Notice: Federal Register 62:54791-54808
Date of Final Listing Rule: October 22, 1997
Entity Listed: *Clarkia imbricata* (Vine Hill clarkia), a plant species
Classification: Endangered

State Listing
Date listed: 1978
Entity listed: *Clarkia imbricate,* Vine Hill clarkia
Classification: Endangered

Review History: No five year reviews have been conducted for *Clarkia imbricata* since its listing in 1997.

Specie's Recovery Priority Number at Start of 5-Year Review: *Clarkia imbricata* has a recovery priority number of 5. Recovery priorities assigned to listed species range from 1 to 18, with species ranking 1 having the highest Service recovery priority (Endangered and Threatened Species Listing and Recovery Priority Guidelines, 48 FR 43098-43105, September 21, 1983). A recovery priority of 5 denotes a species with a high degree of threat and low recovery potential. Low recovery potential may be given if biological and ecological limiting factors are poorly understood, threats to the species existence are poorly understood or are pervasive and difficult to alleviate, and the management needed is intensive with uncertain probability of success or management techniques are unknown or still experimental.

Recovery Plan or Outline: There is no recovery plan or outline for *Clarkia imbricata*.

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*:* In 1953, Frank H. Lewis and Margaret Lewis described *Clarkia imbricata* from type specimens collected on July 10, 1951 along Vine Hill Road, near Pitkin Ranch, Sonoma County, California. *C. imbricata* is an erect annual herb in the Onagraceae (Evening primrose) family (Lewis and Lewis 1953). Stems grow to 60 centimeters tall (2.5 feet) and are unbranched, or have numerous short branches in the upper parts. The plant is densely leafy with entire, lanceolate leaves 2.0 to 2.5 centimeters (0.8 to 1.0 inches) long and 4 to 7 millimeters (0.2 to 0.3 inches) broad that are ascending and overlapping. Showy inflorescences appear from June through July. Flowers are grouped closely together and each flower has a conspicuous funnel shaped tube at its base. Each flower has four fan-shaped, lavender petals 2.0 to 2.5 centimeters (0.8-1.0 inches) long with a V-shaped purple spot extending from the middle to the upper margin of the petal. *Clarkia purpurea* ssp. *viminea* is the only other *Clarkia* species with which *C. imbricata* can be confused, but they do not co-occur.

C. imbricata has a much shorter funnel-shaped tube and a lack of the relatively broad, ascending overlapping leaves in *C. purpurea* ssp. *viminea*.

Clarkia imbricata is a late summer annual, blooming after the spring rains. Seeds generally set in mid to late August. In 2009, mature seeds were collected and stored on September 15. As with many annual plants, numbers can vary enormously from year to year depending on interactions between soil seed bank and seasonal weather variations. The relationships between rainfall pattern, germination, and number of adult plants is somewhat unclear. It is thought that the seeds remain viable in the soil for a few years.

Spatial Distribution and abundance*:* *Clarkia imbricata* is restricted to the Vine Hill Preserve in the Vine Hill region on Goldridge-Sebastopol soil series which consists of acidic sandy loams. At the time of listing in 1997, *Clarkia imbricata* was only known from two separate populations: the introduced Vine Hill Preserve population and the Sequoia Circle population. As of 2011, only the Vine Hill Preserve population is known to remain. The habitat of the other population is on private property with restricted access, and plants have not been surveyed since the listing rule in 1997.

Since its introduction and establishment in 1974, the Vine Hill Preserve population has expanded from an original 2.3 square meter (24.7 square foot) planting, and is now growing across the width of the parcel and onto an adjacent parcel on the eastern boundary of the Vine Hill Preserve. Between 2007 and 2010, the Vine Hill Preserve population fluctuated between 3,357 (2007) and 8,781 (2010) plants. The population on the adjacent parcel fluctuated between zero and 100 plants. In 2010, the area occupied by *C. imbricata* was measured at 1,540 square meters (16,576 square feet), up from 1,467 square meters (1,5791 square feet) in 2009. From 2007-2009, the average *C. imbricata* cover within that area was 1.0 - 5.0% (S. Gordon, personal communication 2010). No quantitative surveys have been conducted in 2011; however *C. imbricata* appear to have declined in number as well as occupied area.

Habitat or Ecosystem: *Clarkia imbricata* is restricted to Vine Hill region on Goldridge acidic sandy loam soil series. Historically the vegetation growing in the Vine Hill region was "chaparral or Sonoma barren", a mixture of chaparral and Douglas-fir/oak woodland, mixed evergreen forest in the canyons and freshwater marsh and riparian habitat along Pitkin, Green Valley and Atascadero Creeks in Sonoma County. *C. imbricata* inhabitated open grassy portions of this area. With the exception of the 0.6 hectare (1.5 acres) Vine Hill Preserve, most of the historic *C. imbricata* habitat was lost by 1993 through land-use conversion to housing, vineyards and orchards. A description of the original habitat from the "Lost Sonoma Barrens" (Roof, 1972) follows:

"The original sand is pale yellow in color, and when left undisturbed for a long time, its surface becomes naturally compacted and sun-bakes to the consistency of adobe brick. In winter it becomes a slick colloidal mud well on the acid side…Low ridges between the Sonoma barren and the ocean bar some of the milder summer fogs but not the major fog banks of July and August. The Sonoma barren is halfway between maritime climate and inland climate. The Vine Hill area lies in a pronounced fog gap and hence is subject to peculiar climatic fluctuations. In

one summer hour the temperature can, and often does rise from 55 degrees to over 90 degrees, and quickly declines as the fog moves in."

Clarkia imbricata may be able to grow in other soil-types and with other plant associates, but the extent of its adaptability and ecological tolerance is not known at this time. On the Vine Hill Preserve, *C. imbricata* grow with other typical Sonoma barren plants such as *Arctostaphylos densiflora* (Vine Hill manzanita), mixed with *Xerophyllum tenax* (squaw lily), *Habenaria elegans* (rein orchid), and *Ceanothus foliosus* var. *vineatus* (Vine Hill ceanothus). Also present at this location is *Horkelia tenuiloba* (Santa Rosa horkelia), *Pteridium aquilinum* var. *lanuginsum* (bracken fern), *Brodiaea laxa*, and *Solidago canadensis* ssp. *elongata* (golden rod). On the slightly elevated margins of the property there are erect shrubs: *Rhamnus californica* (California coffeeberry), what is thought to be a tall hybrid of *A. densiflora* and *A. manzanita*, *Baccharis pilularis* (Coyote Bush), *Adenostoma fasciculatum* (chamise), *Gaultheria shallon* (salal), and a species generally found along the coast, *Ceanothus gloriosus* var. *exaltatus* (Point Reyes ceanothus). The now-extirpated native Sequoia Circle population grew in open flat grassland surrounded by a variety of introduced trees and shrubs, several *Quercus agrifolia* (coast live oak), and an *Arbutus menziesii* (Madrone).

Changes in Taxonomic Classification or Nomenclature: No changes in taxonomic classification or nomenclature for *Clarkia imbricata* have occurred since the listing rule.

Genetics:

Species-specific Research and/or Grant-supported Activities: No species-specific research or grant supported activities involving *Clarkia imbricata* have occurred since the listing rule.

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

Land use conversion: At the time of listing in 1997, the most significant threat to the two remaining populations of *Clarkia imbricata* was extirpation through land use conversion to housing, vineyards and orchards. Land use conversion is now lesser threat given that of the two populations that existed at the time of listing, only one is known to remain and it is on the Vine Hill Preserve which is protected by the California Native Plant Society (CNPS). The second population (Sequoia Circle) was on private land with restricted access and plants have not been surveyed since 1997. The extant Vine Hill Preserve population is protected, monitored and managed by CNPS, but the plants growing on the adjacent property are not protected. Thus habitat destruction, modification or curtailment due to land use conversion remains a threat, but a lesser one than at the time of listing. In 2011 land use changes on the adjacent parcel reduced the available habitat for *C. imbricata*.

Shading and nonnative species: Another mechanism for habitat destruction, modification or curtailment that is probably a greater threat than at the time of listing is succession of the grassland habitat that *Clarkia imbricata* requires. This threat has increased because there is now only a single known population that is restricted to the open, grassy area of the Vine Hill Preserve. The open area will decrease if the grassland is allowed to progress through successional stages into chaparral and forest. This will shade *C. imbricata* and enrich the soil with leaf litter which may encourage competing non-native species such as *Holcus lanatus*, a perennial plant that reseeds readily and can tolerate fire. Invasive species such as *Holcus lanatus* threaten *C. imbricata* through competition for space and resources. In areas where *H. lanatus* grows, *C. imbricata* is shaded and grows at a lower density. *H. lanatus* has increased in numbers over the last few years in an area of the Vine Hill Preserve that lies under trees growing on a neighboring property (S. Gordon, personal communication 2010).

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

At the time of listing, the Vine Hill Preserve population of *Clarkia imbricata* was threatened by over-collection and damage associated with trespassing by recreational plant enthusiasts seeking not only the *C. imbricata* plants and seeds, but also *Arctostaphylos densiflora* and *Ceanothus foliosus* var. *vineatus*, ostensibly for the nursery trade. However at this time overcollecting is not thought to be a major threat, as no incidents have occurred within the last 10 years (P. Van Soelen, personal communication 2010). Therefore over collection remains a threat, but less so since 1997.

FACTOR C: Disease or Predation

Disease and predation were not listed as threats in the listing rule. At this time *Clarkia imbricata* is not known to be significantly threatened by disease or predation.

FACTOR D: Inadequacy of Existing Regulatory Mechanisms

At the time of the listing, regulatory mechanisms thought to provide protection to *Clarkia imbricata* included: 1) listing under the Endangered Species Act; 2) the National Environmental Policy Act (NEPA); 3) listing under the California Endangered Species Act (CESA); 4) the California Environmental Quality Act (CEQA); and 5) the California Native Plant Protection Act (NPPA).

Federal Laws and Regulations:

Endangered Species Act (Act): The Act of 1973, as amended (Act), is the primary Federal law that provides protection for *Clarkia imbricata*. 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 species. Section 9 of the Act and Federal regulations pursuant to section 4(d) of the Act prohibit "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. Section 9 also makes illegal the international and interstate transport, import export and sale or offer for sale of endangered plants and animals. The protection of Section 9 afforded to endangered species is extended to threatened wildlife and plants by regulation. Federally listed plants are included as covered species in habitat conservation plans (HCPs) prepared by non-Federal applicants as part of the terms and conditions for the issuance of an incidental take permit for federally listed wildlife under section 10(a)(1)(B). *C. imbricata* is not within any HCP boundaries.

National Environmental Policy Act (NEPA*):* National Environmental Policy Act (NEPA; 42 U.S.C. 4371 *et seq.*) provides some protection for listed species that may be affected by activities undertaken, authorized, or funded by Federal agencies. Prior to implementation of such projects with a Federal nexus, NEPA requires the agency to analyze the project for potential impacts to the human environment, including natural resources. In cases where that analysis reveals significant environmental effects, the Federal agency must propose mitigation alternatives that would offset those effects (40 C.F.R. 1502.16). These mitigations usually provide some protection for listed species. However, NEPA does not require that adverse impacts be fully mitigated, only that impacts be assessed and the analysis disclosed to the public.

State Laws and Regulations:

California Endangered Species Act (CESA): The Act (CESA; California Fish and Game Code, section 2080 *et seq.*) prohibits the unauthorized take of State-listed threatened or endangered species. The California Native Plant Protection Act (Division 2, Chapter 10, section 1908) prohibits the unauthorized take of State-listed rare or endangered plant species. The CESA requires State agencies to consult with the California Department of Fish and Game 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 allow to take that is incidental to otherwise lawful activities. *Clarkia imbricata* was listed by the State of California as endangered in 1978.

California Native Plant Protection Act (NPPA): With regard to prohibitions of unauthorized take under California Native Plant Protection Act (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 the California Department of Fish and Game 10 days in advance of changing land use in order to allow salvage of listed plants. Salvaging is unlikely to be beneficial for the *Clarkia imbricata* because it is an annual species, and no evidence exists that the species would survive transplantation. However seed collection would be beneficial to maintain genetic diversity if a suitable reintroduction site is identified.

California Environmental Quality Act (CEQA): The CEQA requires review of any project that is undertaken, funded, or permitted by the State or a local government agency. If significant

effects are identified, the lead agency has the option of requiring mitigation through changes in the project. Protection of a listed species through CEQA is dependent on the discretion of the agency involved.

In summary, the Act is the primary Federal law that provides protection for *Clarkia imbricata* since its listing as endangered in 1997. 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 Federal Endangered Species Act.

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

Risk of extirpation due to small population sizes: Small populations are typically at greater risk of extinction than larger ones (Terborgh and Winter 1980; Diamond 1984; Pimm *et al.* 1988; Morris and Doak 2003). Extinction risk can increase through several factors, such as stochasticity in birth and death rates. A chance few years with poor germination could result in extinction. Catastrophic events such as fire, floods or droughts, diseases or invasive species can also cause extinction of a species if the single population is wiped out. In addition, small populations have a higher risk of inbreeding due to reduced numbers of individuals available for reproduction. Inbreeding can reduce fitness, making populations less able to adapt to a variable environment (Shaffer, M. L. 1981; Ellstrand and Elam 1993).

Risk of extinction through random events was listed as a threat in the 1997 listing rule. The small number of individuals in the single *Clarkia imbricata* population increases the threat of extinction of the species as a whole through stochastic demographic and environmental events. *C. imbricata* has been reduced to a single protected population with fluctuating numbers of individuals. Even with as many as 5,000-10,000 plants in an annual plant population, risk of extirpation due to small populations is a major threat because we do not know enough about population dynamics, and annual plant numbers can vary greatly between years.

Climate Change: Global climate change was not included in the 1997 listing rule, but is a potential threat to *Clarkia imbricata*. 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; IPCC 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. *C. imbricata* may be at risk with global climate change if it cannot disperse to favorable climate and conditions.

III. RECOVERY CRITERIA

There is no recovery plan for *Clarkia imbricata* and therefore no recovery criteria.

IV. SYNTHESIS

The following primary threats outlined in the 1997 listing rule remain for *Clarkia imbricata*: habitat loss, over collection or overutilization, inadequacy of existing regulatory mechanisms, and extinction through random events due to small population sizes.

The threat of habitat loss due to land use conversion is no longer a major threat given that the majority of the last known *C. imbricata* population is protected. However habitat loss or curtailment due to nonnative species and community succession is a new major threat. The threat of over collection was listed as a major threat in 1997, but no trespassing events for the purpose of collection have been noted in the past 10 years. Though incidents of trespassing have been noted by the neighbors of the Vine Hill Preserve, trespassers do not appear to be specifically collecting *C. imbricata*, but may be damaging its habitat.

The Service believes that the plant is still endangered, due to low numbers of individuals, only one remaining population, competition with invasive grasses, and habitat curtailment due to succession of the open grassland it requires into chaparral and forest. It is recommended that the Recovery Priority number be maintained at 5, because *C. imbricata* remains under a high degree of threat with low potential for recovery.

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*
_X_ No Change

New Recovery Priority Number and Brief Rationale: No change.

VI. RECOMMENDATIONS FOR ACTIONS OVER THE NEXT 5 YEARS

There is only one small population of *Clarkia imbricata*. Therefore the primary actions needed for recovering *C. imbricata* over the next 5 years are:

1. Protect, manage, and increase the population where possible within its native range. If appropriate areas that are not within the native range are found, reintroduce *C. imbricata*.
2. Establish at least two additional separate populations on protected land.

3. Control of succession and nonnative plants where possible through hand removal of vegetation.
4. Explore the use of a burn box to determine how fire affects *C. imbricata* seed bank and germination, in addition to nonnative species such as *Holcus lanatus* seed bank and germination.
5. Gather information about life history and the ecosystem requirements of *Clarkia imbricata*. More specifically, gather information about how long the seed bank remains viable and how it responds to fire, germination requirements, and genetic diversity.
6. Create and implement a monitoring plan for *Clarkia imbricata*. Yearly plant counts are already conducted. Add estimation of percent cover of nonnative species and percent cover by shrubs and trees.
7. Monitor land-use conversion in parcels adjacent to Vine Hill Preserve. If development occurs, attempt to rescue plants or seeds if possible.
8. Control and monitor access to the Vine Hill Preserve to prevent and monitor trespassing.

VII. REFERENCES CITED

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Personal Communications

Phil Van Soelen. 2010. Former Preserve Manager, Vine Hill Preserve, Sonoma County, California.

Sarah Gordon. 2010. Current Preserve Manager, Vine Hill Preserve, Sonoma County, California.

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

***Clarkia imbricata* (Vine Hill clarkia)**

Current Classification: endangered

Recommendation Resulting from the 5-Year Review:

____ Downlist to Threatened
____ Uplist to Endangered
____ Delist
__X_ No change needed

Review Conducted By: ____Mandi Finger, Sacramento Fish and Wildlife Office_____

FIELD OFFICE APPROVAL:

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

Approve _____ Date 8 Sept 2011