Calochortus tiburonensis
(Tiburon mariposa lily)

5-Year Review:
Summary and Evaluation

Photograph by Ben Solvesky, U.S. Fish and Wildlife Service

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

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5-YEAR REVIEW

Calochortus tiburonensis (Tiburon mariposa lily)

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:

Calochortus tiburonensis (Tiburon mariposa lily) is a bulbous perennial of the lily family (Liliaceae). It has a single, persistent, basal, linear-oblong leaf 1-2 feet long. The flowering stem is about 50 centimeters (20 inches) tall and is usually branched and bears erect flowers in twos or threes at the ends of the branches. Depending on climatic factors, the flowers bloom between May and late June. The three petals and three sepals are light yellow-green with reddish or purplish-brown markings (LSA Associates, Inc. 2007) and are dependent on the bumblebee for pollination. The fruit capsule is triangular in cross-section, and is about 2 inches long. Long slender hairs on the upper surface and margins of the petals and the lack of wings on the capsule distinguish *C. tiburonensis* from the two other *Calochortus* species found on the Tiburon Peninsula, *C. umbellatus* (Oakland star-tulip) and the *C. luteus* (yellow Mariposa lily) (Hickman 1993). *Calochortus tiburonensis* is only known from the open, rocky, serpentine-derived soils of the serpentine bunchgrass community at Ring Mountain Preserve in Marin County, California.

Methodology Used to Complete the 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), survey information from experts who have been monitoring this species, and the California Natural Diversity Database (CNDDB) maintained by the California Department of Fish and Game

(CDFG). Personal communications with experts and published literature were our primary sources of information used to update the species' status and threats. We received one letter 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. 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 provides 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.

Contacts:

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

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 5, 2008 (73 FR 11945). We received one letter from the public in response to this notice, recommending we evaluate the threat of global climate change to *Calochortus tiburonensis*.

Listing History:

Original Listing
FR notice: 60 FR 6671
Date listed: February 3, 1995
Entity listed: *Calochortus tiburonensis,* a plant species
Classification: Threatened

State Listing
Date listed: 1978 and was
Entity listed*: Calochortus tiburonensis*, a plant species
Classification: Threatened in 1987.

Review History: Since the original listing in 1995, no 5-year reviews have been conducted for this species.

Species' Recovery Priority Number at Start of 5-Year Review: The recovery priority for *Calochortus tiburonensis* is 17, 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 this taxon is a

species, faces a low 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 3, 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 of any species of vertebrate wildlife (DPS). This definition of species under the Act limits listing as distinct population segments to vertebrate species of fish and wildlife. Because the species under review is a plant and the DPS policy is not applicable, the application of the DPS policy to the species listing is not addressed further in this review.

Information on the Species and its Status

Spatial Distribution: *Calochortus tiburonensis* was discovered in 1971 and is only known from Ring Mountain Preserve on the Tiburon Peninsula in southern Marin County, California. At the approximately 160-hectare (400-acre) Ring Mountain Preserve, the perimeters of nine distinct areas containing *C. tiburonensis* have been mapped, totaling approximately 16 hectares (40 acres) and ranging in size from approximately 0.1 to 13 hectares (0.25 to 32 acres) (LSA Associates, Inc. 2007). However, the density of *C. tiburonensis* plants within each mapped area is variable (S. Abercrombie personal communication 2011).

Abundance: The population variables and subpopulations chosen to sample during belt-transect surveys by The Nature Conservancy (TNC) each year from 1988 to 1991 were somewhat inconsistent. With the exception of 1988, with an estimated 31,882 total plants and 7,387 flowering plants, only the number of flowering plants were estimated in 1989 (5,783 flowering plants) and 1990 (3,443 flowering plants); and in 1991, only flowering plants in the western part of the preserve were estimated (19,875 flowering plants) (Serpa 1991). These sampling inconsistencies make it difficult to compare data between years. In 2007, a Ring Mountain Preserve Sensitive Resources Monitoring and Enhancement Strategy was developed (LSA Associates, Inc. 2007). As part of the monitoring strategy, 25 one-meter by one-meter permanent plots were randomly established within the nine mapped areas containing *C. tiburonensis* plants (LSA Associates, Inc. 2007). The permanent plots have been surveyed each year from 2007 to 2011, except 2009 (Table 1). Based on the permanent plot data, it does not appear the removal of inflorescence by herbivores has a significant effect on reproduction. Although a relatively high proportion of leaves were found to be affected by herbivores, herbivory does not typically result in leaf senescence (S. Abercrombie personal communication 2011).

Table 1. Summary of data collected from 25 one-meter by one-meter permanent plots randomly established within the nine mapped areas containing *Calochortus tiburonensis* plants at Ring Mountain Preserve in Marin County, California.

Year	Number of Plants	Number of Flowers or Buds	Number of Plants Without Inflorescence	Number of Inflorescence Removed by Herbivores	Number of Leaves Affected by Herbivores
2007	226	229	145	9	50
2008	178	62	139	6	117
2010	262	176	153	10	112
2011	197	114	128	4	80

Reproduction and Demography: *Calochortus tiburonensis* is a bulbous perennial. The solitary basal leaf serves as the major photosynthetic organ throughout the growing season (Fiedler 1987). The basal leaf appears above the ground within six weeks of the onset of winter rains, following initiation and establishment of a simple root system (Fielder 1987). Depending on climatic factors, the flowers bloom between May and late June (LSA Associates, Inc. 2007). Reproductive adults typically bear two to three flowers, but larger individuals may produce as many as eight. Although self-pollination is possible with human intervention, protandry (male reproductive parts mature before female parts) likely limits self-pollination under natural conditions (P. Fiedler, personal communication 1996). The flowers are thought to be pollinated by bumble bees (*Bombus californicus*).

During the warm dry season, the bulbs are dormant, acting as a "bulb bank" (P. Fiedler, personal communication 1996). *Calochortus tiburonensis* is known to produce bulbils (secondary bulbs), and may be capable of vegetative reproduction through bulbifery (the production of new propagules from bulbils). However, the extent to which *C. tiburonensis* vegetatively reproduces through bulbifery is unknown. Although the bulbs are thought to live 10 years or more, it is believed they do not reproduce sexually until about 5 years of age. There is no evidence of a dormant soil seed bank and this species appears to have low seed survival and seedling establishment, low adult mortality, and slow growth (Fielder 1987). Although this species is a perennial, the number of plants blooming varies greatly from year to year (Serpa 1991).

Habitat or Ecosystem: *Calochortus tiburonensis* is an edaphic endemic (restricted to specific soil conditions), growing on open, rocky, serpentine slopes within the serpentine bunchgrass community on Ring Mountain Preserve in Marin County, between 120 and 180 meters (400 and 600 feet) elevation.

Changes in Taxonomic Classification or Nomenclature: We are not aware of any changes in taxonomic classification or nomenclature for *Calochortus tiburonensis* since the time of listing.

Genetics: Since its listing (Service 1995) and the issuance of the Recovery Plan (Service 1998), Patterson and Givnish (2003) developed a molecular phylogeny for 67 species of *Calochortus*,

based on cholorplast DNA (cpDNA). Their phylogeny placed *C. tiburonensis* in a clade with other San Francisco Bay Area *Calochortus* species, despite its unique morphological differences.

Species-specific Research and/or Grant-supported Activities: In March 2011, TNC awarded a $75,000 grant to the Marin County Open Space District to assess and treat invasive plant infestations, develop a database to track restoration actions, monitor *Calochortus tiburonensis* and *Castilleja affinis* ssp. *neglecta* (Tiburon paintbrush) populations, and to increase volunteer opportunities on Ring Mountain Preserve.

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 Ring Mountain Preserve was owned and managed by TNC between 1982 and 1995. In 1995, TNC transferred the property to Marin County Parks and Open Space. Because Ring Mountain Preserve has been protected since 1982, urban development was not cited as a threat at the time of listing. At the time *Calochortus tiburonensis* was listed as threatened in 1995, we cited recreational activities (bicycles, motorbikes, and pedestrians), overuse, and vandalism as Factor A threats (Service 1995). At this time, wayward trails continue to crisscross Ring Mountain Preserve, which has resulted in a small, but overall reduction in available habitat. Hikers, cyclists, and equestrians are most likely to negatively affect *C. tiburonensis* if they stray from designated and social trails and trample plants or if visitation increases to the point that trails widen or new trails form due to overcrowding.

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

Overutilization for commercial, scientific, or educational purposes was not known to be a threat to *Calochortus tiburonensis* at the time of listing. Overutilization for any purpose does not appear to be a threat at this time.

FACTOR C: Disease or Predation

Mammalian herbivory, by mule deer (*Odocoileus hemionus*) and black-tailed jackrabbits (*Lepus californicus*), represents a minor threat to *Calochortus tiburonensis*. According to Serpa (1991), after four years of gathering data, herbivory on buds, flowers, and fruits does not appear to have a significant effect on reproduction; overall, 4.6 percent of the flowering structures were damaged by vertebrates in 1990, one percent in 1989, and 5.1 percent in 1988. The permanent plot data (Table 1) corroborates these findings, and the actual impact on reproduction is likely less, given only a portion of any plant's fruits or flowers are usually removed (Serpa 1991). The effect of herbivory on the leaf blade, the only significant photosynthetic structure, could be a greater threat

than the effects of herbivory on the reproductive structures. Grazing of the basal leaf can reduce the amount of photosynthate available for bulb renewal and reproduction (Fiedler 1987). However, herbivory of the leaf blade does not appear to be a significant threat to *C. tiburonensis* at this time.

FACTOR D: Inadequacy of Existing Regulatory Mechanisms

At the time of listing (Service 1995), regulatory mechanisms thought to have some potential to protect *Calochortus tiburonensis* were the Native Plant Protection Act, the California Endangered Species Act, the California Environmental Quality Act, and the Clean Water Act. A lack of regulatory mechanisms is not considered a threat at this time. The following is a summary of the regulatory mechanisms that are most likely to afford protection to *C. tiburonensis*.

The Endangered Species Act (Act): The Act of 1973, as amended, is the primary Federal law that provides protection for *Calochortus tiburonensis*. 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 the "take" of federally endangered wildlife, however, plants are not protected against take. 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. The protection of section 9 afforded to endangered species is extended to threatened wildlife and plants by regulation. Federally listed plants may be incidentally protected if they co-occur with federally listed wildlife species.

Under the terms of section 7(b)(4) and section 7(o)(2) of the Act, taking that is incidental to and not intended as part of the agency action is not considered to be prohibited taking under the Act provided that such taking is in compliance with the terms and conditions of an incidental take statement. Sections 7(b)(4) and 7(o)(2) of the Act generally do not apply to listed plant species because take of plants in not prohibited. However, limited protection of listed plants from take is provided to the extent that the Act and the implementing regulations prohibit the removal and reduction to possession of federally listed threatened or endangered plants or the malicious damage of endangered plants on areas under Federal jurisdiction, or the destruction of endangered plants on non-Federal areas when in violation of state law or regulation or in the course of any violation of a State criminal trespass law.

Currently there are no completed final regional or county-wide Habitat Conservation Plans (HCPs) authorized under section 10 of the Act, or Natural Community Conservation Plans (NCCPs) authorized under the California Natural Community Conservation Plan Act, in Marin, County, thereby leaving populations on private land without protection under these laws, if the species is on private land.

California Endangered Species Act (CESA) and Native Plant Protection Act (NPPA): CESA (California Fish and Game Code, section 2080 *et seq*.) prohibits the unauthorized take of State-listed threatened or endangered species. NPPA (Division 2, Chapter 10, section 1908) prohibits the unauthorized take of State-listed threatened or endangered plant species. CESA requires State agencies to consult with the 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.

California Environmental Quality Act (CEQA): *Calochortus tiburonensis* is listed under CESA as threatened and it must be considered under CEQA as a rare species (Section 15380, Public Resources Code). CEQA (chapter 2, section 21050 *et seq.* of the California Public Resources Code) requires government agencies to consider and disclose environmental impacts of projects and to avoid or mitigate for impacts where possible. Under CEQA, public agencies must prepare environmental documents to disclose environmental impacts of a project and to identify conservation measures and project alternatives. Through this process, the public can review proposed project plans and influence the process through public comment. However, CEQA does not guarantee that such conservation measures will be implemented.

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

At the time of listing (Service 1995), we cited competition with non-native invasive plant species, restricted habitats/range, and small population size as threats to *Calochortus tiburonensis*.

Non-Native Invasive Plant Species: Competition from non-native invasive plant species was cited as a serious threat at the time of listing and poses one of the greatest threats to *Calochortus tiburonensis* today. The Marin County Open Space District has been working to eradicate or control non-native invasive species from Ring Mountain Preserve for several years. The Ring Mountain Preserve Sensitive Resource Monitoring Plan (LSA Associates, Inc. 2007) provides a list of non-native invasive species that currently occur on Ring Mountain Preserve and describes treatment recommendations. Weed abatement is an ongoing activity that will likely need to occur in perpetuity.

Restricted Range and Stochasticity: Because *Calochortus tiburonensis* exists as a single population with a highly restricted range it is susceptible to stochastic events such as prolonged drought, disease, landslide, or other infrequent and unforeseen causes of extinction. However, because *C. tiburonensis* has only been known from Ring Mountain Preserve, is likely naturally rare, and is a perennial plant species that does not appear to experience drastic fluctuations in population numbers, the threat of loss of genetic variability that is often associated with rare and highly restricted species does appear to represent a significant threat at this time.

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. 2008, 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, greater variability in 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 the effects to this particular species at this time.

III. RECOVERY CRITERIA

The Recovery Plan for *Calochortus tiburonensis* (*Recovery Plan for Serpentine Species of the San Francisco Bay Area*) was issued in 1998 (Service 1998).

Recovery plans provide guidance to the Service, States, and other partners on ways to minimize threats to listed species and on criteria that may be used to determine when recovery is achieved. There are many paths to accomplishing 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 reclassify the species from endangered to threatened or perhaps to delist it. In other cases, new recovery opportunities unknown at the time the Recovery Plan was finalized may be more appropriate. 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 how progress toward achieving recovery criteria has contributed to eliminating or reducing the listing threats discussed in the five factor analysis.

The Recovery Plan (Service 1998) does not provide criteria for delisting *Calochortus tiburonensis***.** Rather, the plan recommends the species should not be delisted and lists four actions that should be implemented to aid survival of the species: 1) Secure and protect occupied habitat at Ring Mountain Preserve along with adjacent unoccupied habitat and a 150-meter (500-foot) buffer from incompatible uses; 2) a management plan be approved and implemented for the Ring Mountain Preserve and adjacent occupied or unoccupied habitat identified as essential to the continued survival; 3) the population is stable or increasing over 20 years that include the normal precipitation cycle (or longer if suggested by the results of demographic monitoring); and 4) seed is stored in at least two Center for Plant Conservation certified facilities and seed germination and propagation techniques are understood. Ring Mountain Preserve, along with adjacent unoccupied habitat, is secure. However, the implementation of a 150-meter (500-foot) buffer is not possible due to the presence of a housing development along the western border of the westernmost area containing *C. tiburonensis*. The approved 2007 Ring Mountain Preserve Sensitive Resources Monitoring and Enhancing Strategy (LSA Associates, Inc. 2007) is presently

being implemented by Marin County Open Space District with species survival as the objective. At this time, the population appears to be stable. We are not aware of *C. tiburonensis* seed storage or propagation and germination techniques being understood.

IV. SYNTHESIS

When *Calochortus tiburonensis* was listed as threatened in 1995, the primary threats to its survival and recovery were recreational activities, non-native invasive plant species, and stochasticity. We have no new information to suggest that these threats have substantially changed since the time of listing in 1998. The Ring Mountain Preserve population of *C. tiburonensis* does have management plan and monitoring program, and actions are taken annually to control non-native invasive plants species. However, long-term funding for management and monitoring is not guaranteed and the need for non-native invasive plant control will continue into the foreseeable future. Because *C. tiburonensis* exists as a single population threatened by stochasticity and climate change and due to the continuing threats of habitat loss from non-native invasive plants and recreational activities, we believe *C. tiburonensis* is vulnerable to becoming endangered in the foreseeable future throughout its range. No status change is recommended at this time.

V. RESULTS

Recommended Classification:

____ **Downlist to Threatened**
____ **Uplist to Endangered**
____ **Delist** (*Indicate reasons for delisting per 50 CFR 424.11):*
    ____ *Extinction*
    ____ *Recovery*
    ____ *Original data for classification in error*
_X_ **No change is needed**

New Recovery Priority Number: No change. Due to the highly restricted range of the species and the likely perpetual threat of non-native invasive plants species to *Calochortus tiburonensis* without active management, we believe the current threats and the likelihood of recovering the species are low.

VI. RECOMMENDATIONS FOR ACTIONS OVER THE NEXT 5 YEARS

1) Continue annual population monitoring and non-native invasive plant control efforts.

2) Post informative signs at Ring Mountain Preserve entrances that describe the effects of off-trail use on rare plants.

3) Determine if it is biologically feasible to store bulbs or seeds to reduce the threat of stochastic events.

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

Species: *Calochortus tiburonensis* (Tiburon mariposa lily)

Current Classification: Threatened

Recommendation resulting from the 5-Year Review

____ Downlist to Threatened
____ Uplist to Endangered
____ Delist
_X_ No change is Recommended

Review Conducted By: Ben Solvesky, Sacramento Fish and Wildlife Office

FIELD OFFICE APPROVAL:

Lead Field Supervisor, Fish and Wildlife Service

Approve _____ Date 8 Sept 2011