

Draft
Recovery Plan
for Five Plants from
Monterey County, California

Astragalus tener var. *titi* (coastal dunes milk-vetch)

Piperia yadonii (Yadon's piperia)

Potentilla hickmanii (Hickman's potentilla)

Trifolium trichocalyx (Monterey clover)

Cupressus goveniana ssp. *goveniana* (Gowen cypress)

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Region 1
U.S. Fish and Wildlife Service
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EXECUTIVE SUMMARY

Current Species Status: This recovery plan includes five plants that occur in Monterey County, California. *Astragalus tener* var. *titi*, *Piperia yadonii*, *Trifolium trichocalyx*, and *Potentilla hickmanii* are listed as endangered, and *Cupressus goveniana* ssp. *goveniana* is listed as threatened.

- *Astragalus tener* var. *titi* (coastal dunes milk-vetch) occurs in 11 scattered patches within 1 population that is separated by 17-Mile Drive on the western edge of the Monterey Peninsula. The land is owned by the Pebble Beach Company and the Monterey Peninsula Country Club. Approximately 4,000 individuals were counted within 11 patches of this 1 remaining population during 1995; fewer than 200 plants remained in a protective enclosure in 1999 with none of these plants flowering in 2000.
- *Piperia yadonii* (Yadon's piperia) has a center of distribution within large undeveloped tracts of *Pinus radiata* (Monterey pine) forest. Its range extends from the Los Lomos area near the border of Santa Cruz County in the north to approximately 25 kilometers (15 miles) south of the Monterey Peninsula near Palo Colorado Canyon where it occurs in maritime chaparral habitat. Approximately 84,000 plants on about 140 hectares (350 acres) were counted at all known locations throughout its range since 1990.
- *Potentilla hickmanii* (Hickman's potentilla) is currently known from within Monterey pine forest on the Monterey Peninsula, and at one site in San Mateo County. Fewer than 40 plants were found in 1999 at the Monterey Peninsula location and between 2000 and 3000 individuals were found during 1995 and 1996 in San Mateo County.
- *Trifolium trichocalyx* (Monterey clover) is known from only one area, Huckleberry Hill, covering approximately 16 hectares (40 acres) on property owned by the Pebble Beach Company on the Monterey Peninsula. During 1996, 2 locations with a total of 22 plants were located.
- *Cupressus goveniana* ssp. *goveniana* (Gowen cypress) is currently found in only two stands. The largest stand (Del Monte Forest) is near Huckleberry Hill on the west side of the Monterey Peninsula and covers approximately 40 hectares (100 acres) within lands owned by the Pebble Beach Company and the Del Monte Forest Foundation. The second stand (Point Lobos) occurs approximately 10 kilometers (6 miles) south of the

Huckleberry Hill stand on the north side of Gibson Creek inland of the Point Lobos Peninsula. The property is owned by the California Department of Parks and Recreation and is approximately 16 to 32 hectares (40 to 80 acres) in size.

Habitat Requirements and Limiting Factors: The five plant taxa are found primarily along the coast of northern Monterey County, California. *Potentilla hickmanii* also occurs in San Mateo County and has historically occurred in Sonoma County. *Astragalus tener* var. *titi* has also historically occurred in both Los Angeles and San Diego Counties. *Astragalus tener* var. *titi* occurs on sandy soils within 30 meters (100 feet) of the ocean surf zone. *Piperia yadonii* and *Cupressus goveniana* ssp. *goveniana* occur in Monterey pine forest and in maritime chaparral habitats. *Trifolium trichocalyx* is found in openings that occur within Monterey pine forest. *Potentilla hickmanii* is found in a meadow community of grasses and herbs. The five plant taxa are threatened by one or more of the following factors: alteration, destruction, and fragmentation of habitat resulting from urban and golf course development; recreational activities; competition with nonnative plant species; herbivory from native or nonnative species; random naturally occurring variation in population characteristics; and disruption of natural fire cycles due to fire suppression associated with increasing residential development around and within occupied habitat.

Recovery Objectives: To delist *Cupressus goveniana* ssp. *goveniana*, and to reclassify *Astragalus tener* var. *titi*, *Piperia yadonii*, *Potentilla hickmanii*, and *Trifolium trichocalyx* to threatened status. The biology of the latter four species is not yet well enough known to set delisting as an objective of this plan.

Recovery Criteria:

- Permanent protection of habitat presently occupied by the species and the surrounding ecosystem on which they depend, with long-term commitments to conserving the species and availability of funding for long-term management.
- In protected habitat, successful control of invasive nonnative plants and successful management of other problems, including but not limited to snails, deer, pedestrians, recreation, and fire suppression activities.

Management success must be demonstrated through at least 10 years of biological monitoring. This amount of time is needed to observe the effectiveness of management and make adjustments as necessary.

- Development of management strategies that include results from research on the life histories of the taxa, and results from monitoring the species response to vegetation management.
- Successful reintroductions or establishment of populations for *Astragalus tener* var. *titi*, *Potentilla hickmanii*, and *Trifolium trichocalyx*.
- Implementation of a prescribed burn plan or successful alternative management strategy for *Cupressus goveniana* ssp. *goveniana*.
- Monitoring that demonstrates long-term viability of existing populations, including successful recruitment and reproduction.
- Establishment of seedbanks for the taxa at a recognized institution.
- Delisting criteria are given only for *Cupressus goveniana* ssp. *goveniana*; downlisting criteria are given for *Astragalus tener* var. *titi*, *Piperia yadonii*, *Potentilla hickmanii*, and *Trifolium trichocalyx*. Criteria for delisting of the latter species may be addressed in future revisions of this recovery plan when additional information about their biology is available.

Actions Needed:

1. Secure and protect existing populations and habitat on private or unprotected lands through willing landowners.
2. Manage lands to control or eliminate threats to the plants and their habitat.
3. Conduct research to document life histories and the plants' responses to vegetation management.
4. Survey for additional populations and suitable habitat for reintroduction or reestablishment and establish new populations.
5. Develop management strategies and monitor populations to determine effectiveness of management.
6. Coordinate recovery actions with other listed species or species of concern.
7. Develop and implement an education and outreach program.

8. Reevaluate recovery criteria and revise recovery plan in the future based on Actions 1 through 7.

Recovery Costs: \$1,346,000, with costs yet to be determined for securing and protecting lands, and for assurance of successful implementation of additional populations of *Astragalus tener* var. *titi*, *Potentilla hickmanii*, and *Trifolium trichocalyx*.

Date of Recovery: For *Astragalus tener* var. *titi*, *Piperia yadonii*, *Potentilla hickmanii*, and *Trifolium trichocalyx*, whose current objectives are downlisting to threatened status, meeting the objective depends on how soon habitat can be secured and monitoring programs begin, assurances that ecosystem and community processes of surrounding habitat are maintained, and additional populations of *A. tener* var. *titi*, *P. hickmanii*, and *T. trichocalyx* are established and successfully reproducing. At least 10 years of monitoring would be needed to assure that site management benefits these plants. If the recovery criteria have been met by 2012, these species may be considered for downlisting.

For *Cupressus goveniana* ssp. *goveniana*, the speed of meeting the objective of delisting depends on determining effective means of managing secured areas and improving the surrounding habitat, assuring the long-term reproductive success of the populations, and monitoring to determine whether successful recruitment has caused an increase in the overall size of both populations. Ten years of monitoring may be needed to assure that site management is appropriate. If the recovery criteria have been met by 2012, this species may be considered for delisting.

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I. INTRODUCTION

A. Brief Overview

The final rule determining Federal endangered status for *Astragalus tener* var. *titi* (coastal dunes milk-vetch), *Piperia yadonii* (Yadon's piperia), *Potentilla hickmanii* (Hickman's potentilla), *Trifolium trichocalyx* (Monterey clover), and Federal threatened status for *Cupressus goveniana* ssp. *goveniana* (Gowen cypress) was published in the August 12, 1998, *Federal Register* (63 FR 43100). The five taxa are found primarily along the coast of northern Monterey County, California; *Potentilla hickmanii* also occurs in San Mateo County and has a historical occurrence in Sonoma County, and *Astragalus tener* var. *titi* has historical occurrences in Los Angeles and San Diego Counties (Figures 1 and 2).

Astragalus tener var. *titi* has a recovery priority of 6C; *Piperia yadonii* has a recovery priority of 2C; *Potentilla hickmanii* has a recovery priority of 5C; *Trifolium trichocalyx* has a recovery priority of 5C; and *Cupressus goveniana* ssp. *goveniana* has a recovery priority of 9C. Appendix A presents an explanation of recovery priority numbers.

This recovery plan discusses threats and conservation efforts for the five plant taxa individually, summarizing current knowledge of the taxonomy, distribution, habitat requirements and biology of each species. The plan recommends measures for a program that will develop and implement strategies for effective management of existing populations and establish new populations where necessary. If these measures are successfully carried out, it may be possible to reclassify *Astragalus tener* var. *titi*, *Piperia yadonii*, *Potentilla hickmanii* and *Trifolium trichocalyx* as threatened in the future, and/or remove them and *Cupressus goveniana* ssp. *goveniana* entirely from the Federal List of Endangered and Threatened Species. Appendix B outlines a list of the threats identified for each of the species as documented in the Final Rule Listing Five Plants from Monterey County, California, as Endangered or Threatened (63 FR 43100) and management actions that this recovery plan outlines. Appendix C provides a glossary of technical terms mentioned throughout this recovery plan.

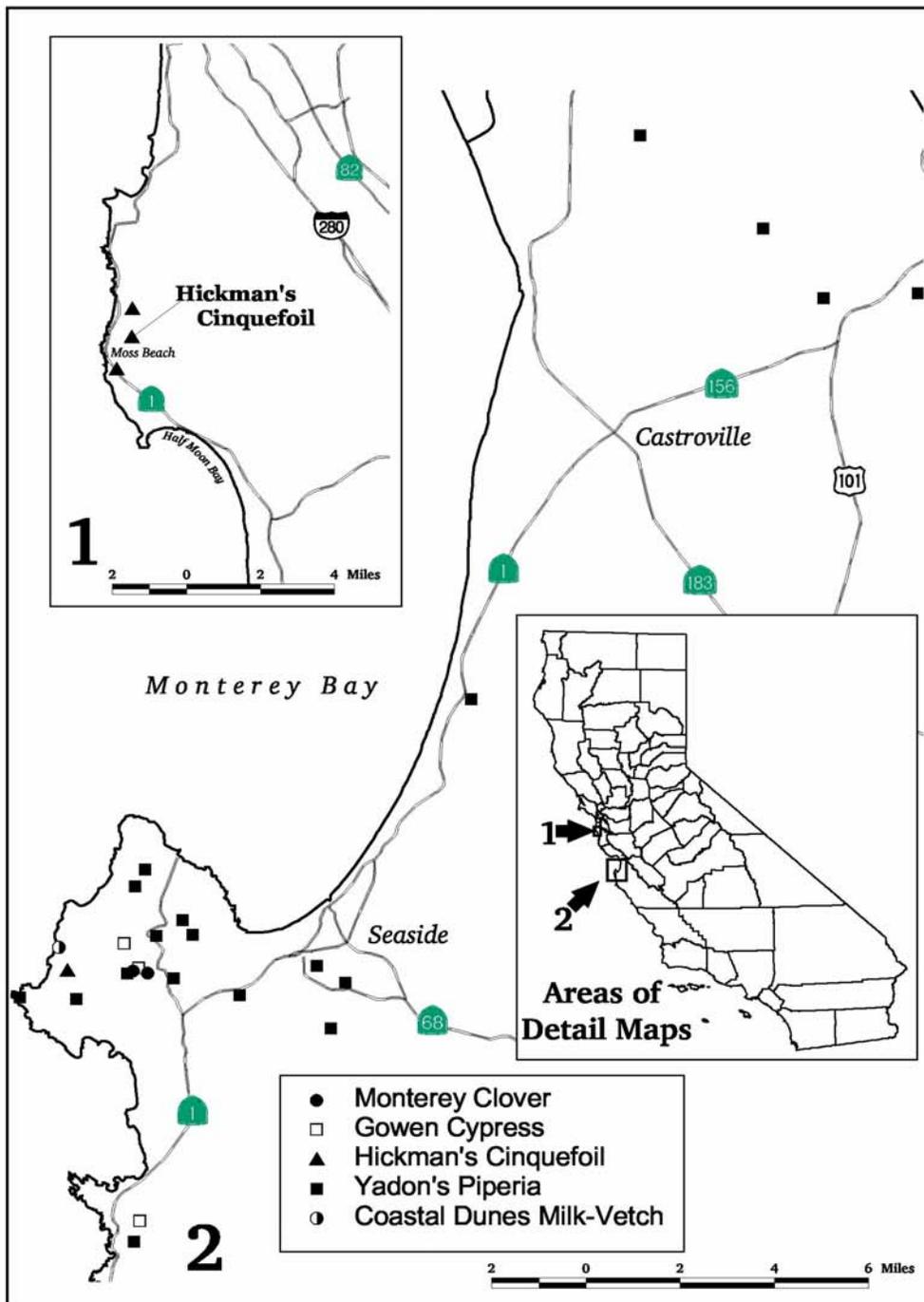


Figure 1: Current Distribution of the Five Taxa, Monterey and San Mateo Counties



Ventura Fish & Wildlife Office, July 2001
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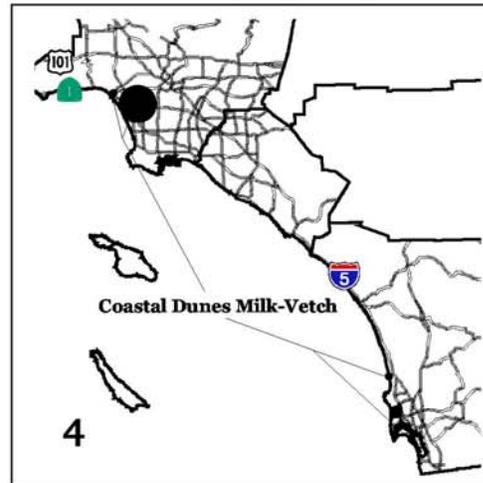
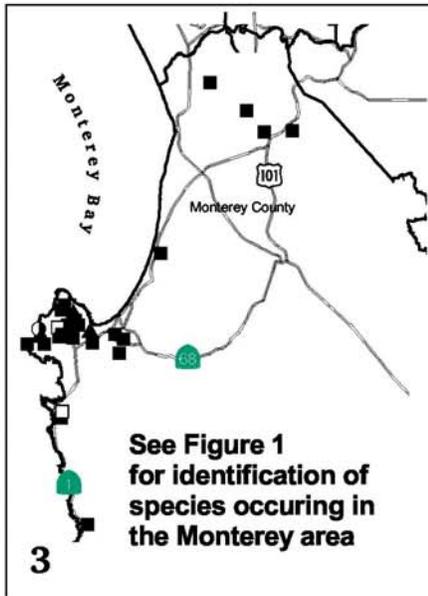
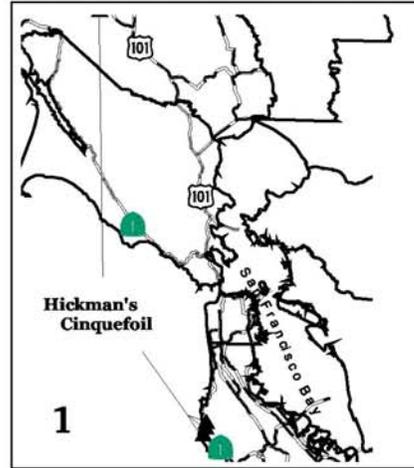
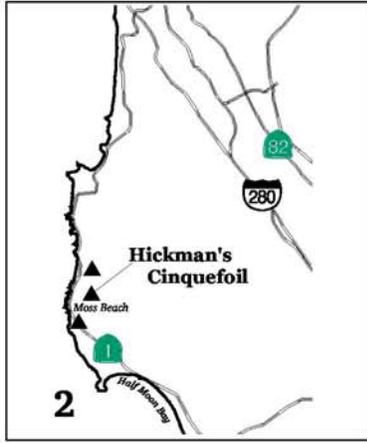


Figure 2: Historic Distribution of the Five Taxa, Monterey, San Mateo, Sonoma, Los Angeles, and San Diego Counties, California



B. General Description of the Monterey Area¹

1. History

The earliest known inhabitants of the Monterey Peninsula were the Essalen, a Hokan-speaking primitive people; they were replaced by the Ohlone Indians between 500 BC and 500 AD. Monterey Bay's modern history began when Juan Rodriguez Cabrillo sighted the "Bay of Pines" in 1542. The Monterey area was not settled until Franciscan priest Junípero Serra and Spanish Governor Gaspar de Portolà arrived in 1770 to build a mission and establish a seat of government, the Presidio of Monterey. The mission was moved to Carmel, and by the early 1840's a few people lived outside the Presidio in outlying ranchos. The Presidio was soon in ruins, and the pattern of the town of Monterey was established. The fishing industry was the original start of the economy, with whaling as the mainstay. A Chinese fishing village (China Point) was established in the early 1850's, as well as settlements by Japanese abalone divers and Portuguese whalers off Carmel Bay. During the late 1800's, tourism took precedence over whaling only until sardine harvesting began in the 1920's, developing the famed Monterey's Cannery Row. By the end of the 1940's, sardines began to disappear, the fisheries industry was lost, and pollution worsened. The sardines vanished in the early 1950's. Today, the economy depends on tourism. The Monterey area (including the Peninsula) harbors the Cities of Monterey, Pacific Grove, Carmel-by-the-Sea, Seaside, Sand City, and Marina, and the community of Pebble Beach.

2. Landscape

During glacial times, the rising ocean cut terraces into the landscape while the retreating ocean spread beach deposits over the landscape. As a result, today's Monterey area harbors dramatic coastlines, gently rolling hills, streams, and forests. The dominant landscape feature of the area is the Monterey Peninsula,

¹ Facts regarding the Monterey area were obtained from the following sources: Axelrod (1982); Howitt (1972); Schoenherr (1992); Vogl *et al.* (1988); <http://www.webdzone.com/monterey/focus.html>; <http://users.dedot.com/mchs/colonization.html>; <http://monterey.org/museum/history.html>; <http://www.mty.com/weather.html>

which includes the Cities of Monterey and Pacific Grove and the community of Pebble Beach. To accommodate its growing human population, the landscape of the Monterey area was converted from thick Monterey pine forests, pristine coastal dunes, and beaches to scattered pine forests mixed with golf courses and developed coastal areas. A number of protected areas have been established, including Point Lobos State Reserve, Samuel F.B. Morse Botanical Reserve, and Huckleberry Hill Preserve, as well as a few State parks both inland and on the beaches. The main riparian corridors to the Monterey area are the Carmel River to the south of the Monterey Peninsula, and the Salinas River north of the City of Marina.

3. Weather and Climate

This low-lying region of central California has a much lower total rainfall than other areas along the coast. Average rainfall for Monterey is 43 centimeters (17 inches) per year, compared to coastal areas to the north (Santa Cruz - 76 centimeters [30 inches]) and south (Cambria - 102 centimeters [40 inches]). The “rainy season” occurs between November and April. The annual average temperature is 14 degrees Celsius (57 degrees Fahrenheit). Farther inland toward the city of Salinas, approximately 14 kilometers (9 miles) from Monterey Bay, temperatures increase significantly. During summer months, the coastal area is foggy with the wet, marine layer usually burning off by late afternoon.

4. Habitats

The Monterey area is rich in endemic species. This area represents the northern or southern limit of the ranges of many plant species. This “range limit” for many plant species may be directly related to the ever-changing geologic morphology of the area, such as the extremely deep, underwater canyon that occurs in the Monterey Bay. This deep submarine canyon has branch canyons to the north and south that reach close to shore, causing sites of intense upwelling of colder water that provides greater fog frequency in this area. This effect may account for the discontinuous distribution and occurrences of other endemic species along the central California coastline.

Historically, the dominant natural community for the Monterey Peninsula area was Monterey pine forest (*Pinus radiata*). Scientists debate why Monterey's Monterey pine forest (made up of *Pinus radiata*, *Pinus muricata* [Bishop pine], *Cupressus macrocarpa* [Monterey cypress], and *Cupressus goveniana* ssp. *goveniana*) is isolated from the other closed-cone pine forests in Año Nuevo to the north and Cambria to the south, which both harbor only *Pinus radiata*. The Monterey pine forest understory and surrounding open grassland meadow areas are dominated by various annual and perennial grasses and herbs, as well as scrub species such as *Arctostaphylos* sp. (manzanita).

Periodic fires are a natural component of healthy Monterey pine forests, as well as for coastal sage scrub and chaparral communities. In the past, slopes in forest and scrub communities were a mosaic of burned and unburned terrain where dead wood and fuels could not accumulate for long. Now there are homes and villages all throughout the Monterey Peninsula and other areas along coastal California. Because of the potential loss to persons and property, fire suppression is a very common practice; tremendous amounts of money and effort go into protecting the communities from being destroyed. As a result, some plant species in Monterey pine forest, coastal sage scrub, and chaparral habitats are struggling to survive and reproduce because they depend on fire or the subsequent open canopy that a fire produces for successful regeneration. Monterey pine cones can open without fire, resulting in modest recruitment of plants. However, optimum conditions for reestablishment of Monterey pines occur with fire.

The Monterey area also has marshy areas, remnant patches of coastal prairies, and extensive bayshore sand dunes along the northern and western shores of the bay. Many of the sand dunes are now gone or have been replaced by housing developments and golf courses, while closer to the water are shoreline mesas and cliffs whose many flowering plants, such as *Chorizanthe* sp. (spineflower), *Eriogonum* sp. (buckwheat), and *Erysimum* sp. (wallflower) are also threatened by onshore development and recreation. The coastal terraces generally have poor drainage and highly leached soils. Maritime chaparral exists in scattered patches from just south of the Monterey Peninsula to southern Santa Cruz County. Regions around the Monterey area include humid coastal canyons, coastal mountains, and fertile valley lands, resulting in a floristically rich area.

C. *Astragalus tener* var. *titi* (coastal dunes milk-vetch)

(Recovery Priority Number = 6C)

1. Taxonomy and Description

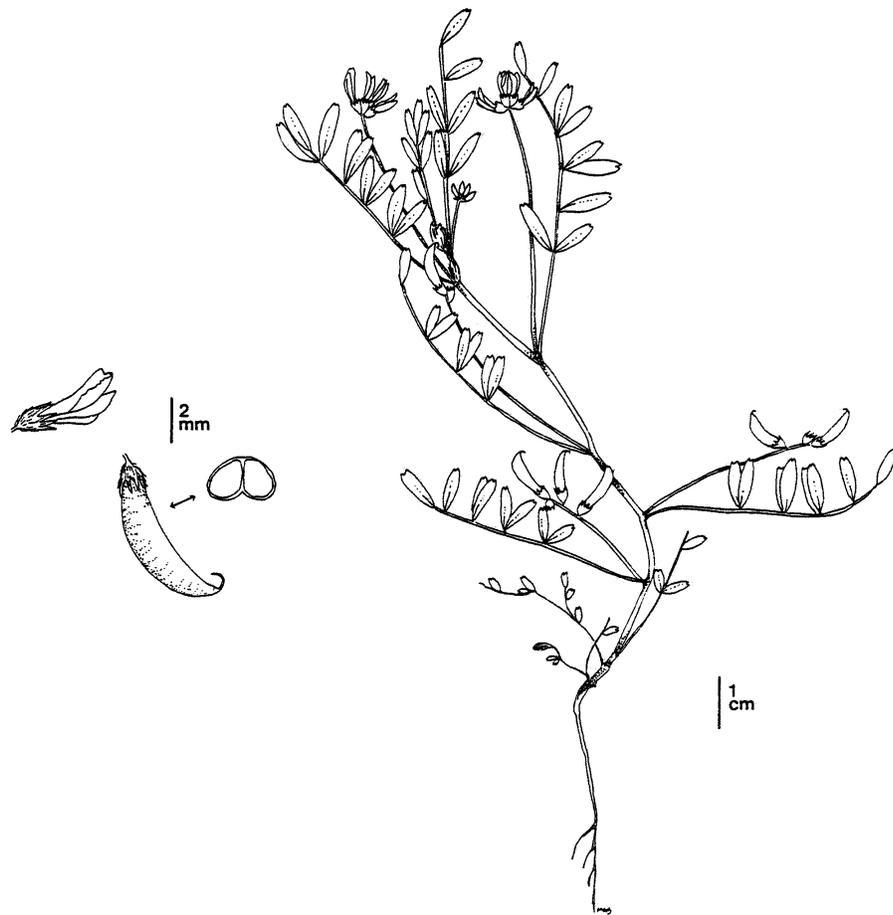
Astragalus tener var. *titi* (Figure 3) was first collected by Mrs. Joseph Clemens in 1904 and was described by Alice Eastwood as *Astragalus titi* based on specimens collected by Mrs. Joseph Clemens in 1904 near Moss Beach, Monterey (Eastwood 1905). Eastwood named the plant *Astragalus titi* in honor of Dr. F. H. Titus, who also collected specimens of this plant. Jepson (1936) considered these two taxa synonymous. Howell (1938) compared type specimens of *A. tener* and *A. titi* and confirmed that the two plants were different, based on the low decumbent habit and smaller flowers of *A. tener* var. *titi*. Barneby (1950) published the name *A. tener* var. *titi*, noting differences from *A. tener* var. *tener* (alkali milk-vetch) in size of various flower parts, habitat, and geographic range (Barneby 1950). *A. tener* var. *tener* is native to alkaline grass flats in the Central Valley, San Francisco Bay region, and the lower Salinas Valley (Barneby 1950).

Astragalus tener var. *titi* is a small annual herb from the legume family (Fabaceae). The stems are slightly pubescent and reach 2 to 12 centimeters (0.8 to 4.7 inches) in height. It has pinnately compound leaves ranging from 2 to 7 centimeters (0.8 to 2.7 inches) long with 7 to 11 wedge-like to oblanceolate leaflets, each having a slightly bilobed tip. Lavender to purple flowers are borne on 2 to 12 subcapitate racemes. The flowers are 5 to 6 millimeters (0.3 inch) long. The fruit can be a straight or curved legume that is 6 to 14 millimeters (0.2 to 0.5 inch) in length (Spellenberg 1993).

2. Distribution

Historically, *Astragalus tener* var. *titi* was found in Monterey, Los Angeles, and San Diego Counties (Ferreira 1995). Specimens from the two historical locations in Los Angeles County (Hyde Park in Inglewood and Santa Monica) and two locations in San Diego County (Silver Strand and Soledad) were annotated by Barneby (1964) as *A. tener* var. *titi*. Both Los Angeles locations have been heavily urbanized, and it is unlikely that suitable habitat exists in those areas

Figure 3. Illustration of *Astragalus tener* var. *titi* (coastal dunes milk-vetch).
Used with permission by the California Department of Fish and Game. Drawing
by Mary Ann Showers.



today. This taxon has not been collected in Los Angeles County since 1903. In San Diego County, part of the Silver Strand area is owned by the Department of Defense (Miramar Naval Weapons Center), who has used a portion of the area for amphibious vehicle training exercises. Another part of the Silver Strand area is leased to the California Department of Parks and Recreation from the Navy for development of a campground and recreational facilities. The Soledad site (near Torrey Pines State Reserve) in San Diego County needs additional surveys (Ferreira 1995). This species was last collected in San Diego County in 1983. Many unsuccessful searches have been conducted in both Los Angeles and San Diego Counties since 1980 (Ferreira 1995).

The only known extant population of *Astragalus tener* var. *titi* is on Pebble Beach Company and Monterey Peninsula Country Club property, along 17-Mile Drive on the western edge of the Monterey Peninsula near Bird Rock in Monterey County. During the 1980's and 1990's, 15 to 1,000 individuals were counted within this population (Ferreira 1995). By 1995, 11 scattered patches of plants within this 1 population, totaling approximately 4,000 individuals, were known on each side of 17-Mile Drive, along Bird Rock Road, and at a horse jumping area on the Monterey Peninsula Country Club Golf Course (Jones and Stokes Associates 1996). Surveys conducted within an enclosure on the west side of 17-Mile Drive found ranges of hundreds of individuals in 1998, likely fewer than 200 plants in 1999, and no flowering individuals in 2000 (Doak *et al.* 2000). Remnant patches of habitat are surrounded by golf greens and a bank covered with exotic *Carpobrotus edulis* (sea-fig) (Ferreira 1995, Jones and Stokes Associates 1996).

3. Habitat Requirements

On the Monterey Peninsula, a single population of *Astragalus tener* var. *titi* occurs on relatively flat coastal terraces within 30 meters (100 feet) of the ocean beach and 8 meters (25 feet) above sea level. The plants occur primarily on Antioch soils, with a few colonies found on compacted Sheridan soils (Jones and Stokes Associates 1996). Due to the plants' exposure to ocean sprays and periodic saturation from salt water inundation, *A. tener* var. *titi* is likely tolerant of slightly saline soil conditions (Jones and Stokes Associates 1996). The loamy fine sands comprise a series of shallow swales that support standing water during

wet winter and spring seasons. Flowering plants were also found after a heavy rainfall year in a dry, less vegetated, and open rocky area (Doak *et al.* 2000). Individual plants are found along the bottoms or sides of the swales with low growing grasses and herbaceous species between 10 and 15 centimeters (4 and 6 inches) tall (Doak *et al.* 2000).

Astragalus tener var. *titi* grows well in areas of low-level disturbance, such as that caused by gophers or light pedestrian traffic (Doak *et al.* 2000). A number of native and nonnative plants are associated with *A. tener* var. *titi*, including *Plantago coronopus* (cut-leaf plantain), *Danthonia californica* (California oatgrass), *Deschampsia cespitosa* ssp. *holciformis* (tufted hairgrass) and *Lasthenia minor* (goldfields). The occurrence of *Plantago coronopus* and *Lasthenia minor* may be a good indicator of the appropriate habitat conditions needed for *A. tener* var. *titi* (Jones and Stokes Associates 1996). No associations with other biotic or abiotic variables have been found, including soil moisture, amount of bare ground, or percent cover of other plant species (Doak *et al.* 2000).

4. Life History/Ecology

Astragalus tener var. *titi* flowers between March and May. Based on its floral structure, small bees have been presumed to be its main pollinators. Surveys conducted during 1998 and 1999 resulted in only one observed visitor: a small, unidentified black beetle (Doak *et al.* 2000). A greenhouse study during 1998 found that high seed set and flower morphology indicates selfing as the common form of pollination. This suggests that pollinator services are not likely a strong concern in the establishment and maintenance of populations (Doak *et al.* 2000).

The average number of seeds produced per plant was approximately 33 seeds, as measured in 1998; a statistically significant relationship occurs between *Astragalus tener* var. *titi* density of plants and number of seeds produced per plant (Doak *et al.* 2000). This may indicate either that significant competition exists between plants when plants are at high densities, or that habitats that are best for germination or accumulation of seeds (*i.e.* swales) are not optimal for continued growth and reproduction (Doak *et al.* 2000).

5. Reason for Listing

Astragalus tener var. *titi* was federally listed as endangered on August 12, 1998 (63 FR 43100). The California Department of Fish and Game listed it as endangered in February 1982, and the California Native Plant Society also considers it a rare and endangered plant species (List 1B) (Skinner and Pavlik 1994).

Urban development, loss of habitat, recreation, and coastal military activities resulted in extirpation of the historical occurrences of *Astragalus tener* var. *titi* in southern California, and possibly other occurrences in Monterey County. Reasons for listing this species as endangered include alteration of habitat from trampling associated with recreational activities such as hiking, picnicking, ocean viewing, wildlife photography, equestrian use, and golfing, and/or modifications in hydrology resulting from improvements or maintenance activities along 17-Mile Drive. The current population of *A. tener* var. *titi* in Monterey County is also highly fragmented. The small population size and the human uses that surround this population greatly increase its chance of extinction from random naturally occurring events (*e.g.*, inbreeding depression, genetic drift, disease, wave erosion from a major storm) or human activities that could negatively affect a significant portion of the remaining plants. *A. tener* var. *titi* may also be threatened with competition from nonnative *Carpobrotus edulis*, *Plantago coronopus*, and *Carex pansa* (Pansa sedge), which are spreading within the fenced area of *A. tener* var. *titi* habitat (Jones and Stokes Associates 1996). No germination or growth of *A. tener* var. *titi* was found to occur during 1999 and 2000 in areas within existing *Carex pansa* or in a mixed vegetative area within a protected enclosure (Doak *et al.* 2000). These surveys also indicate that in years with heavy rainfall, this enclosure may not contain the best habitat for the species (Doak *et al.* 2000).

The plants occurring on the east side of 17-Mile Drive are on Monterey Peninsula Country Club property and are vulnerable to ongoing equestrian use, recreational golfing activities, and effects of fertilizers and insecticides. Individuals of *Astragalus tener* var. *titi* occur within 1 meter (approximately 3 feet) of the managed turf (Ferreira 1995).

6. Conservation Measures

Recent surveys were conducted in 1999 and 2000, supported by funds received through section 6 of the Endangered Species Act. These studies were conducted to better characterize occurrence patterns, characterize habitat, evaluate competition from nonnative species, and to assess the costs and benefits of disturbances caused by foot traffic and gopher activity.

The Pebble Beach Company constructed a fenced enclosure in 1989 on the west side of 17-Mile Drive to reduce inadvertent trampling from both passive and active recreational activities. The enclosure includes a narrow buffer zone and protects approximately 930 square meters (10,000 square feet) of the terrace from foot and vehicle traffic (Ferreira 1995). The Pebble Beach Company has reported that they have been managing and monitoring the population within the enclosure for several years (M. Zander, Zander Associates, *in litt.* 1996). In 1993, the Pebble Beach Company planted approximately 380 plants along 17-Mile Drive, with plans to cultivate additional *Astragalus tener* var. *titi* in their nursery for eventual establishment (upon completion of a Memorandum of Understanding with the California Department of Fish and Game) (M. Zander *in litt.* 1996). Success measures from these plantings have not yet been reported to the U.S. Fish and Wildlife Service. As of 1996, no new development activities were proposed for the areas that support *A. tener* var. *titi* and the Company's stated long-term goal is to preserve and enhance the existing population (M. Zander *in litt.* 1996). In addition, the Pebble Beach Company has implemented a directed program to eradicate invasive, nonnative species (such as *Carpobrotus edulis*) (Ferreira 1995, M. Zander *in litt.* 1996).

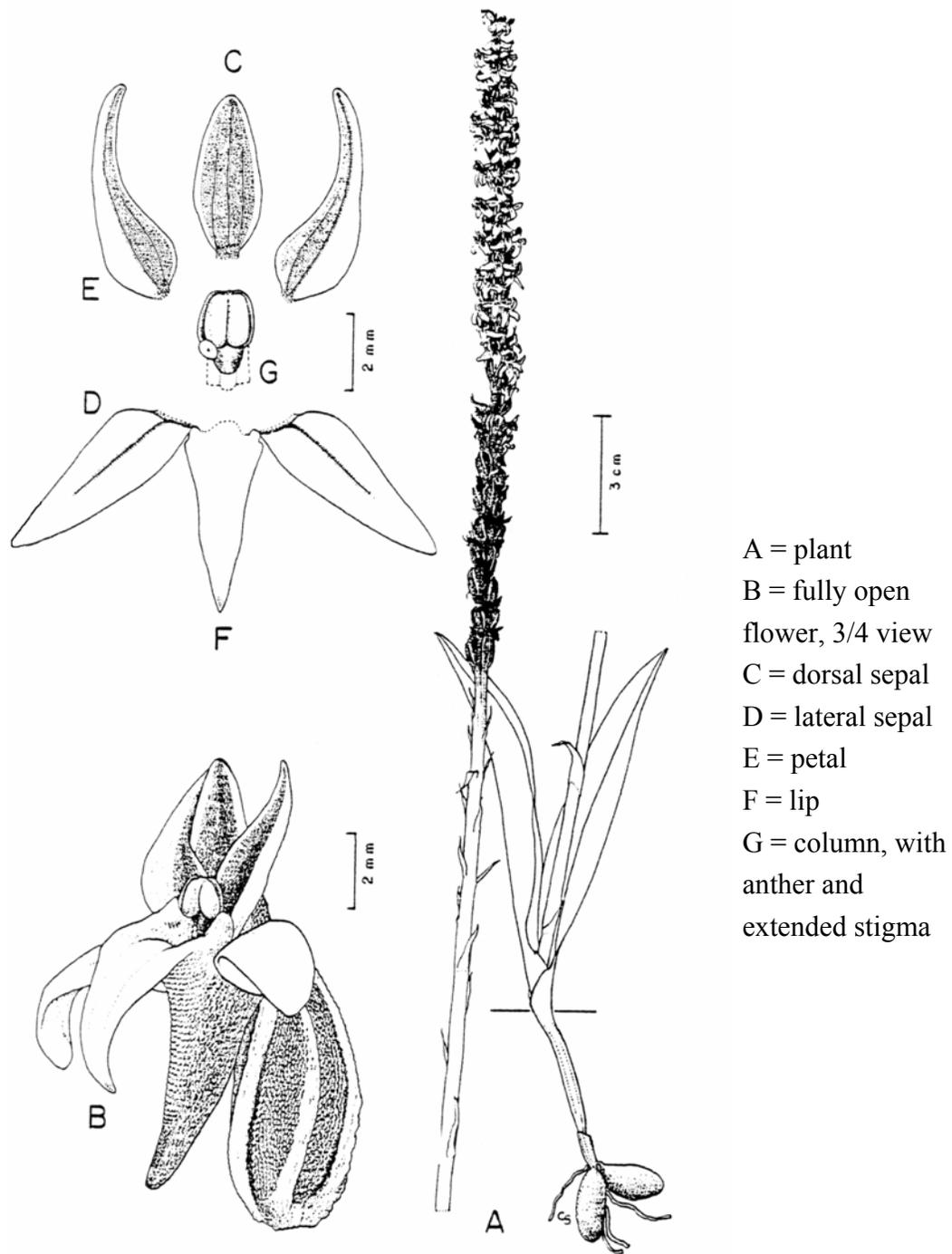
D. *Piperia yadonii* (Yadon's piperia)

(Recovery Priority Number = 2C)

1. Taxonomy and Description

Piperia yadonii (Figure 4) was first collected by Leroy Abrams in 1925 in open pine forest near Pacific Grove. At that time, it was identified as *Piperia unalascensis*, a polymorphic, wide-ranging species in the western United States (Morgan and Ackerman 1990), although at least two naturalists who collected

Figure 4. Illustration of *Piperia yadonii* (Yadon's piperia). Used with permission by James D. Ackerman, Ph.D., and Lindleyana Scientific Journal of the American Orchid Society.



from the Monterey region in the 1920's (George Henry Grinnel and Leroy Abrams) noted the uniqueness of the plants from the Monterey area (Coleman 1995). In the most recent treatment of the genus *Piperia*, Ackerman (1977) segregated out several long-spurred taxa from the *P. unalascensis* complex but attempted no analysis of the short-spurred forms. Subsequently, Morgan and Ackerman (1990) segregated out two new taxa from the *P. unalascensis* complex on the basis of floral markings, inflorescence type and partly on geographic range. One of these taxa, *P. yadonii*, was named after Vernal Yadon, previous Director of the Museum of Natural History in Pacific Grove, Monterey County.

Piperia yadonii is a slender perennial herb in the orchid family (Orchidaceae). Mature plants typically have two or three lanceolate to oblanceolate basal leaves 10 to 15 centimeters (4 to 6 inches) long and 2 to 3 centimeters (0.8 to 1.2 inches) wide. The single flowering stems are up to 50 centimeters (20 inches) tall with flowers arranged in a dense narrow-cylindrical raceme. Each raceme has approximately 56 flowers spirally arranged along its axis (Doak and Graff 2001). The flowers consist of three petal-like sepals and three petals (together referred to as tepals). The most easily distinguished characteristic of *P. yadonii* is that the upper three tepals are green and white and the lower three are white. The lowermost tepal is specialized into a lip that is narrowly triangular (2.5 to 5 millimeters [0.09 to 0.20 inch] long) and is strongly decurved so that the tip nearly touches the spur (2.5 millimeters [0.09 inch] long) of the flower (Morgan and Ackerman 1990). *P. yadonii* is sympatric with *P. elegans*, *P. elongata*, *P. michaelii*, and *P. transversa*, but is distinguished from them in flower by its shorter spur length (1.5 to 6 millimeters [0.06 to 0.24 inch] long), particular pattern of green and white floral markings, and its earlier flowering time (Wilken and Jennings 1993, Coleman 1995).

2. Distribution

Piperia yadonii is endemic to Monterey County. The plant is found within Monterey pine forest and maritime chaparral communities. Its center of distribution appears to be the Monterey Peninsula where plants are found throughout the larger undeveloped tracts of the Del Monte Forest in Monterey

pine forest. To the north, the range of *P. yadonii* extends to the Los Lomos area, near the border of Santa Cruz County (Allen 1996; V. Yadon, Pacific Grove Museum of Natural History, *in litt.* 1997). To the south, plants have been found to the east of Point Lobos State Reserve outside of the Monterey Peninsula. Searches north into Santa Cruz County have uncovered little suitable habitat and no *P. yadonii* (R. Morgan, California Native Plant Society, pers. comm. 1996; Allen 1996), nor do regional herbaria contain collections from Santa Cruz County (R. Morgan pers. comm. 1996). An occurrence of six individuals was reported near State Route 1 at Fort Ord in 1991, although no plants were found in subsequent surveys between 1993 and 1995 (Jones and Stokes Associates 1996). *P. yadonii* was also found at one location about 25 kilometers (15 miles) south of the Monterey Peninsula near Palo Colorado Canyon in maritime chaparral along the Big Sur Coast, supporting approximately 38 individuals (Jones and Stokes Associates 1996). *P. yadonii* has been found only 6.5 to 10 kilometers (4 to 6 miles) inland (Allen 1996, V. Yadon *in litt.* 1997) despite searches of lands farther east (Allen 1996). Toro Regional Park, 16 to 24 kilometers (10 to 15 miles) inland, was searched and four unidentified piperia were found, but the habitat was reported to not be that favored by *P. yadonii* (Allen 1996).

During surveys that were conducted between 1990 and 1995, approximately 96 percent of the *Piperia yadonii* plants were found on the Monterey Peninsula (Jones and Stokes Associates 1996). Allen (1996) reports a total of 82,712 individuals over approximately 144 hectares (355 acres) during a 1995 and 1996 survey funded by the Pebble Beach Company. Plants were often densely clustered, with 100 to 200 plants per square meter (9 to 19 per square foot). Because size and flowering are not always age-dependent, the age structure of these populations is not known. During these surveys, the greatest concentrations of *P. yadonii* (approximately 57,000 plants or 67 percent of all known plants) were found scattered throughout much of the remaining Monterey pine forest owned by the Pebble Beach Company and the Del Monte Forest Foundation on the Monterey Peninsula (Allen 1996). Approximately 2,000 of these plants (2 percent of total) occur on remnant patches of Monterey pine forest in parks and open space areas of Pacific Grove and Monterey (Allen 1996, Jones and Stokes Associates 1996). Approximately 3,000 plants have been identified on or near the Monterey Peninsula Airport (B. Leitner, Environmental Science Associates, *in*

litt. 2001). More than 2,350 plants have been identified at the Naval Postgraduate School in Monterey (Greening Associates 1999). Inland to the north, about 15,000 *P. yadonii* plants, (18 percent of all known plants) have been found on the chaparral covered ridges north of Prunedale (Allen 1996). About 8,000 of these are on lands that receive some protection at Manzanita County Park and The Nature Conservancy's Blohm Ranch parcel; the remainder are on private lands that are not protected. Approximately 7,500 plants have been found south of the Peninsula, on State Park properties at Point Lobos Ranch, on surrounding lands that are to be turned over to the California Department of Parks and Recreation in the future (Nikki Nedef, Big Sur Land Trust, pers. comm. 2001), and on a smaller parcel that has remained in private ownership.

3. Habitat Requirements

Piperia yadonii has been found in two primary habitat types: Monterey pine forest with an herbaceous, sparse understory; and ridges in maritime chaparral growing beneath dwarfed *Arctostaphylos hookeri* (Hooker's manzanita) shrubs in shallow soils (Morgan and Ackerman 1990, Allen 1996, Doak and Graff 2001). In the Monterey pine forest habitat, the species grows through pine needle duff in filtered sun on soils with a shallow clay hard pan that becomes very dry during the flowering season. Plants may also be found among dense stands of nonnative annual grasses, especially *Briza maxima* (quaking grass) (Doak and Graff 2001). In maritime chaparral, it grows on sandstone and is found under the edges of prostrate mats of *Arctostaphylos hookeri*, along with *Arctostaphylos pajaroensis* (Pajaro manzanita), *Adenostoma fasciculatum* (chamise), *Ceanothus cuneatus* var. *rigidus* (Monterey ceanothus), *Eriophyllum confertiflorum* (golden-yarrow), and *Mimulus aurantiacus* (bush monkeyflower) (Doak and Graff 2001). Overall, it favors a well drained soil that retains moisture during the rainy season but is not subject to inundation.

Piperia yadonii can be found in some locations where disturbance has occurred previously, such as abandoned dirt roads or the cut slopes created by their construction (Allen 1996). As in other orchid species, *P. yadonii* does not appear to be an early successional species but is able to colonize trails and road banks within dwarf maritime chaparral or Monterey pine forest once a decade or more

has passed and if light and moisture regimes are favorable (Allen 1996, V. Yadon *in litt.* 1997).

4. Life History/Ecology

As in other orchids, germination of *Piperia yadonii* seeds probably involves a symbiotic relationship with a fungus. Following germination, orchid seedlings typically grow below ground for one to several years before producing their first basal leaves. Plants may produce only vegetative growth for several years, before first producing flowers (Rasmussen 1995). In mature plants of *P. yadonii*, the basal leaves typically emerge sometime after fall or winter rains and wither by May or June when the plant produces a single flowering stem. The blooming season of *P. yadonii* is fairly short: the first flowers are dependent on age and/or tuber size and will open in mid to late June with blooming completed by early August (Coleman 1995, Doak and Graff 2001). The plant is dormant from September to December until the winter rains stimulate root and leaf bud development.

Only a small percentage (5 percent or less) of individuals in a population flower in any year (Allen 1996, V. Yadon *in litt.* 2000). This pattern is consistent with what is known of other orchid species. As in some other plant taxa, individual orchids that flower in one year may not have the necessary energy reserves to flower in the following year, so size and flowering are not necessarily age-dependent (Wells 1981, Rasmussen 1995).

Piperia yadonii is capable of both outcrossing and selfing. Recent research results indicate a very low rate of fruit and seed production in plants that are not visited by pollinators (Doak and Graff 2001). These plants produced a lower number of seeds per fruit than in outcrossed pollination, indicating that inbreeding depression occurs at the level of seed set (Doak and Graff 2001). A number of different pollinator species were identified during this study, including species from the following families: Pyralidae (snout moths), Geometridae (geometer moths), Noctuidae (noctuid moths), and Pterophoridae (plume moths); only one diurnal visitor, a *Bombus* sp. (bumble bee), was observed (Doak and Graff 2001).

Disease and herbivory appear to affect reproductive success of *Piperia yadonii*. Plants appear to be negatively affected by deer, rabbits, and possibly rodent herbivores (Doak and Graff 2001). A fungal disease (*Rhizoctonia* sp.) has also been shown to affect *P. yadonii* plants. A small number of diseased plants set fruit compared to healthy plants; any diseased plants that do set fruit have a significantly lower seed count than healthy plants (Doak and Graff 2001).

5. Reason for Listing

Piperia yadonii was listed as endangered on August 12, 1998 (63 FR 43100). It is not listed under the State of California Endangered Species Act, although it is considered a “rare, threatened, or endangered plant” by the California Native Plant Society (List 1B) (Skinner and Pavlik 1994).

The numerous historical collections reported from the Pacific Grove area suggest that many *Piperia yadonii* populations have been extirpated from the Monterey Peninsula (60 FR 39326). Urban and recreational development (most specifically golf courses) threaten this plant’s existence. The remaining populations occur on property owned by the Pebble Beach Company, Del Monte Forest Foundation, U.S. Department of Defense, County of Monterey, City of Monterey, The Nature Conservancy, and an undetermined number of private landowners, with the largest populations occurring on the Pebble Beach Company property (Jones and Stokes Associates 1996). Although large numbers of plants have been reported (Allen 1996, Jones and Stokes Associates 1996, M. Zander *in litt.* 1996), the populations are concentrated in small areas. Most of the remaining *P. yadonii* on the Peninsula are found on private property within sites that have been proposed for development. A number of plants are also threatened from a potential roadway circulation improvement project at the Monterey Peninsula Airport. Up to 73 percent (approximately 2,200 plants) of the existing population at the airport may be lost if the roadways are expanded (B. Leitner *in litt.* 2001).

In addition to development threats, large populations of deer on the Monterey Peninsula browse on flowering stems and threaten orchid reproduction. At least one population of *Piperia yadonii* was browsed so heavily during 2000 that no plants successfully matured seed capsules (V. Yadon *in litt.* 2000). Competition

from nonnative plants, roadside maintenance (including a fire directive requesting removal of roadside vegetation for prevention of wildfires), and a proposed realignment of U.S. Route 101 near Prunedale threaten persistence of the only wild orchid in California officially protected as an endangered plant. The fragmented nature of all the existing sites makes management difficult and local extinctions of this species probable.

6. Conservation Measures

The Blohm Ranch Nature Preserve is owned by The Nature Conservancy and is stewarded by the Elkhorn Slough Foundation. *Piperia yadonii* occurs within this protected property, ranging from as few as 25 flowering individuals during 1999 to 1,000 flowering individuals in 1996 (Jones and Stokes Associates 1996, Doak and Graff 2001). With proper management, this protected population may persist. Due to the severely fragmented habitat supporting some of the remaining patches of plants and the lack of information on its life history, both reproductive and pollination ecology studies of *Piperia yadonii* were carried out at eight locations in 1999 (Doak and Graff 2001). We funded a 2-year study to determine the species breeding system, pollinators, fecundity, herbivory rate, disease incidence, size at reproduction, and the proportion of plants in a given area that flower. Results and recommendations from this study have been incorporated into this recovery plan. We funded additional research in August 2001, for expanded studies on the life history of this species.

The Naval Postgraduate School has proposed protective measures for this species in their draft Integrated Natural Resource Management Plan. These measures include protection, continued monitoring, and management of existing *Piperia yadonii* populations, removal of nonnative invasive weeds (french broom and pampas grass), and fencing populations for added protection (Naval Postgraduate School 2001).

In 1995, approximately 13.5 percent of the total number of *Piperia yadonii*, or over 7,600 plants, were known to occur on lands that are set aside as open space at the Samuel F.B. Morse Botanical Reserve and Huckleberry Hill Natural Area (Jones and Stokes Associates 1996). A fire in the pygmy forest area during 1987

removed the cover of dense trees and shrubs, creating an increased open area more favorable to orchid species. This open area may have increased the *P. yadonii* populations following the fire by creating more suitable habitat, although it is likely this temporary habitat will decline over time as the pygmy forest recovers and matures.

Since the proposed rule for listing was prepared in 1994, the Pebble Beach Company funded intensive surveys for *Piperia yadonii* (focusing on the Monterey Peninsula in 1995 and beyond the Peninsula in western Monterey County in 1996) in an effort to better quantify the extent of *P. yadonii* throughout its range (Allen 1996, M. Zander *in litt.* 1996).

E. *Potentilla hickmanii* (Hickman's potentilla)

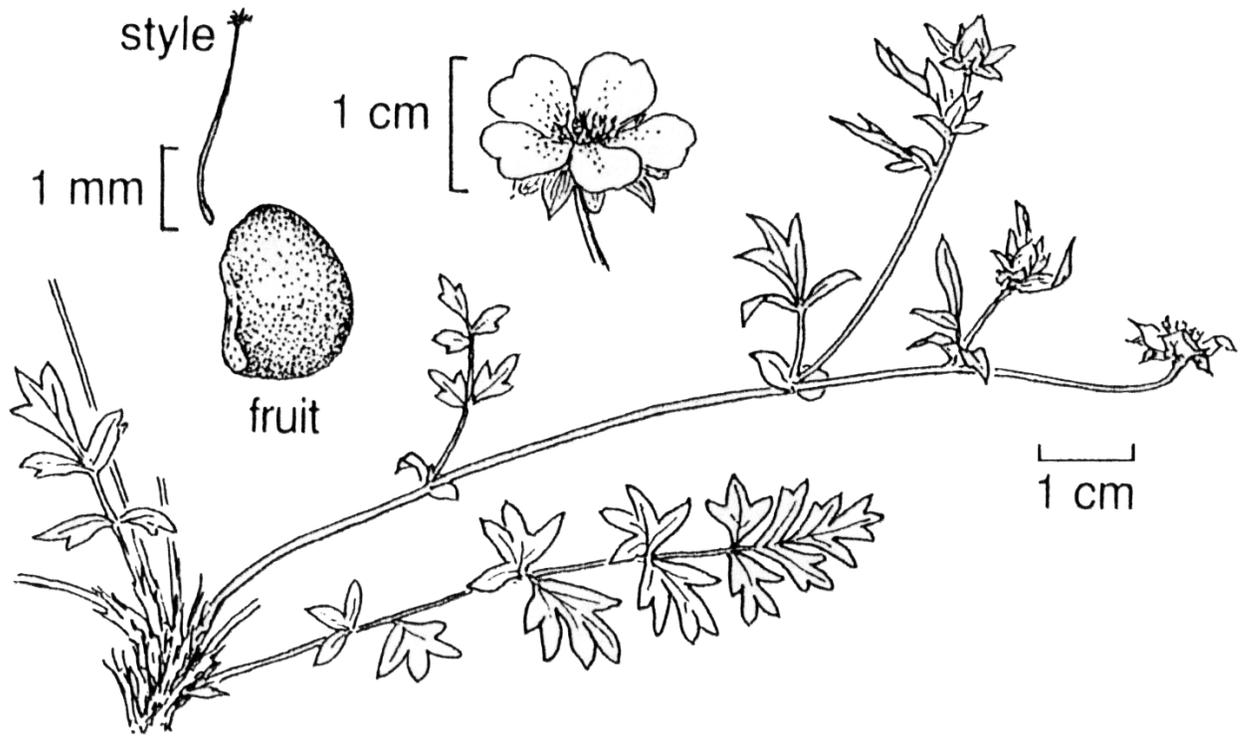
(Recovery Priority Number = 5C)

1. Taxonomy and Description

Potentilla hickmanii (Figure 5) was described by Alice E. Eastwood, based on her collection made in 1900 from Monterey County, along a road to Cypress Point (Eastwood 1902). Eastwood named the plant after Mr. J. B. Hickman who was her guide on that collecting trip.

Potentilla hickmanii is a small perennial herb in the rose family (Rosaceae) that dies back to a woody taproot each year. The annually produced leaves are pinnately compound into generally six paired, palmately cleft leaflets each 2 to 8 millimeters (0.1 to 0.3 inch) long and 1 to 3 millimeters (0.04 to 0.12 inch) wide. Several reclining stems 5 to 45 centimeters (2 to 16 inches) long support two to four branched cymes, each of which has fewer than 10 flowers. The flowers consist of 5 yellow obovate petals 6 to 10 millimeters (0.2 to 0.4 inch) long and 5 millimeters (0.2 inch) wide, typically with 20 stamens and about 10 styles (Abrams 1944, Ertter 1993). *P. hickmanii* is distinguished from two other potentillas that occur on the Monterey Peninsula (*P. anserina* var. *pacifica* and *P. glandulosa*) by a combination of its small stature, leaflet size and shape, and color of the petals.

Figure 5. Illustration of *Potentilla hickmanii* (Hickman's potentilla). Reprinted from The Jepson Manual, J. Hickman, Ed., 1993, with permission from the Jepson Herbarium. © Regents of the University of California.



2. Distribution

The type locality of *Potentilla hickmanii* was noted by Eastwood (1902): “Pinus radiata forest, near the reservoir which supplies Pacific Grove, California, along the road to Cypress Point, April 4, 1900”. The reference to a reservoir could refer to Forest Lake in Pebble Beach but more likely refers to the Pacific Grove reservoir (Ferreira 1995). The known geographical range for *P. hickmanii* includes the following historical locations: Moss Beach, San Mateo County, 1.1 kilometers (0.7 mile) south of Point Montara near Half Moon Bay in 1905 by Katherine Brandegee and in 1933 by Mrs. E.C. Sutcliffe (Ertter 1993); Monterey Peninsula, approximately 800 meters (0.5 mile) east of Seal Rock at a picnic area, Pebble Beach, Monterey County; Pacific Grove, near a reservoir supplying Pacific Grove, on the road to Cypress Point, Monterey County; and within the Two Rock Quadrangle in Sonoma County (Ferreira 1995, California Natural Diversity Data Base 2001a). A collection of the Pacific Grove population was made by Ethel K. Crum in 1932, apparently in the vicinity of Eastwood's original collection on the Monterey Peninsula. Ferreira (1995) surveyed the area surrounding the Pacific Grove reservoir in 1992, but found no *P. hickmanii* plants or suitable habitat for the species.

Two extant populations of this species are known today: one in the hills above Martini Creek adjacent to Montara State Beach in San Mateo County, and another at a picnic area on the Monterey Peninsula on lands owned by the Del Monte Forest Foundation. The San Mateo County (Montara) population grows on grassland slopes on privately owned land near Devil’s Slide and covers an area of between 65 and 130 hectares (0.25 and 0.5 square miles) (T. Morosco *in litt.* 1997). The population in San Mateo County was presumed extirpated until it was rediscovered in 1995 by biologists from California Department of Transportation surveying for a highway project (R. Vonarb, Caltrans, *in litt.* 1995). The population size was estimated at 2,000 to 3,000 individuals in 1995 and 1996 (R. Vonarb *in litt.* 1995, T. Morosco *in litt.* 1997).

The Monterey Peninsula population of *Potentilla hickmanii* is in a meadow opening within Monterey pine forest inland of Seal Rock along 17-Mile Drive. Twenty-four individuals of *P. hickmanii* were located during 1992 surveys in an

area that covers no more than 279 square meters (3,000 square feet) (Ferreira 1995). In 1995 the site was surveyed on two occasions, and no more than 21 plants were found (Jones and Stokes Associates 1996). Surveys in 1999 indicate fewer than 40 plants (Doak *et al.* 2000). Research on reproduction of *P. hickmanii* has shown that the two populations may not be fully compatible, suggesting genetic divergence (Doak *et al.* 2000).

3. Habitat Requirements

The Monterey Peninsula population of *Potentilla hickmanii* is found in loamy fine sandy soils that support a small meadow community of nonnative grasses and several nonnative and native herbs. The site consists of Santa Ynez soils, which support an upper surface of sand and organic material underlain by clay soils (Jones and Stokes Associates 1996). Wet meadow conditions appear to be essential for the persistence of *P. hickmanii*, although competition with nonnative grassland species is apparent (H. Crowell, U.S. Fish and Wildlife Service, pers. obs. 2001). Species that dominate the area include nonnative grasses such as *Avena barbata* (slender oats), *Bromus mollis* (soft chess brome), *Bromus diandrus* (ripgut brome), *Hordeum murinum* ssp. *leporinum* (wild barley), *Briza minor* (little rattlesnake grass), and other species, such as *Vulpia* sp. (annual fescues), *Grindelia latifolia* (coast gumplant), *Danthonia californica* (California oatgrass), *Geranium dissectum* (common geranium), and *Rumex crispus* (curly dock) (Jones and Stokes Associates 1996).

The densest concentration of *Potentilla hickmanii* in the Montara population of San Mateo County grows in the most intact native habitats in the area with few competing annual grasses (B. Ertter, U.C. Berkeley, *in litt.* 1997). It occurs on level to gently sloping grasslands in an area with native grasses that has been grazed (Jones and Stokes Associates 1996). Associated plants include native *Nassella* spp. (needlegrass), *Danthonia californica*, and nonnative *Phalaris* sp. (canary grass) (Jones and Stokes Associates 1996).

4. Life History/Ecology

Potentilla hickmanii has protogynous flowers with a stigma that is receptive to pollen before the pollen-bearing anthers open within the same flower (Jones and Stokes Associates 1996). This mechanism can reduce self-pollination and increase the possibility of outcrossing. It is also likely that some level of interpopulational genetic diversity exists (B. Ertter *in litt.* 1997). Seeds are produced late in the season. In dryer years, plants may produce little to no seeds, especially among early-blooming flowers (Jones and Stokes Associates 1996, B. Ertter *in litt.* 1997). This occurrence might be due to the observed absence of pollinators during blooming time in dryer years. Natural population increases do appear to occur during wet years, although they may not occur during dry years (Doak *et al.* 2000).

Research during 1998 and 1999 was conducted to explore environmental factors that limit seed production and establishment, and how a limitation might vary through the plants' flowering season (Doak *et al.* 2000). Evidence for pollen limitation of seed set was apparent and pollen augmentation also significantly reduced the probability of reproductive failure (Doak *et al.* 2000). Reproductive failure may exist if both pollinator visitation and pollen dispersal is low. Doak *et al.* (2000) observed only one pollinator in the 2-year study (a small beetle). In addition, the research discovered that developed, mature seed was found significantly more frequently in plants that were within at least 50 centimeters (20 inches) of each other than in isolated plants (Doak *et al.* 2000).

5. Reason for Listing

Potentilla hickmanii was listed as endangered on August 12, 1998 (63 FR 43100). It was listed as endangered under the California Endangered Species Act in September 1979 and is considered a California Native Plant Society List 1B species (Skinner and Pavlik 1994).

At the time of its listing, *Potentilla hickmanii* was threatened by a proposed residential development in the Del Monte Forest that would alter the hydrology of the habitat (EIP Associates 1995). This development proposal is currently under

redesign. An enclosure exists around most of the population. Heavy competition by nonnative grasses within and around the enclosure threatens the populations survival (H. Crowell pers. obs. 2001). Mowing and heavy recreational use of areas of suitable habitat surrounding the enclosure appears to prevent *P. hickmanii* from expanding (Jones and Stokes Associates 1996, H. Crowell pers. obs. 2001). In addition, browsing by deer likely reduces survivorship and reproduction, although gopher activity in the area may possibly improve habitat for *P. hickmanii* by removing competing vegetation (Jones and Stokes Associates 1996). High vole herbivory and soil inundation may cause adult plant mortality (Doak *et al.* 2000). In addition, high levels of nonnative snail and slug damage have been observed on both vegetative and reproductive structures, likely causing mortality and reducing growth and reproduction (Doak *et al.* 2000). Competition from surrounding vegetation strongly suppresses the survival and reproductive performance of young *P. hickmanii* plants (Doak *et al.* 2000). The extremely small number of individual plants remaining at the Monterey site also make *P. hickmanii* vulnerable to extirpation from random naturally occurring events, such as genetic drift, poor years of reproduction, and tree fall.

As with the Monterey site, invasive nonnative species may be competing with *Potentilla hickmanii* in San Mateo County (Ferreira 1995, Jones and Stokes Associates 1996, B. Ertter *in litt.* 1997). Possibly more importantly, the *P. hickmanii* may be drastically affected by a proposed State Route 1 bypass and potential development of the private land where it occurs. Currently, competition from nonnative invasive species, grazing by livestock, low fecundity, and alteration of fire frequency and intensity threaten survival of this unprotected population (T. Morosco *in litt.* 1997, B. Ertter *in litt.* 1997).

6. Conservation Measures

The Pebble Beach Company has maintained management responsibilities for the Monterey population, although ownership of the land has been transferred to the Del Monte Forest Foundation. The Del Monte Forest area is considered Environmentally Sensitive Habitat under the Del Monte Forest Land Use Plan and will be protected and managed so as to promote preservation and expansion of the current population (M. Zander *in litt.* 1996). The picnic area is available

for use by residents and has been developed as an outdoor recreational area. Recreational activities are no longer allowed within the enclosure built around the majority of the population in the 1970's (M. Zander *in litt.* 1996). Recreational impacts continued surrounding this fenced area through the mid-1990's (Ferreira 1995, Jones and Stokes Associates 1996). In 1996, the Pebble Beach Company installed additional fencing with advisory signs to protect this population from recreational activities and browsing by deer (M. Zander *in litt.* 1996).

We funded experimental outplanting with clones and seedlings in both the picnic area and at Carmello Meadows in Point Lobos State Reserve. Survival of transplanted individuals at the picnic area was high during 1998 to 1999 and somewhat lower for 1999 to 2000 (73 percent and 64 percent, respectively) (Doak *et al.* 2000). Transplants at Point Lobos were less successful, with only 4 of 10 plants surviving into spring 1999, and none surviving into spring 2000, although 5 individuals had been planted at a single site with a dry, rocky substrate (Doak *et al.* 2000).

Jones and Stokes Associates conducted surveys in 1995 to determine suitable sites for establishing new populations of *Potentilla hickmanii*. One site was found at Point Lobos Ranch along Allen Road on land that belongs to the Big Sur Land Trust but is slated to be transferred to the California Department of Parks and Recreation (Jones and Stokes Associates 1996, N. Nedeff pers. comm. 2001). The area supports a wet meadow on Santa Ynez soils, making the site similar to the picnic area site. *P. hickmanii* that originated from the picnic area population is being grown successfully by the Pebble Beach Company and Vern Yadon; the seed from these plants could be used to propagate new or additional experimental populations at Point Lobos (Jones and Stokes Associates 1996).

No conservation measures have been implemented to protect the Montara population near Devil's Slide in San Mateo County.

F. *Trifolium trichocalyx* (Monterey clover)

Recovery Priority Number = 5C

1. Taxonomy and Description

Trifolium trichocalyx (Figure 6) was first collected by Amos A. Heller in 1903 following a fire 2 years earlier "in sandy pine woods about Pacific Grove", and described by him the following year (Heller 1904). Laura F. McDermott considered the taxon a variety of *T. oliganthum* in her treatment of the genus (McDermott 1910), but this classification was not recognized in subsequent floras. Axelrod (1982) reported that at least one researcher has suggested that Monterey clover is a sporadic hybrid between *T. microcephalum* and *T. variegatum* and recommended removing it from the list of taxa considered Monterey endemics. This view was challenged by V. Yadon (*in litt.* 1983) who had grown *T. trichocalyx* and observed that it consistently produced up to seven seeds per pod, while both of the parent plants were two-seeded taxa. *T. trichocalyx* has continued to be recognized as a distinct species by Abrams (1944), Munz and Keck (1959), Howitt and Howell (1964), and Isely (1993), and we accept it as such.

Trifolium trichocalyx is a member of the pea family (Fabaceae). The genus *Trifolium* is well-represented in North America, with approximately 50 species recognized in California (Munz and Keck 1959) and 31 species currently recognized as native (Isely 1993). Members of this herbaceous genus are characterized by the palmately three-foliolate leaves (hence the name *Trifolium*) and flowers in spheroid or oblong heads.

Trifolium trichocalyx is a much-branched prostrate annual herb with leaflets that are obovate-cuneate, 0.4 to 1.2 centimeters (0.2 to 0.5 inch) long, and have truncate or shallowly notched ends. The numerous flowers are clustered into heads subtended by a laciniate-toothed involucre. The calyces are 7 millimeters (0.3 inch) long, toothed, and conspicuously pilose; the purple corollas scarcely equal the length of the calyx; the deciduous seed pods enclose up to seven seeds. The plant can be quite inconspicuous, as the prostrate branches may be only 3 to 4 centimeters (1.2 to 1.6 inches) long. With favorable conditions, however,

Figure 6. Illustration of *Trifolium trichocalyx* (Monterey clover). Used with permission by the California Department of Fish and Game. Drawing by Mary Ann Showers.



branches may reach a length of 20 to 30 centimeters (8 to 12 inches) (Abrams 1944). Branches from one large plant may spread through the forest litter and give the appearance of many plants. *T. trichocalyx* can be distinguished from other *Trifolium* species because it has seven-seeded fruits as opposed to two seeds per fruit pod (Ferreira 1995).

2. Distribution

Trifolium trichocalyx is found in only one area within the central portion of the Monterey Peninsula, within the Del Monte Forest at Huckleberry Hill. The area has been mapped as covering approximately 16 hectares (40 acres) (Ferreira 1995). Only scattered individuals were reported within this area by Theodore Niehaus in 1973 and 1979, and by V.Yadon in 1980 in forest openings or edges (California Natural Diversity Data Base 1997b). A number of plants are presumed to have been extirpated when Poppy Hills Golf Course was developed in 1980; the other plants were located within the boundaries of the Samuel F.B. Morse Botanical Reserve.

In 1988, surveyors found no *Trifolium trichocalyx* plants at the locations previously reported by Niehaus and Yadon. However, several hundred to 1,000 plants were scattered in an area that had burned in 1987 near Huckleberry Hill and historical locations (M. Griggs *in litt.* 1988, V.Yadon *in litt.* 1992). Surveys of this same burned area conducted in 1996 located 2 sites containing a total of 22 plants (Jones and Stokes Associates 1996). The largest past and present occurrences of *T. trichocalyx* appear to be situated between Haul Road and Costanilla Way. A seedbank is expected to exist in the soil in those locations where the plants were found in 1988 (Forest Maintenance Standard 1990, Jones and Stokes Associates 1996).

3. Habitat Requirements

Trifolium trichocalyx is a classic fire-follower, taking advantage of the reduced forest cover that allows a significantly higher proportion of light to reach the herbaceous ground cover for the first few years after a fire. *T. trichocalyx* then becomes scarce, persisting primarily as a seedbank in the soil, while shade and

competition increase during succession of the forest community. Recent studies indicate that there are no specific germination requirements, other than light (Doak *et al.* 2000).

The majority of the *Trifolium trichocalyx* occurrences documented during 1988 and 1996 were on slopes ranging from 15 to 30 percent grade (Ferreira 1995; Jones and Stokes Associates 1996). The taxon occurs in openings within Monterey pine forest on poorly drained Narlon loamy fine sand, and on well drained Sheridan coarse loamy sand. These soils support a thin or loamy sand upper surface underlain by highly compacted sandy clay (Jones and Stokes Associates 1996, U.S. Department of Agriculture 2001). Herbaceous species associated with *T. trichocalyx* include *Avena barbata* (slender wild oat), *Vulpia* sp., *Bromus hordeaceus* (brome), *Erechtites argula* (Australian fireweed), and *Trifolium microdon* (thimble clover) (Jones and Stokes Associates 1996). Typical woody species commonly associated with the *T. trichocalyx* are *Pinus radiata*, *Arctostaphylos hookeri*, *Arctostaphylos tomentosa* (shaggy-barked manzanita), and *Vaccinium ovatum* (huckleberry); in areas where *T. trichocalyx* occurs within pygmy forest, associated plants include *Pinus muricata* and *Cupressus goveniana* ssp. *goveniana*.

4. Life History/Ecology

Following a fire that removes the dense vegetative cover that shelters its seed bank, *Trifolium trichocalyx* appears to regenerate in large numbers during spring. As the forest begins to recover following a fire, shrubs and seedlings will overshadow the *T. trichocalyx*, causing populations to decline. Recent research has been conducted to examine possible germination requirements for this species. Laboratory results indicate that *T. trichocalyx* has no specific germination requirement other than light, however, seeds buried in the soil at Huckleberry Hill may require different germination cues than those seeds used in this experiment that were never buried (Doak *et al.* 2000).

Trifolium trichocalyx flowers between April and June. Although no pollinators were observed in previous studies (Jones and Stokes Associates 1996), small bees are likely pollinators as they are with other *Trifolium* clover species.

5. Reason for Listing

Trifolium trichocalyx was listed as endangered on August 12, 1998 (63 FR 43100). It was listed as endangered under the California Endangered Species Act in November 1979. The California Native Plant Society considers this plant rare and endangered in California (List 1B) (Skinner and Pavlik 1994).

The most significant threat to the population of *Trifolium trichocalyx* on the Monterey Peninsula is the loss of potential habitat from residential and golf course development. Jones and Stokes Associates (1996) estimated that habitat has declined from 710 hectares (1,754 acres) to the current extent of 218 hectares (539 acres) (estimated using data from Jones and Stokes Associates (1994), which examined vegetation and soils on different geomorphic surfaces of the Monterey Peninsula). In addition to the loss of habitat, fire suppression is a serious concern. Due to the close proximity of residential buildings to the current population, natural fire cycles are suppressed. In order for a fire-follower to survive between fire cycles, its habitat and seed bank must remain relatively intact and undisturbed. Extinction of *T. trichocalyx* is possible due to the small amount of remaining habitat and the ephemeral nature of the plant's reappearance after fires.

6. Conservation Measures

The Huckleberry Hill Natural Area and Samuel F.B. Morse Botanical Reserve comprise over 162 hectares (400 acres) of permanently dedicated natural open space area within the Del Monte Forest. Because of the species' rarity, the location where *Trifolium trichocalyx* was last found has been excluded from development in the new Del Monte Forest Development Initiative proposed by the Pebble Beach Company (Area G) (T. Grove, California Coastal Commission, *in litt.* 2000).

A number of research studies and management measures have occurred within the Del Monte Forest to aid in recovery of this species (Jones and Stokes Associates 1996, Doak *et al.* 2000), including research funded by us through the California Department of Fish and Game. The studies have included germination requirements, tests for presence of seed banks, experimental establishment of new

populations, and seed sowing techniques (Doak *et al.* 2000). Vern Yadon reported to Jones and Stokes Associates (1996) that *Trifolium trichocalyx* has been grown successfully from seed in pots without the use of heat treatment.

G. *Cupressus goveniana* ssp. *govoniana* (Gowen cypress)

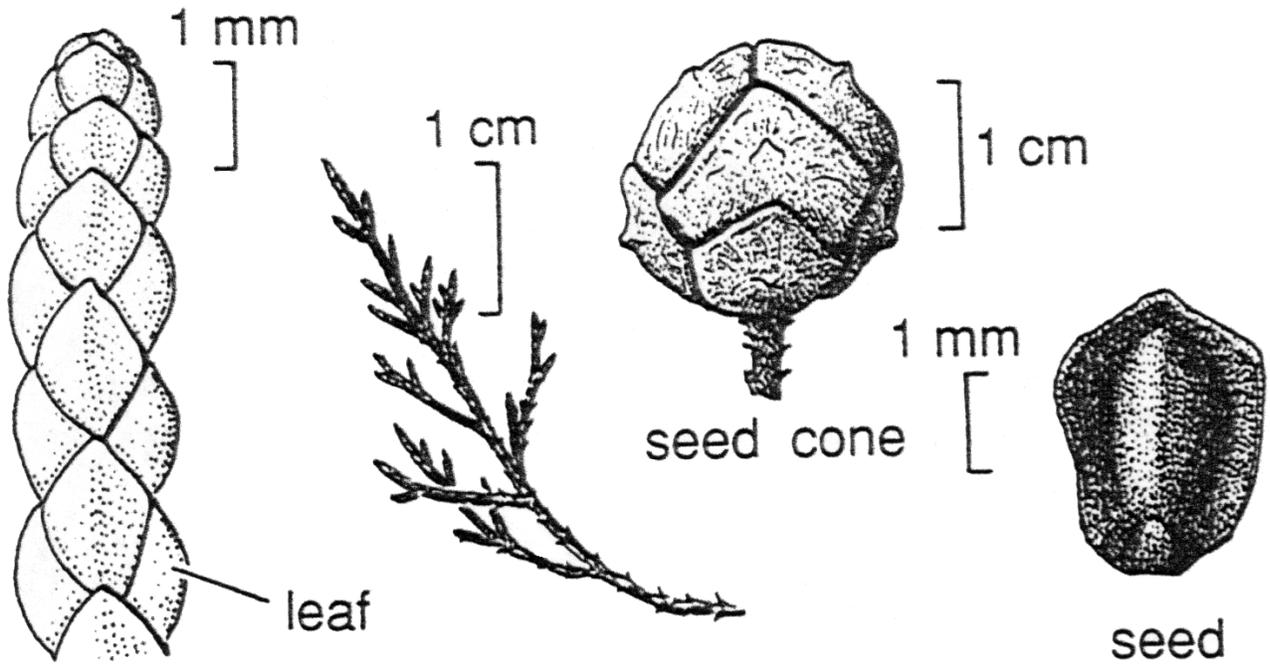
Recovery Priority Number = 9C

1. Taxonomy and Description

Cupressus goveniana ssp. *govoniana* (Figure 7) and its close relative *C. goveniana* ssp. *pigmaea* (Mendocino cypress) were historically distributed along the coast from Mendocino County to the mountains of San Diego County and were discovered in 1846 by Karl Theodor Hartweg. *Cupressus goveniana* ssp. *govoniana* was named “Gowen cypress” to commemorate the services to horticulture of James Robert Gowen (Sargent 1896).

Cupressus goveniana ssp. *govoniana* is a small coniferous tree in the cypress family (Cupressaceae). It generally reaches a height between 5 and 7 meters (17 to 23 feet) (Munz and Keck 1959), though Griffin noted one individual that was 10 meters (33 feet) high at Huckleberry Hill (Griffin and Critchfield 1976). The sparsely branched tree forms a short, broad crown with a spread of 2 to 4 meters (7 to 13 feet). The bark is brown to gray in color and is generally smooth, although it becomes rough and fibrous on old trees. The scale-like foliage is a light rich green, with leaves 1 to 2 millimeters long (0.04 to 0.08 inch). The female cones are subglobose, 10 to 15 millimeters (0.4 to 0.6 in) long, and produce 90 to 110 dark brown to black seeds (Wolf and Wagener 1948, Bartel 1993). *C. goveniana* ssp. *govoniana* is distinguished from its close relative *C. goveniana* ssp. *pigmaea* (pygmy or Mendocino cypress) by its much taller stature, the lack of a long, whip-like terminal shoot, and light to yellow-green rather than dark dull green foliage (Bartel 1993)

Figure 7. Illustration of *Cupressus goveniana* ssp. *goveniana* (Gowen cypress).
Reprinted from The Jepson Manual, J. Hickman, Ed., 1993, with permission from
the Jepson Herbarium. © Regents of the University of California.



2. Distribution

Only two natural stands of *Cupressus goveniana* ssp. *goveniana* are known, although individuals can be found locally in cultivation. No historical distribution beyond these two sites is known. One population is on Huckleberry Hill on the western side of the Monterey Peninsula (Del Monte Forest stand), and another is approximately 10 kilometers (6 miles) to the south of Huckleberry Hill on the north side of Gibson Creek and inland of the Point Lobos Peninsula (Point Lobos stand). Both stands are on protected lands designated as permanent open space for preservation of native habitat. Scattered groups of trees (due to fragmentation by golf courses and development) that radiate out from the Del Monte Forest stand are on Pebble Beach Company lands within recently proposed residential and recreational developments (T. Grove *in litt.* 2000).

The largest stand, the Del Monte Forest stand, covers approximately 40 hectares (100 acres), with individuals scattered within 1 kilometer (0.6 mile) of the main stand. The stand is on lands owned by the Pebble Beach Company and the Del Monte Forest Foundation. A large portion of the Del Monte Forest stand is within a 34-hectare (84-acre) area designated as the Samuel F.B. Morse Botanical Reserve in the 1960's and donated to the Del Monte Forest Foundation in 1976. Patches of crowded, poorly developed individuals were cut for posts in the past, making it difficult to determine the original extent of the grove (Wolf and Wagener 1948).

The second, smaller stand of *Cupressus goveniana* ssp. *goveniana* (the Point Lobos stand), occurs on a 60-hectare (150-acre) parcel acquired by the California Department of Parks and Recreation (Point Lobos State Reserve) in 1962. This stand is approximately 16 to 32 hectares (40 to 80 acres) in size. The very western edge of the stand is on lands purchased by the Big Sur Land Trust from a private owner. In the Point Lobos stand, *C. goveniana* ssp. *goveniana* is associated with *Pinus radiata* and chaparral species (Griffin and Critchfield 1976, Vogl *et al.* 1988).

3. Habitat Requirements

Cupressus goveniana ssp. *goveniana* occurs in mixed conifer forest and maritime chaparral habitats. Within the chaparral habitat, *C. goveniana* ssp. *goveniana* grows in a dense, dwarf or pygmy forest. Pygmy forest habitat is made up of stunted *Pinus radiata* and chaparral shrubs such as *Arctostaphylos tomentosa*, *Vaccinium ovatum*, and *Arctostaphylos hookeri* (Jones and Stokes Associates 1996). *C. goveniana* ssp. *goveniana* can also occur alone, in a mixed stand with *P. muricata*, or as scattered individuals within *P. muricata* stands. At the Point Lobos stand, individuals grow within Monterey pine forest and scattered among maritime chaparral species, including *A. tomentosa*, *A. hookeri*, and *Adenostoma fasciculatum*. It survives best in full sunlight on bare mineral soils with no plant cover or litter, with reproduction generally restricted to burned areas (Vogl *et al.* 1988).

Soil types vary between the two occurrences of *Cupressus goveniana* ssp. *goveniana*. Within the pygmy forest on the Monterey Peninsula, *C. goveniana* ssp. *goveniana* occurs where claypan or hardpan soils are shallow, acidic, strongly leached, and poorly drained (Griffin and Critchfield 1976, Jones and Stokes Associates 1996). The Point Lobos stand occurs on Cieneba soils on the inland granitic bedrock geologic formation (Jones and Stokes Associates 1996). While *C. goveniana* ssp. *goveniana* can grow in a variety of habitats with minor disturbances, it apparently requires mineral soil surfaces and unshaded conditions for successful recruitment (Doak *et al.* 2000).

Cupressus goveniana ssp. *goveniana* is a fire-adapted species. Cones release seeds upon stimulation from heat; in addition, cones open with age (Doak *et al.* 2000). Studies during 1998 and 1999 indicate that the important role of fire is to remove vegetation to bare mineral soil, which will allow light to penetrate the area and allow for seedling establishment (Doak *et al.* 2000). Prior to these studies, researchers believed that fire cues (such as heat, smoke, or ash leachate) were required for *C. goveniana* ssp. *goveniana* germination and recruitment. At least three fires have burned portions of the Del Monte Forest stand in the last 100 years. A large fire burned most of the stand in 1901 (Coleman 1905, Dunning 1916 as cited in Vogl *et al.* 1988), the northern portion of the stand apparently

burned in 1959 (California Natural Diversity Data Base 1997c), and the most recent fire burned the south central portion of the population in 1987. In each case, regeneration of *C. goveniana* ssp. *govoniana* has occurred.

4. Life History/Ecology

Like other closed-cone cypresses, *Cupressus goveniana* ssp. *govoniana* is a fire adapted species. It possesses cones that remain sealed and attached to the trees following the second season when seeds are mature. Seeds can be dispersed upon mechanical removal from the tree, death of the tree or supporting branch, or when heat from fires breaks the cones' resinous seal and allows seeds to escape. *C. goveniana* ssp. *govoniana* is also wind pollinated. Natural seed dispersal occurs during September and October, although the seeds are not light enough to be carried far from the parent plant (Sudworth 1967 as cited in Jones and Stokes Associates 1996). Following a fire, regeneration is generally rapid and prolific. Light and bare mineral soils are also needed by *C. goveniana* ssp. *govoniana* for seedling establishment; in areas with herbaceous cover, seedling mortality is higher due to fungal infections (Vogl *et al.* 1988).

Recent studies were conducted to examine the species range, recruitment patterns, and age structure of trees (Doak *et al.* 2000). No pattern of distribution was clearly obtained, and age estimates were difficult to obtain for the following reasons: 1) *Cupressus goveniana* ssp. *govoniana* grows slowly when trees are in close proximity to each other and are growing on poor soils, making it difficult to resolve individual ring boundaries; and 2) a number of trees at the Gibson Creek site displayed two separate ring boundaries within a calendar year, which is possibly a result of early growth during warm winters followed by the regular, expected growth of wood during spring (Doak *et al.* 2000).

5. Reason for Listing

Cupressus goveniana ssp. *govoniana* was listed as threatened on August 12, 1998 (63 FR 43100). It is not listed as threatened or endangered under the California Endangered Species Act. The California Native Plant Society considers this

species to be rare and endangered in California (List 1B) (Skinner and Pavlik 1994).

Despite measures taken to protect the stand of *Cupressus goveniana* ssp. *goveniana* at the Del Monte Forest, such as establishing the Samuel F.B. Morse Reserve, the opportunities for maintaining a viable long-term population of this taxon may be compromised by the site's close proximity to urbanization. A portion of the Del Monte forest stand (approximately 840 trees) was removed during the early 1980's for construction of the Poppy Hills Golf Course (60 FR 39326). Although the lands on which the majority of the remaining *C. goveniana* ssp. *goveniana* trees grow will not be developed, the residential development (including the most recent initiative for the Pebble Beach Lot Program development) that is occurring on all sides of the stand reduces the opportunity for the continuation of ecosystem processes that are needed for stand regeneration. This species is threatened by habitat alteration due to the influence of continued urban development in Pebble Beach, and to the disruption of natural fire cycles that is likely to result from fire suppression activities. However, recent research indicates that management that mimics some effects of fire should allow for regeneration. Future maintenance or expansion of existing fire roads within the Del Monte Forest stand could also reduce the current *C. goveniana* ssp. *goveniana* population. Due to the physical inaccessibility of the Point Lobos stand and the Reserve's mandate to protect sensitive plant taxa, the Point Lobos stand is less affected by human disturbance than the Del Monte Forest stand.

In addition, stands of *Cupressus goveniana* ssp. *goveniana* at both locations have been invaded by aggressive nonnative species, including *Cortaderia jubata* (pampas grass), *Genista monspessulana* (French broom), and *Erechtites* sp. (fireweed) (Forest Maintenance Standard 1990; K. Gray, California Department of Parks and Recreation, pers. comm. 1997). An increase in such invasive nonnative plants will undoubtedly alter the composition of the plant community and may adversely affect *C. goveniana* ssp. *goveniana* regeneration.

6. Conservation Measures

Both occurrences of *Cupressus goveniana* ssp. *govoniana* are located on protected sites, although some of the Del Monte Forest stand occurs on private property owned by the Pebble Beach Company. The Point Lobos stand has been acquired by the Point Lobos State Reserve. The majority of the Del Monte Forest stand is on lands owned by the Pebble Beach Company that are designated as “forested open space” in the Huckleberry Hill Open Space area, through a conservation easement held by the Del Monte Forest Foundation. The purpose of the Del Monte Forest Foundation, originally established as the Del Monte Foundation in 1961 by the Pebble Beach Company, is to "acquire, accept, maintain, and manage lands in the Del Monte Forest which are dedicated to open space and greenbelt" (Penick *in litt.* 1992). The most recent initiative proposed for development by the Pebble Beach Company appears to affect a smaller portion of the *C. goveniana* ssp. *govoniana* population at Del Monte Forest than was previously proposed for development in the Lot Program (T. Grove *in litt.* 2000).

H. Recovery Strategy

The taxa addressed in this recovery plan are restricted both geographically and by the amount of available habitat within their ranges. The distribution of *Piperia yadonii*, *Potentilla hickmanii*, *Trifolium trichocalyx*, and *Cupressus goveniana* ssp. *govoniana* are overlapping, while *Astragalus tener* var. *titi* occurs within 30 meters (98 feet) of the ocean surf zone. Recovery efforts should be focused on conserving Monterey pine forest and maritime chaparral habitat, open meadow communities that occur within and around Monterey pine forests, and coastal dune habitat exposed to ocean sprays and periodic saturation. The priorities for achieving recovery are as follows:

1. Secure and protect existing species populations and habitats that occur on private or unprotected lands.

Astragalus tener var. *titi* and *Trifolium trichocalyx* plants currently exist within unsecured habitat on Pebble Beach Company property. In addition, over 50 percent of the *Piperia yadonii* population is found on land owned by the Pebble Beach Company, and one of two locations where *Cupressus goveniana* ssp.

goveniana is found occurs on Pebble Beach Company property (part of which is protected by a conservation easement between the Pebble Beach Company and the Del Monte Forest Foundation). The San Mateo County population of *Potentilla hickmanii* is also located on private land. A strong relationship needs to be formed between agencies and these landowners (in addition to any other private landowners) in order to ensure that the habitat is secured and protected for all five listed species.

Protection of habitat can be achieved through several means. Because the primary threat to these taxa is loss of habitat resulting from residential and recreational development, these activities should be curtailed or reduced significantly in appropriate habitat areas, or relocated to reduce current threats. Agencies such as the California Coastal Commission, the County of Monterey, and the County of San Mateo should use their authorities, including the use of conservation easements and other tools, to ensure that future development does not affect habitat for these taxa.

In addition to regulating future activities, all interested parties, including the U.S. Fish and Wildlife Service, California Department of Fish and Game, the California Department of Parks and Recreation, the Counties of Monterey, San Mateo, Sonoma, Los Angeles and San Diego, the Cities of Monterey and Pacific Grove, the Pebble Beach Company, and other nongovernmental organizations such as the California Native Plant Society, Big Sur Land Trust, should work together to acquire high priority parcels to add to current conservation areas.

2. Manage private and secured lands to control or eliminate threats to existing populations and their habitat.

Because the status of these species (in particular *Astragalus tener* var. *titi*, *Potentilla hickmanii*, and *Trifolium trichocalyx*) are so critical, the immediate objective is to prevent extinction. Populations and their habitats on both private and protected lands should be managed to ensure that the ecosystem processes vital to the long-term survival of the taxa are maintained. This management includes eliminating any threats that are directly or indirectly affecting each of the species to such a degree that successful reproduction and seedling survival are impaired. Management plans should be developed for specific sites that identify

the most appropriate activities for maintaining ecosystem functioning. These activities include controlled burning, control of nonnative plants, control of herbivory, and control of residential and recreational activities that would cause soil erosion and adverse effects from herbicide or pesticide runoff.

3. Develop management strategies based on research on the species life histories and the species responses to vegetation management.

Additional research on the subject taxa will contribute to a greater understanding of what individual taxa require for long-term survival. Research will also contribute to the development and revision of more appropriate management goals. Working groups should be established to collaborate with affected landowners and interested parties to develop specific guidelines that will aid in effective management.

4. Determine other potentially suitable habitat areas that should be surveyed for additional populations, or that can be used for reestablishment or reintroduction of populations.

Should additional populations of the plant taxa in this recovery plan be located as a result of future surveys, these populations should be evaluated to assess appropriate conservation measures. Other potentially suitable habitat areas in the range of these species should be identified and considered for establishment of new populations. Reestablishment should be considered throughout the range of the plant taxa even at sites where no historical occurrences have been documented. Such reestablishment could occur when habitat conditions are suitable, similar site factors exist, and no other potentially suitable habitat is available. Clear protocols and success criteria should be established for new, reestablished, or reintroduced populations.

5. Use monitoring, research results, and assessment of potential threats to determine effectiveness of management actions.

Conducting regular monitoring of each of the plant taxa will be necessary for long-term management to be effective in conservation of the five plant taxa. Monitoring the populations will reveal trends in population dynamics, and allow for evaluation of the effects of management actions that call for a reduction of competition from nonnative plants and herbivory on selected species.

6. Coordinate recovery actions with other listed species or species of concern.

By taking an ecosystem approach to habitat protection for the five listed species, other listed species could benefit from various conservation management actions implemented as part of this recovery plan.

7. Develop and implement an education and outreach program.

Development and implementation of an educational program will increase the awareness of critical needs and management strategies that the public could participate in to aid in conservation of these plant taxa. Private groups and lead agencies involved with the recovery effort should be approached about participating in this program. Benefits include protection of the listed plant species and their habitats, maintenance of the native biological communities, and local landowner participation and support in multiple aspects of these plants long-term recovery.

8. Reevaluate recovery criteria and revise recovery plan based on knowledge obtained from research, monitoring, and management.

Based on the effectiveness of the efforts to preserve and manage habitat, and the information resulting from research, recovery criteria for each of the taxa should be revised in the future, as necessary.

II. RECOVERY

A. Objectives and Criteria

This section of the recovery plan outlines the management actions and research needed to protect all five listed taxa addressed in this recovery plan. The objective of the recovery plan is to minimize the threats to the species and their habitats, with the primary goal of removing them from the list of threatened and endangered species.

Reclassification to threatened status for *Astragalus tener* var. *titi*, *Potentilla hickmanii*, *Piperia yadonii*, and *Trifolium trichocalyx* can occur before delisting. Downlisting to threatened status can be considered if habitat currently occupied by these species has been secured, and if management measures are implemented, populations are monitored, and an adequate reduction in threats has been documented. The recovery actions for each of the five species are outlined in the stepdown narrative immediately following the objectives listed below. Appendix B links recovery criteria to the five listing factors and the recovery tasks.

1. *Astragalus tener* var. *titi*

The status of this species is so critical at this point that the immediate objective is to prevent extinction. Further losses of existing plants and the species' habitat should be prevented, and threats to its survival should be eliminated. Recovery criteria will be revised and delisting criteria will be developed after management is underway and specific data become available relating to population viability, effects of altered drainage, effects of exotic species, and roles of competitor plants.

Downlisting for *Astragalus tener* var. *titi* can be considered when the following have been achieved:

- a) At least five viable populations (including at least two in San Diego or Los Angeles County) occur on habitat with suitable conditions (*e.g.* few to no nonnative competitors, no threats from trampling, etc.) that allow for movement and expansion of the populations throughout its range.

- b) All five of the populations are on land that is permanently protected. Funds must be available for appropriate long-term management. Protected habitat must be of adequate size and configuration to ensure that ecosystem and community processes and associated species (*e.g.*, hydrologic regime, food webs, pollinator fauna, coastal dune community associates) are maintained, and an adequate diversity of sites exists for population expansion and for colonization of new areas as microhabitat conditions change.
- c) Site selection, restoration, and plant reintroduction has been initiated in at least two historical localities in Los Angeles or San Diego Counties. These two reintroduced populations will be considered as part of the five populations of plants described in 1(a) and 1(b) above.
- d) The populations of plants are being adequately maintained, such that encroachment by nonnative plants, excessive herbivory, fire prevention activities, or other threats are not negatively affecting *Astragalus tener* var. *titi* directly or indirectly.
- e) The 17-Mile Drive population and additional populations have been appropriately managed such that monitoring has determined that these populations are stable or increasing.
- f) A seed bank has been established at a recognized institution and has been certified by the Center for Plant Conservation.

2. *Piperia yadonii*

The current recovery objective for *Piperia yadonii* is reclassification to threatened status. Further losses of existing plants and the species' habitat should be prevented, and threats to its survival should be eliminated. Recovery criteria will be revised and delisting criteria will be developed after management is underway and specific data become available relating to population characteristics, inbreeding depression, and fragmentation effects.

Downlisting for *Piperia yadonii* can be considered when the following have been achieved:

- a) Preserves are established that encompass and protect six metapopulations, composed of multiple colonies of *Piperia yadonii* in each of the two community types in which this species occurs: Monterey pine forest and

maritime chaparral. Protected habitat must be of adequate size and configuration to ensure that: ecosystem and community processes and associated species (*e.g.*, hydrologic regime, food webs, pollinator fauna, Monterey pine forest and maritime chaparral community associates) are maintained; gene flow between the colonies, either through wind-dispersed seed or animal-mediated pollen exchange, can occur unimpeded; and an adequate diversity of sites exists for population expansion and for colonization of new areas as microhabitat conditions change. Preserves should encompass colonies throughout the geographic range of the species, as well as the range of habitat variation in which the species occurs to ensure that genetic diversity is maintained. Preserves should be of adequate acreage and diversity to ensure that the *P. yadonii* metapopulations can persist through the extremes of environmental conditions they are likely to encounter (*e.g.*, extended drought, wildfire). They should also include long-term availability of funding for appropriate maintenance.

- b) These protected areas are being adequately maintained, such that encroachment by nonnative plants, excessive herbivory, fire prevention activities, or other threats are not negatively affecting *Piperia yadonii* directly or indirectly.
- c) Monitoring has determined that the colonies are of adequate size, density, and number that the trend for the metapopulation is projected to be stable or increasing in the future. Because this species is a perennial that exhibits dormancy and spends an undetermined period underground between seed germination and emergence of first leaf above-ground, it is likely that at least 10 to 15 years of monitoring will be needed to define a population trend.

3. *Potentilla hickmanii*

The status of this species is so critical that the immediate objective is to prevent extinction. Further losses of existing plants and the species' habitat should be prevented, and threats to its survival should be eliminated. Recovery criteria will be revised and delisting criteria will be developed after management is underway

and specific data become available relating to population viability, greenhouse techniques for increasing seed supplies, techniques for enhancing survival and reproduction, limits of seed dispersal, and pollinator limitations.

Downlisting for *Potentilla hickmanii* can be considered when the following have been achieved:

- a) At least five viable populations occur in suitable habitat.
- b) All five of the sites are on land that is protected from human-induced disturbance. Funds must be available for appropriate long-term management. Protected habitat must be of adequate size and configuration to ensure that ecosystem and community processes and associated species (*e.g.*, hydrologic regime, food webs, pollinator fauna, forest meadow communities) are maintained, and that an adequate diversity of sites exists for population expansion and for colonization of new areas as microhabitat conditions change. One of these protected sites should be the Montara population in San Mateo County.
- c) Surrounding vegetation has been managed for a reduction of nonnative plant species and nonnative snails and slugs. The populations should be adequately maintained, such that encroachments by nonnative plants and herbivorous predators (including deer) are not negatively affecting *Potentilla hickmanii* directly or indirectly.
- d) The populations have been appropriately managed to such a degree that monitoring has determined that the populations are of adequate size, density, and number that the trend for each of the populations is projected to be stable or increasing in the future.
- e) A seed bank has been established at a recognized institution that is certified by the Center for Plant Conservation.

4. *Trifolium trichocalyx*

The status of this species is so critical at this point that the immediate objective is to prevent extinction. Further losses of existing plants and its habitat should be prevented, and threats to its survival should be eliminated. Recovery criteria will be revised and delisting criteria will be developed after management is underway and specific data become available relating to presence of seed banks, germination, recruitment, and prescribed burn strategies.

Downlisting for *Trifolium trichocalyx* can be considered when the following have been achieved:

- a) At least five viable populations (one of which is the Huckleberry Hill population) occur in suitable habitat.
- b) All five of the sites are on land that is protected from human-induced disturbance (*i.e.* development, recreation) that would negatively affect growth or reproduction of the plants. Funds must be available for appropriate long-term management. Protected habitat must be of adequate size and configuration to ensure that ecosystem and community processes and associated species (*e.g.*, hydrologic regime, fire, food webs, pollinator fauna, Monterey pine forest communities) are maintained, and that an adequate diversity of sites exist for population expansion and for colonization of new areas as microhabitat conditions change.
- c) The Huckleberry Hill population and four additional viable populations (as described in (a) above) have been managed so as to allow regeneration of plants and replenishment of the seed bank found in the soil within the protected habitat.
- d) A seed bank has been established at a recognized institution certified by the Center for Plant Conservation.

5. *Cupressus goveniana* ssp. *goveniana*

The recovery objective for *Cupressus goveniana* ssp. *goveniana* is for the populations to recover sufficiently to warrant removing this species from the list of threatened and endangered species. Further losses of existing trees and its habitat should be prevented, and threats to its survival should be eliminated, otherwise reclassification to endangered status may be warranted. Even though two stands are managed for and protected, trees lying on the fringe of these sites are not protected. It is still possible for random naturally occurring events to extirpate this species. Delisting for *C. goveniana* ssp. *goveniana* can be considered when the following have been achieved:

- a) Monitoring of the Del Monte Forest population and the Point Lobos population for at least 10 years shows long-term reproductive success in both populations. The populations must be of adequate size to ensure that ecosystem and community processes and associated species (*e.g.*, hydrologic regime, fire, food webs, pollinator fauna, Monterey pine forest

communities) are maintained, and that the locations are adequate to provide for population expansion and for colonization of new areas as microhabitat conditions change.

- b) At least 10 years of monitoring have determined that successful recruitment has caused an increase in overall size of both populations.
- c) A prescribed burn plan is established to improve surrounding habitat to reduce high vegetative cover and promote recruitment, or research has documented an alternative method to burning that is successful in promoting reproduction. Appropriate management to improve the surrounding habitat would need to be successfully implemented. Funds must be available for appropriate long-term management.
- d) A seed bank is established at a recognized institution that is certified by the Center for Plant Conservation. The seed bank is needed for protection of the species in case of an unforeseen naturally occurring event that would create a lack of reproduction or die-off from disease.

B. Narrative Outline

1. Secure and protect existing species habitats that occur on private or unprotected lands.

The listed species addressed in this recovery plan should be secured and protected where they occur on private lands through mechanisms such as acquisition of property, acquisition of property rights or fee title purchase (*i.e.* development rights or timber harvest rights), open space and conservation easements, and conservation agreements. This protection is necessary to prevent further declines in distribution and abundance of the listed species from loss and degradation of habitat.

1.1 Inform landowners

Affected private landowners should be informed of efforts to recover the species, invited to participate in recovery efforts, and be asked to prevent inadvertent or intentional destruction of habitat. Affected private landowners include:

- a) *Astragalus tener* var. *titi*: Pebble Beach Company and Monterey Peninsula Country Club Golf Course Equestrian Center.
- b) *Potentilla hickmanii*: Pebble Beach Company, unknown landowner in San Mateo County.
- c) *Piperia yadonii*: Pebble Beach Company, First United Methodist Church in Pacific Grove, and numerous other private landowners.
- d) *Trifolium trichocalyx*: Pebble Beach Company.
- e) *Cupressus goveniana* ssp. *goveniana*: Pebble Beach Company; private land owners.

1.2 Consult and coordinate with agencies involved with recovery activities.

The Monterey County Planning Department should be consulted regarding conservation opportunities for easements and acquisition opportunities, and to determine if there are existing easements. The planning department should be made aware of the need to appropriately use and manage land to preserve and manage these plants and their habitat. Agencies involved with recovery activities include the U.S. Fish and Wildlife Service, California Department of Fish and Game, California Department of Parks and Recreation, Monterey County, San Mateo County, The Nature Conservancy, the California Coastal Conservancy, California Native Plant Society, university and research departments, botanic gardens and herbaria, property owners, and other individuals knowledgeable about the species and their habitats. Existing plans, data, and information pertinent to the recovery of these five species must be synthesized and shared effectively by promoting information exchange and discussion between all agencies, groups or individuals. Support from local lead agencies for the protection of habitat for these five species is essential for their recovery. The U.S. Fish and Wildlife Service and California Department of Fish and Game should review development proposals and comment on the adequacy of the protective measures for the species.

1.3 Establish protection agreements and secure habitat sites with permission of the landowners.

Lead Agencies can solicit private landowner participation and support for recovery, establish open space or conservation easements by the property owner, establish permanent resource management easements, or acquire lands through fee acquisition from willing sellers.

1.3.1 Land Acquisition or Fee Title Ownership

Land purchase could be made through an existing land trust, such as Big Sur Land Trust, the Del Monte Forest Foundation, The Nature Conservancy, or Trust for Public Land. Fee title ownership includes obtaining all property rights. This acquisition can be accomplished by fee simple purchase, dedication, complete donation, exchange, or transfer from one agency to another. This method of land preservation provides complete control over land use and avoids potential problems associated with partial ownership or rights to access, water, or minerals. The disadvantage to fee title ownership is that it is the most expensive form of property ownership.

1.3.2 Open Space and Conservation Easements

Open space and conservation easements provide a method to acquire specific property rights needed to conserve biological values, and physical or scenic characteristics of the land, while offering the landowner the economic incentive of reduced property taxes. The State, cities, counties, or nonprofit organizations whose primary purpose is to preserve and protect land in its natural condition may accept easements. The advantage to easements is that in many circumstances, the landowner can continue to use lands in the ways they were used prior to the easement.

1.4 Secure and protect existing primary sites on unprotected lands

Pebble Beach Company property supports the large concentrations of these five listed plant species, although populations of *Piperia yadonii*, *Potentilla hickmanii*, and *Cupressus goveniana* ssp. *goveniana* occur on lands owned by other agencies or private landowners. To promote recovery of these species, protected habitat for the plants should be contiguous, with low perimeter-to-

area ratios, to minimize the effects of surrounding land use practices that could potentially be detrimental to the taxa, such as invasion by nonnative plants used for landscaping, pesticide use, or excessive irrigation. Managing lands that are secured from development and recreation will be difficult due to the high density urban development that currently exists within and around many of the current plant populations.

1.4.1 Protect habitat for *Astragalus tener* var. *titi*

Currently only one naturally occurring population exists. This population is on the Pebble Beach Company property (west side of 17-Mile Drive) and the Monterey Peninsula Country Club Golf Course Equestrian Center property (east side of 17-Mile Drive). The fenced enclosure, measuring approximately 930 square meters (10,000 square feet), was established by the Pebble Beach Company on the west side of 17-Mile Drive to protect *Astragalus tener* var. *titi*. This enclosure may need to be removed or some sort of minor ground disturbance may need to be applied to help reduce competing vegetation and aid in producing flowering plants. A possible association between *A. tener* var. *titi* and light disturbance was observed during 1999 and 2000, based on low-level disturbance from gopher activity and light pedestrian traffic (Doak *et al.* 2000). These studies found that flowering plants were only observed outside of the enclosure on a recently disturbed vegetation island northwest of the enclosure and on rocky areas to the east of 17-Mile Drive. Experimental studies should be implemented and monitored to better understand if this minimal disturbance supports flowering individuals. If so, then erection of low fencing that would discourage vehicular traffic and allow for minimal foot traffic should be established in place of the fenced enclosure along existing coastal access roads, and along pedestrian/equestrian trails.

The populations of *Astragalus tener* var. *titi* that occur on the east side of 17-Mile Drive need to be protected from various land use practices, such as road construction and maintenance activities (including weed whacking), parking lot activity, golfing, and horseback riding.

1.4.2 Protect habitat for *Piperia yadonii*

A number of *Piperia yadonii* populations are secured from development (approximately 17 percent of total known plants), however, many populations have land-use designations that do not provide protection from development (approximately 83 percent of total known plants). In securing lands from development, populations should be protected within Monterey pine forest and pygmy forest with an open canopy and grassy understory, in addition to protection of maritime chaparral habitats, focusing on large tracts that maintain ecosystem processes and function. The current proposed initiative submitted by the Pebble Beach Company for the Del Monte Forest Area Land Use Plan calls for rezoning for development of largely forested land in the Spanish Bay, Spyglass/Cypress, Gowen Cypress, Middle Fork, Spyglass/Pebble Beach, and Pescadero planning areas. The Pebble Beach Company is aware that these areas include *P. yadonii*.

Many of the unprotected *Piperia yadonii* populations exist in areas with native vegetation, which already harbors native soil with fungal spores that are needed for its survival. Consideration should be given to spring sources for proper soil drainage, appropriate habitat for pollinators, and surrounding land use practices that could potentially allow for *P. yadonii* expansion. Large populations should be chosen that are close enough to one another so that pollinators can affect gene flow to reduce potential inbreeding depression, and to maximize the potential for outcrossing through pollen transfer within and between populations (Doak and Graff 2001).

1.4.3 Protect Habitat for *Potentilla hickmanii*

The Montara population of *Potentilla hickmanii* encompasses a small area composed of two slopes south of Martini Creek in San Mateo County. The possibility of acquiring this site or permanently protecting it by entering into a conservation easement should be pursued.

The Monterey Peninsula population is mostly encompassed within an enclosure that is approximately 104 square meters (1,117 square feet), with 18 individually caged plants recently documented outside the northeast end of the enclosure. The Pebble Beach Company is aware of the existence of *Potentilla hickmanii* on their property. Protection of the entire stretch of habitat that is necessary for this species' survival is recommended. This protection would require relocation of several recreational activities currently in place adjacent to the enclosure, including horseshoe pits, volleyball/badminton courts, and equestrian horse tie posts. The entire meadow opening and the surrounding areas should be protected to ensure that ecosystem and community processes are maintained.

1.4.4 Protect habitat for *Trifolium trichocalyx*

The only known population of *Trifolium trichocalyx* exists at Huckleberry Hill and surrounding area; a portion of these lands are protected by the Del Monte Forest Foundation. However, there is currently no active management for this species. A seedbank is also likely to occur in the soil between Haul Road and Costanilla Way where *T. trichocalyx* was last seen in 1988. No protection is provided for this area. The owner of the property, the Pebble Beach Company, is aware of this species on their property. The current proposed initiative under consideration for the Del Monte Forest Area Land Use Plan calls for rezoning 19 hectares (48 acres) from residential to open space forest at the Huckleberry Hill planning area, which harbors a portion of the seedbank area where *T. trichocalyx* is expected to occur.

1.4.5 Protect habitat for *Cupressus goveniana* ssp. *goveniana*

Both stands of *Cupressus goveniana* ssp. *goveniana* occur on protected lands designated as open space for species preservation, although scattered groups of trees that radiate out from the Del Monte Forest stand are located on unprotected property owned by the Pebble Beach Company. The current proposed initiative for the Del Monte Forest Area Land Use Plan calls for rezoning 19 hectares (47 acres) of largely forested land in the *C. goveniana* ssp. *goveniana* planning area

of Pebble Beach Company property, establishing 86 potential residential development units.

Habitat considered for purchase and protection should include lands that are not directly surrounded by residential property, allowing for management and expansion of populations of *C. goveniana* ssp. *goveniana*.

2. Manage private and secured lands to control or eliminate threats to existing populations and their habitats.

Habitat destruction due to development and recreational activities is the highest threat affecting each of these taxa. Collaboration among landowners, affected agencies, and the recovery working group will be necessary to share important information on effective methods to control threats. Management of the private and secured lands should include not only the plants, but also an adequate amount of surrounding habitat to ensure the continued functioning of ecosystem processes and critical species interactions. The community of which these species are a part needs to be adequately maintained.

2.1 Eliminate or minimize threats on private and secured lands

Threats identified to date are addressed below. Any additional threats should be addressed as focused research is conducted, or as additional populations are discovered, reintroduced, or established. As new threats become apparent, management actions should be implemented to reduce or eliminate their effects on the listed species.

2.1.1 Minimize threats to *Astragalus tener* var. *titi*

Threats identified to date for *Astragalus tener* var. *titi* include encroachment and competition from nonnative *Carex pansa*, *Carpobrotus edulis*, and *Plantago coronopus*; exposure to and destructions from roadside maintenance activities; and trampling caused by recreational activities such as golfing, horseback riding, and dog-walking. Once this population is secured, the plants should be managed to prevent further loss of individuals, and for prevention of habitat disturbance and degradation.

Controlling *Carex pansa*, *Carpobrotus edulis*, and *Plantago coronopus* by use of hand pulling should be conducted within the enclosure, surrounding the enclosure, and on habitat that lies on the east side of 17-Mile Drive in both existing habitat and all suitable habitat that remains. Control efforts should be prioritized, with consideration given to the aggressiveness of the invader, its potential to alter the composition of the native community, and future plans for the site. Nonnative plant control should be conducted regularly as part of the Pebble Beach Company's ongoing maintenance program for weed control actions on their property.

The threat from ongoing roadside maintenance activities (*i.e.* weed removal from mowing or weed whacking, fire control for fire prevention) should be discussed with the Pebble Beach Company, the local fire department, the California Division of Forestry, and roadside maintenance crews to investigate alternative methods that would achieve their goals and requirements for trail maintenance, roadside maintenance, and safety hazards. The County should designate the area of County road right-of-ways where *Astragalus tener* var. *titi* grows as an environmentally sensitive area. Road maintenance workers should be informed of the occurrence of *A. tener* var. *titi* in this area and directed to avoid it. In addition, the current roadside drainage system is likely causing negative impacts to existing habitat by increasing the rate of water drainage off the habitat area. Future modifications to the current hydrologic system will likely cause adverse effects to this habitat by increasing ponding of runoff.

Preliminary research suggests a small amount of ground disturbance may be advantageous to this plant's survival, possibly by opening up germination sites, reducing competition from nonnatives, or other mechanisms. High levels of ground disturbance caused by horseback riding and golfing activities are likely to continue adverse effects on *Astragalus tener* var. *titi* so that successful reproduction will likely not occur. Any increase in trail use may result in loss of plants and habitat. The running of horses that currently takes place on the trails

that border or enter existing *A. tener* var. *titi* habitat should be discouraged. A meeting with the Monterey Peninsula Country Club Golf Course Equestrian Center should take place to discuss development of a timing schedule for various equestrian activities, including the timing of the Los Altos Hunt. As mentioned in section 1.4.1, erection of low fencing should be established that would discourage vehicular or equestrian traffic along the trails or coastal access roads, while allowing a light amount of pedestrian traffic to continue within suitable habitat.

2.1.2 Minimize threats to *Piperia yadonii*

Threats identified to date for *Piperia yadonii* include urban, residential, and golf course development, browsing by deer and rabbits, competition from nonnative plants (*Genista monspessulana* and *Cortaderia jubata*), roadside maintenance to control weeds, closed-canopy forests due to fire suppression, a potential roadway circulation improvement project at the Monterey Peninsula Airport, and expansion of the proposed realignment of U.S. Route 101 near Prunedale (60 FR 39326).

Urban, residential, and golf course development on the Monterey Peninsula is of immediate threat to this species. In particular, the Pebble Beach Company's Pescadero tract and the area just north of the Pebble Beach Equestrian Center harbors such a high percentage of existing plants (54 percent of the known individuals, according to Jones and Stokes Associates [1996]) that these populations should be protected from development. These sites could serve as valuable locations that would ensure the long-term viability of this species. Many other sites on private property are difficult to manage due to fragmentation and bordering residential and recreational practices that make long-term management and recovery on the sites extremely difficult. Continued loss of plants and further fragmentation of the populations should be avoided if these sites are to be developed.

Browsing of *Piperia yadonii* by deer and rabbits has been extremely detrimental at some locations, especially in parts of Pebble Beach and Pacific Grove. Researchers have documented that few to no plants have successfully produced mature seed capsules at these locations during one or more surveys (V. Yadon *in litt.* 1997, Doak and Graff 2001). A number of plants in areas where herbivory and browsing has been documented should be caged so that flowering, seed production, and dispersal can occur. Without cages, herbivores can reduce successful flowering to less than 5 percent (Allen 1996). Consideration should also be given to reducing the high population levels of deer on the Monterey Peninsula.

Genista monspessulana and *Cortaderia jubata* are the nonnative weedy species that are currently posing a high threat to *Piperia yadonii* through competition. If herbicides are used to control these weedy, invasive species, the applicator should apply the herbicide in a manner so that drift would not affect the surrounding vegetation. *Cortaderia jubata* should be controlled at locations where it co-occurs with *P. yadonii*, including locations at Blohm Ranch and Manzanita County Park. *Genista monspessulana* should be controlled at locations where it is invading *P. yadonii* habitat, including areas along Skyline Drive, the Presidio, and the “Spyglass Cypress O” tract, the Stevenson tract, and the Pescadero Canyon (P/Q/R) tracts of the Pebble Beach Company’s property. Control efforts should be prioritized, with consideration being given to the most aggressive competitor plant, the effectiveness of the control method, the future plans for the site, and the potential for reinvasion from surrounding sources.

The City and County should designate regions of road rights-of-way where *Piperia yadonii* grows as environmentally sensitive areas. Road maintenance workers should be informed of the occurrence of *P. yadonii* at designated areas and directed to avoid it. The extent of these sites should be mapped and the Cities and Counties should

modify their mowing schedules and other road maintenance activities so that the flowering and fruiting season for *P. yadonii* can be avoided.

2.1.3 Minimize threats to *Potentilla hickmanii*

Threats identified to date for *Potentilla hickmanii* include coastal development, changes in hydrology of its habitat, maintenance activities such as mowing, heavy recreational activities, herbivory, and possible competition from surrounding grasses. The population south of Montara State Park in San Mateo County is also threatened by the proposed State Route 1 bypass. Once all existing plants in the two areas are secured, they should be managed to prevent further loss of individual plants, and for prevention of habitat disturbance and degradation.

Recreational use at the Pebble Beach Company picnic area population site should be restricted to the western portion of the area outside of *Potentilla hickmanii* habitat. This restriction would require relocation of the existing horseshoe pits, volleyball courts, and horse tie posts. All designated *P. hickmanii* habitat at this site should be fenced off to discourage pedestrian and equestrian activities, including the individuals transplanted to this site during a 1998 study (Doak *et al.* 2001).

Threats from potential development or re-routing of State Highway 1 at the Montara population in San Mateo County should be eliminated through discussions with the landowner and City/County agencies involved with the proposed route changes. Destruction of this population would pose a jeopardy to the persistence of this species because only two populations are currently known.

Grasses may compete with seedlings of *Potentilla hickmanii*. Benefits from clipping competing vegetation are apparent, and competition from other plants strongly suppresses the survival and reproductive performance of young *P. hickmanii* plants (Doak *et al.* 2001). Clipping of vegetation surrounding young plants could be conducted

regularly as part of the Pebble Beach Company's ongoing maintenance program for weed control actions on their property. This type of intensive management is necessary due to the extremely small population persisting at this site. In addition, the habitat should be managed to keep *Pinus radiata* from establishing in the meadow and producing excessive shade.

High levels of herbivory by nonnative predatory snails and slugs on both vegetative and reproductive structures has been observed at the picnic area site (Doak *et al.* 2000). It is possible that this predation is causing a lack of survival and reproduction of *Potentilla hickmanii* plants. A commercially available snail and slug desiccant that is harmless to pollinators and other insects could be used to control herbivory. Use of pesticides for controlling damage from snails and slugs should be conducted cautiously to prevent damage to *P. hickmanii* pollinators. Any additional plants discovered outside of the existing fenced enclosure at the picnic area should also be caged to exclude vertebrate predators.

2.1.4 Minimize threats to *Trifolium trichocalyx*

Threats identified to date for *Trifolium trichocalyx* include loss of habitat and fire suppression. Loss of habitat due to residential and golf course development poses further threats to the *T. trichocalyx* seed bank. The largest known historical occurrence of *T. trichocalyx* exists in an unprotected area (Huckleberry Hill tract, Area G) owned by the Pebble Beach Company. The current Del Monte Land Use Plan proposes a change in the land use designation from residential to open space/forest, which potentially could aid in preservation of this site. The area, however, is still unprotected and requires additional management. For *T. trichocalyx* to persist, consideration must be given to developing and implementing a burn plan that would reduce high fuel loads while avoiding risk to life and property from surrounding developed areas. Fire is an essential process in habitat of *T. trichocalyx* in that it removes the canopy by reducing the stands of pine forest and shrubs, and it exposes bare mineral soils. In addition,

recent research studies suggest that seeds buried in soil may require germination cues quite different from those that have never been buried (Doak *et al.* 2000). Additional germination research will likely be required to confirm these recent studies.

2.1.5 Minimize threats to *Cupressus goveniana* ssp. *goveniana*

Threats identified to date for *Cupressus goveniana* ssp. *goveniana* include loss of habitat and fire suppression. The prevention of fire has caused a lack of open canopy and exposed mineral soils that are needed to maintain *C. goveniana* ssp. *goveniana* populations. For *C. goveniana* ssp. *goveniana* to persist, consideration must be given to developing and implementing a burn plan or alternative measures that would reduce high fuel loads while avoiding risk to life and property from surrounding developed areas. Mechanical removal of ground cover could also be considered to aid in *C. goveniana* ssp. *goveniana* reproductive success in the absence of fire. In addition, recent research suggests that fire is not needed for regeneration to occur. This management practice would need to be developed so that it would ensure that those aspects of a natural fire that are missing (*e.g.*, nutrient conversion, soil alteration) are not critical to continued existence of the forest if an alternative practice to promote regeneration is adopted.

3. Develop management strategies based on the research on the species life histories and the species responses to vegetation management.

3.1 Establish a working group to collaborate with private and public landowners, and appropriate agencies to develop and implement specific recovery guidelines

Establish an interagency-landowner(s) collaboration to develop resource management guidelines for the parcels of land that support *Astragalus tener* var. *titi*, *Piperia yadonii*, *Potentilla hickmanii*, *Trifolium trichocalyx*, and/or *Cupressus goveniana* ssp. *goveniana*. Evaluate parcel specific best management practices for each of the populations of plants, such as, but not limited to, prescribed burning for *T. trichocalyx* and *C. goveniana* ssp.

goveniana, selective thinning of Monterey pine forest for *Potentilla hickmanii* at the picnic area site, and nonnative plant control for *A. tener* var. *titi*, *P. yadonii*, and *P. hickmanii*. Prepare management guidelines that would include buffer zones against noncompatible adjacent land uses and develop monitoring strategies to evaluate effects from these adjacent land use practices. Define appropriate and inappropriate management activities, such as seeding or revegetating for erosion control following controlled burning.

Include results of studies conducted in Task 3.2 in specific management recommendations for each plant. Include recommendations for controls of nonnative plants and control of herbivory when warranted.

The California Department of Parks and Recreation (Department) is aware of the *Piperia yadonii* and *Cupressus goveniana* ssp. *goveniana* populations located on State Parks property, Point Lobos State Reserve, and at Point Lobos Ranch, which is slated to be turned over from Big Sur Land Trust to the Department by 2003. The Department should prepare a Resource Management Plan to address specific actions for these species. In 1987 the Department developed a Point Lobos State Reserve Unit Prescribed Fire Management Plan.

3.1.1 Implement species management guidelines

Investigate cost-sharing funding mechanisms with other State agencies and the U.S. Fish and Wildlife Service to implement management guidelines with landowner(s). Funds or in-kind services may be available through Agencies, nonprofit organizations, a local assessment district, volunteer/donated labor, or a combination thereof.

3.2 Assemble or develop life history profiles and obtain species specific data to manage listed plants

3.2.1 *Astragalus tener* var. *titi*

Research is needed on the effects of *Carex pansa* and *Carpobrotus edulis* removal to assess the role of competition by both native and nonnative plant species, observing effects from applied disturbance to

Astragalus tener var. *titi* populations and how this disturbance may affect the overall health and persistence of this species, and information on this species' breeding system and pollinator activity. Data on hydrology, reproduction, and seedling survival will help define where critical problems occur with the management of this species.

3.2.2 *Piperia yadonii*

Recent studies have produced information on the reproductive biology and pollination ecology of *Piperia yadonii* (Doak and Graff 2001). Results from these studies are thorough enough that future research should focus on the following: 1) demographic studies to estimate population size and performance, and to track dormancy, size, reproductive success, disease incidence, and herbivory; 2) effects of pollen limitation; and 3) information from transplanting to determine if large populations can be successfully transplanted (Doak and Graff 2001).

3.2.3 *Potentilla hickmanii*

Examining species specific data on all life history stages of *Potentilla hickmanii* is necessary, with special emphasis on effects of competition and herbivory on recruitment. Understanding the exact habitat requirements is necessary in order to fully understand this species' life history and to determine what factors are limiting its spread and population size. The picnic area population on Pebble Beach Company property historically has poor recruitment, which needs to be examined in greater detail. Although relatively high seed production has been evident, *P. hickmanii* appears to be most limited at the seedling establishment stage (Doak *et al.* 2000). Studies should be conducted to determine which factors are responsible for the poor seedling performance, and which strategies might result in a higher seed germination rate. Doak *et al.* (2000) suggested combining this research with experimental transplanting, as described in section 4.2.3.

All *Potentilla hickmanii* plants (including transplanted individuals) should be studied to examine changes in population characteristics for this species. Doak *et al.* (2000) has also recommended that the following data be collected: 1) genetic analysis to determine the degree of differentiation or similarity between the Montara population and the picnic area population on the Monterey Peninsula. This work should determine the level of interaction between the two populations, and if there is any genetic variation within the picnic site population on the Monterey Peninsula; 2) research to determine whether *P. hickmanii* seeds are being dispersed any farther than within close proximity to existing plants; and 3) research to determine what limitations may exist relating to pollinators to assist in efforts of establishing self-sustaining populations of *P. hickmanii*. In addition, greenhouse techniques need to be developed in order to amplify seed for application in the field. Plants should also be brought into successful cultivation with strict records maintained regarding the origin of the material. Techniques to enhance the survival and reproduction of plants should be refined, such as caging of individual plants to reduce herbivory, and possibly providing supplemental watering to enhance fruit and seed production while the population is in such a critical state.

3.2.4 *Trifolium trichocalyx*

Research needs to be conducted to determine the number and distribution of populations that remain. This task is difficult because as a “fire-follower”, this species persists as a seedbank in the soil until the appropriate openings and soil conditions are created. Historically this function has been fulfilled by fire. Few if any plants currently exist above ground due to the lack of fires in the Huckleberry Hill area over the past decade. Germination studies for *Trifolium trichocalyx* should be conducted. Doak *et al.* (2000) suggested the following research: 1) conducting trials mimicking natural soil conditions and germination cues, including using treatments that simulate different potentially important fire effects; 2) testing suitability of experimentally cleared areas for *T. trichocalyx* germination; and 3)

conducting burn box experiments in an attempt to expand surveys for seed banks.

3.2.5 *Cupressus goveniana* ssp. *goveniana*

Studies should be conducted to examine recruitment possibilities for *Cupressus goveniana* ssp. *goveniana*. Recent studies have found that *C. goveniana* ssp. *goveniana* recruitment is possible without the use of fire (Doak *et al.* 2000).

4. Determine other suitable habitat areas for additional occurrences, reestablishment, or reintroduction of populations

4.1 Develop predictive models using Geographic Information Systems to identify potentially suitable or restorable habitat

4.2 Survey likely habitat with similar site factors for reintroduction or establishment of new populations, or additional occurrences of listed plants

Because the distributions of *Astragalus tener* var. *titi*, *Potentilla hickmanii*, and *Trifolium trichocalyx* are restricted, additional populations are needed to ensure long-term viability of the species. If new populations are discovered or successfully established, they will reduce the likelihood that a catastrophic event could result in the severe reduction, or even extinction of these taxa. When discoveries are made, it is the responsibility of the survey biologists to report those occurrences to the California Department of Fish and Game's Natural Diversity Data Base. Efforts should be made to initiate protective recovery actions for each newly-discovered or newly-established population.

4.2.1 *Astragalus tener* var. *titi*

Potentially suitable habitat for *Astragalus tener* var. *titi* should be surveyed between the known population in Monterey County and the historical sites in Los Angeles and San Diego Counties. Dune and coastal sandy areas characterized by small swales and low cover of other vegetation are the likely indicators for finding other populations, or for establishing new populations or reintroduced populations.

Recent studies, however, suggest that *A. tener* var. *titi* is not strongly dependent on swale microhabitats and soil moisture (Doak *et al.* 2000). These studies are supported by plants being found in drier areas outside of the existing enclosure on 17-Mile Drive, although this occurrence may be due to the wetter conditions supplied by El Niño during 1998. In addition, areas where there is light disturbance, such as from gopher activity, should be surveyed.

Locations that may be suitable for *Astragalus tener* var. *titi* have been identified by Jones and Stokes Associates (1996) at Point Lobos State Reserve. These areas are similar to habitat that exists along 17-Mile Drive on the Monterey Peninsula and should be examined for suitable habitat for discovering unknown populations, establishment of new populations or reintroduction: coastal areas of San Luis Obispo County, including the Hearst Ranch; Seal Beach National Wildlife Refuge, Ballona Wetlands, and Bolsa Chica in Los Angeles County; and areas north and south of Silver Strand State Beach in San Diego County.

4.2.2 *Piperia yadonii*

Additional surveys should be conducted for new occurrences of plants within Fort Ord property and adjacent potentially suitable habitat. Jones and Stokes Associates (1996) reports conducting surveys in this area in 1992 and that *Piperia* spp. identified there may have been misidentified due to surveys being conducted prior to flowering.

4.2.3 *Potentilla hickmanii*

Additional experimental transplants need to take place in suitable habitat, such as at Carmello Meadows (Point Lobos State Reserve) where transplanted populations did not successfully survive into the year 2000. Based on the appropriate microhabitat conditions of the area, this site should be used for establishment of new populations. Transplanting strategies could be improved by using information obtained from studies on the populations of *Potentilla hickmanii* near Montara State Park in San Mateo County.

4.2.4 *Trifolium trichocalyx*

Suitable soil conditions and habitat is available on the Monterey Peninsula for establishment of *Trifolium trichocalyx* populations. Surveys need to be conducted to determine the most suitable locations within Monterey pine forest that are isolated from development, thus allowing the use of fire for management of this species. Jones and Stokes Associates (1996) identified Montara Ranch as a possibility for establishing new populations of *T. trichocalyx*.

4.3 Implement reintroduction/establishment to suitable sites

Experimental approaches should be used in establishing new populations of *Astragalus tener* var. *titi*, *Potentilla hickmanii*, and *Trifolium trichocalyx*. This approach would be valuable in understanding future management requirements that would aid in protecting the existing populations as well as newly discovered or established populations. Our policy guidelines regarding controlled propagation of listed species should be used for reintroduction or establishment of new populations (65 FR 56916). Once areas have been identified for *A. tener* var. *titi*, *P. hickmanii*, and *T. trichocalyx*, reintroduction or establishment to these new sites should commence. In addition, the following factors should be considered for *A. tener* var. *titi* and *P. hickmanii*:

4.3.1 *Astragalus tener* var. *titi*

Recent studies conducted by Doak *et al.* (2000) recommended the following strategies for establishing new populations of *Astragalus tener* var. *titi*: 1) develop a protocol for genetic sampling of small populations; 2) establish small populations initially; 3) use greenhouse-cultivated seeds due to little cross-pollination occurring from so few plants, providing the seeds are no more than two greenhouse-generations removed from the current existing population along 17-Mile Drive, and providing a minimum of 50 fruits were used to start the plants that were grown in the greenhouse; 4) establish populations in areas with high levels of gopher activity; 5) choose areas where low vegetation cover exists (likely due to ground cover disturbances); 6) establish populations in locations where small dune swales are present; and 7) provide consistent management to control

nonnative (e.g., *Carpobrotus edulis*) and native (e.g., *Carex pansa*) vegetation in order for long-term success of reintroduced or established populations.

4.3.2 *Potentilla hickmanii*

Experimental transplants were established at Carmello Meadows in Point Lobos State Reserve in 1998 (Doak *et al.* 2000). Although high mortality occurred among those individuals (likely due to most individuals being planted at a single localized site with dry, rocky substrate), it is probable that this location is still a good candidate for introduction of new populations. Care should be given to transplant individuals to microhabitats with a variety of moisture regimes. More experimental transplants need to be conducted, with consideration being given to maximizing potential genetic diversity. Transplanting and introduction of new populations could be improved by conducting various ecological surveys at the Montara population in San Mateo County, due to its larger population size compared to the Monterey Peninsula picnic area site.

5. Use research results in addition to monitoring current populations, reintroduced populations, and potential threats to determine effectiveness of management actions.

Develop standards to measure the success of existing or reintroduced populations of these plant species, in addition success in reducing the levels of threats, need to be developed. These standards will assist in determining the downlisting or delisting status of the five plant taxa.

5.1 Monitor occurrences to evaluate trends in population dynamics

Studies should be conducted to document population dynamics and cycles to determine population trends for all five taxa. Standard monitoring methods should be used to track population data from one year to the next and to compare results between sites. In addition, the following information should be used when monitoring populations of *Astragalus tener* var. *titi* and *Potentilla hickmanii*:

5.1.1 Utilize recent mapping of density and individual performance of *Astragalus tener* var. *titi* plants within the 17-Mile Drive enclosure

Doak *et al.* (2000) conducted a thorough analysis of *Astragalus tener* var. *titi* density and individual plant performance (by examining seed production) within the enclosure along 17-Mile Drive. These data should be used for future monitoring of this population. This research study also included mapping the *Carex pansa* cover within the enclosure to assess its spread in future monitoring attempts.

5.1.2 Monitor existing *Astragalus tener* var. *titi* population via areal extent of populations due to above-ground plants being highly erratic from year-to-year

Due to plant numbers occurring erratically each successive year, annual monitoring of population size cannot provide an accurate assessment as to whether or not the population of plants are increasing or decreasing in size. Monitoring the 17-Mile Drive population through individual plant performance and areal extent of the population will likely give a better estimate of the populations status on a year-to-year basis (Doak *et al.* 2000).

5.1.3 Monitor survival, seed production, and recruitment of *Potentilla hickmanii* from year-to-year

Based on recent studies conducted by Doak *et al.* (2000), plants in the current and newly established populations need to be monitored for growth, survival, seed production, and recruitment. These data should be used to support management recommendations for the current populations or any additional established populations.

5.2 Monitor effects of the reduction of threats and review research results

Studies should be conducted to ascertain if methods used for reducing threats to each species are effective, and whether results obtained from research are beneficial to the recovery of each species to such a degree that they should be incorporated into the revised recovery plan.

5.2.1 Evaluate effectiveness of methods used to reduce threats

Regular monitoring is needed to evaluate the success of reducing threats for all five listed species. Monitoring is necessary to determine if recovery goals are being met and if downlisting or delisting is appropriate.

5.2.2 Evaluate research results and use in future management

Based on findings, review and incorporate research results into management strategies for the five listed species. Implement control methods for those potential threats determined to be actual threats.

5.3 Establish an *ex situ* (i.e., outside the original location) seed bank for seed representing each of the populations of the five listed plants

Due to the few numbers of populations (and few numbers of individuals as with *Astragalus tener* var. *titi*, *Potentilla hickmanii*, and *Trifolium trichocalyx*), a seed bank should be established to maintain the genetic variability within and between the populations of each of the species as insurance against the possibility of population extinction. Seed should be stored at a Center for Plant Conservation member institution, such as Rancho Santa Ana Botanic Garden in Claremont, California, Santa Barbara Botanic Garden in Santa Barbara, California, or at the USDA National Seed Storage Laboratory in Fort Collins, Colorado. A seed collection program should be designed and implemented with the goal of representing all genetic variability within and between populations.

6. Coordinate recovery actions to benefit other listed species and species of concern.

A number of other rare and endangered wildlife and plant species occur either on the Monterey Peninsula or within the vicinity of Monterey. (Appendix D). Management actions such as herbicide use to remove nonnative plant species may affect these species. Management actions should be designed to avoid adversely affecting these species and their habitats.

Habitats need to be managed at the community level rather than for specific species to ensure that management methods do not further endanger organisms that are already endangered by habitat loss. Coordination with other agencies, private landowners, or interested parties will help ensure that recovery actions outlined in this recovery plan will benefit the habitat of other listed species.

7. Develop and implement an education outreach program.

An educational program should be established for the public, including private landowners to encourage conservation and proper management of each of the five listed species. Private groups such as the California Native Plant Society and the Monterey Pine Forest Ecology Cooperative should be approached about participating in this effort. The benefits of protecting native plant species and their habitats, and maintaining native biological communities should be explained clearly to all concerned parties.

7.1 Inform and coordinate with lead agencies

Because City and County governments are the primary agencies that determine future land uses for unprotected occurrences and habitats, their participation is critical for recovery. It may be necessary for lead agencies to revise existing land use plans to accurately address the current status of the five listed species.

7.2 Inform and educate the public

Implement an educational program. Educational brochures and other materials (such as videos or slide presentations) should be prepared that include discussion of the importance of each of the species to the region (*e.g.*, legal status as a federally protected species), plant identification, plant ecology and related management issues. Encourage landowners to landscape with local native plant species and describe to them the benefits of establishing effective buffer areas between secured areas and intensely used residential or recreational areas. These restoration areas could also serve as demonstration gardens to increase the public's knowledge and appreciation for the local landscape and unique habitat of this area of California. Separate brochures could be developed to target youth in public schools and an adult audience. Distribute educational brochures and other educational materials

through local public schools and directly to private landowners and other interested parties in the local area.

7.2.1 Hold public meetings

The U.S. Fish and Wildlife Service, California Department of Fish and Game, California Department of Parks and Recreation, and Monterey County should hold at least one informal public meeting to explain recovery activities for the listed species and to encourage local appreciation of the unique species found in the County.

8. Reevaluate recovery criteria and revise recovery plan on knowledge obtained from research, monitoring, and management.

The scientific validity of the recovery criteria and recovery plan should be reviewed and revised as more information becomes available. The criterion of maintaining sufficient numbers of populations or conservation areas should be examined, and the success or failure of management actions should be evaluated.

8.1 Reevaluate recovery criteria

Based on the future information gathered from life history, research studies, monitoring, and management actions, the criteria for downlisting and delisting the taxa in this recovery plan should be evaluated and, if necessary, refined.

8.2 Revise recovery plan

Based on the expanded knowledge from research and monitoring results and the evaluation of the relative success and failure of the management programs in attaining recovery goals, the recovery plan should be revised to improve future management. When potential threats are found to be actual threats, management responses should be incorporated into the revised recovery program.

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IV. IMPLEMENTATION SCHEDULE

The table that follows is a summary of scheduled actions and costs for recovery of *Astragalus tener* var. *titi*, *Piperia yadonii*, *Potentilla hickmanii*, *Trifolium trichocalyx*, and *Cupressus goveniana* ssp. *goveniana*. It is a guide for meeting the objectives discussed in Part II of this recovery plan. The table includes the following five elements:

1. Priority. The actions identified in the implementation schedule are those that, in our opinion, should bring about the recovery of these species. However, the tasks are subject to modification as dictated by new findings, changes in species status, and the completion of recovery actions. The priority for each task is given in the first column of the implementation schedule, and are assigned as follows:

- Priority 1: An action that must be taken to prevent extinction or to prevent the species from declining irreversibly in the foreseeable future.
- Priority 2: An action that must be taken to prevent a significant decline in species population/habitat quality or some other significant negative impact short of extinction.
- Priority 3: All other actions necessary to provide for full recovery of the species.

2. Task Number and Description. The task number and description are extracted from the stepdown narrative found in Part II of the recovery plan. Please refer back to this narrative for a fuller description of each task.

3. Task Duration. The task duration column indicates the number of years estimated to complete the task if it is a discrete task, or whether it is a continual or ongoing task. Continual and ongoing tasks are defined as follows:

- Continuous: Task will be implemented on an annual basis one it is begun.
- Ongoing: Task is currently being implemented and will continue until no longer necessary for recovery.

4. Responsible Parties. In the table, we have identified agencies and other parties that we believe are primary stakeholders in the recovery process. The list of potential stakeholders is not limited to the list below; other stakeholders are invited to participate. In some cases, the most logical lead agency (based on authorities, mandates, and capabilities) has been identified as the “responsible party” with an asterisk (*). The following abbreviations are used to indicate the responsible party for each recovery task for the five listed species:

Agencies	refers to the local lead agencies with planning authority for actions that may affect the listed species
CDFG	California Department of Fish and Game
CDPR	California Department of Parks and Recreation
CITY	City of Monterey, Pacific Grove, etc.
COUNTY	County of Monterey, San Mateo, Los Angeles or San Diego
DMFF	Del Monte Forest Foundation
FWS	U.S. Fish and Wildlife Service
NGO	nongovernmental organizations (<i>e.g.</i> , California Native Plant Society, Big Sur Land Trust, The Nature Conservancy, etc.)
PBC	Pebble Beach Company
PVT	Private parties
RSABG	Rancho Santa Ana Botanic Garden
TBD	to be determined
WG	working group

5. Cost Estimates. Cost estimates are shown for each recovery task, both for the first 5 years after release of the recovery plan and for the total estimated cost of recovery. Total costs for continuous and ongoing tasks are based on estimated time to recovery. The estimated costs include estimated salaries for individuals who would carry out the identified task. Typically, the responsible party (or lead agency) is shown as assuming the largest share of the cost, with other stakeholders shown as contributors. The inclusion of estimated costs in this recovery plan does not commit any agency or party to an expenditure of funds. Therefore, initiation and completion of these tasks is subject to the availability of funds as well as other constraints affecting the stakeholders involved.

**IMPLEMENTATION SCHEDULE FOR RECOVERY PLAN
FOR FIVE PLANTS FROM MONTEREY COUNTY, CALIFORNIA**

Priority #	Task #	Task Description	Task Duration (years)	Responsible Party	Total Cost	Cost Estimates (in thousands of dollars)				
						FY1	FY2	FY3	FY4	FY5
Need 1: Secure and protect existing species habitats that occur on private or unprotected lands										
1	1.1	Inform landowners	5	FWS, CDFG, NGOs	10	2	2	2	2	2
1	1.2	Consult and coordinate with agencies involved with recovery activities	ongoing	FWS	40+	4	4	4	4	4
1	1.3	Establish protection agreements and secure habitat sites with permission of the landowners	TBD	FWS, CDFG, CITY, PVT, COUNTY	TBD	TBD	TBD	TBD	TBD	TBD
1	1.3.1	Land Acquisition or fee title ownership	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD
1	1.3.2	Open space and conservation easements	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD
1	1.4	Secure and protect existing primary sites on unprotected lands	ongoing	FWS, CDFG, CITY, PBC, PVT COUNTY	TBD	TBD	TBD	TBD	TBD	TBD

Priority #	Task #	Task Description	Task Duration (years)	Responsible Party	Cost Estimates (in thousands of dollars)					
					Total Cost	FY1	FY2	FY3	FY4	FY5
1	1.4.1	Protect habitat for <i>Astragalus tener</i> var. <i>titi</i>	2	FWS, CDFG, PBC, PVT	6	3	3	0	0	0
1	1.4.2	Protect habitat for <i>Piperia yadonii</i>	2	FWS, CDFG, PBC, PVT, CITY	20	10	10	0	0	0
1	1.4.3	Protect habitat for <i>Potentilla hickmanii</i>	2	FWS, CDFG, DMFF, PVT	10	5	5	0	0	0
1	1.4.4	Protect habitat for <i>Trifolium trichocalyx</i>	2	FWS, CDFG, DMFF, PBC, PVT	10	5	5	0	0	0
1	1.4.5	Protect habitat for <i>Cupressus goveniana</i> ssp. <i>goveniana</i>	2	FWS, CDFG, PBC, DMFF, PVT	6	3	3	0	0	0
		Need 1 Subtotal Cost:			102+ TBD	32+ TBD	32+ TBD	6+ TBD	6+ TBD	6+ TBD
	Need 2: Manage private and secured lands to control or eliminate threats to existing populations and their habitats									
1	2.1	Eliminate or minimize threats on private and secured lands	continuous	Agencies, NGOs, DMFF, CITY, COUNTY, PBC, PVT	TBD					

Priority #	Task #	Task Description	Task Duration (years)	Responsible Party	Cost Estimates (in thousands of dollars)					
					Total Cost	FY1	FY2	FY3	FY4	FY5
1	2.1.1	Minimize threats to <i>Astragalus tener</i> var. <i>titi</i>	continuous	Agencies, PBC	50+	5	5	5	5	5
1	2.1.2	Minimize threats to <i>Piperia yadonii</i>	continuous	Agencies, PBC, PVT, NGOs, CITY, COUNTY	50+	5	5	5	5	5
1	2.1.3	Minimize threats to <i>Potentilla hickmanii</i>	continuous	Agencies, DMFF, PBC, PVT	50+	5	5	5	5	5
1	2.1.4	Minimize threats to <i>Trifolium trichocalyx</i>	continuous	Agencies, CITY, COUNTY, PBC, PVT	50+	5	5	5	5	5
1	2.1.5	Minimize threats to <i>Cupressus goveniana</i> ssp. <i>goveniana</i>	continuous	Agencies, CDPR, PBC, DMFF, PVT	50+	5	5	5	5	5
		Need 2 Subtotal Cost:			250+	25	25	25	25	25
		Need 3: Develop management strategies based on the species life histories and the species responses to vegetation management								

Priority #	Task #	Task Description	Task Duration (years)	Responsible Party	Total Cost	Cost Estimates (in thousands of dollars)				
						FY1	FY2	FY3	FY4	FY5
1	3.1	Establish a working group to collaborate with private and public landowners, and appropriate agencies to develop and implement specific recovery guidelines	3	FWS	25	15	5	5	0	0
1	3.1.1	Implement species management guidelines	4	TBD	40	0	20	10	5	5
1	3.2	Assemble or develop life history profiles and obtain specific data to manage listed plants	5	Agencies, WG	TBD					
1	3.2.1	<i>Astragalus tener</i> var. <i>titi</i>	4	Agencies, WG	42	12	12	12	6	0
1	3.2.2	<i>Piperia yadonii</i>	3	Agencies, WG	42	12	12	12	6	0
1	3.2.3	<i>Potentilla hickmanii</i>	4	Agencies, WG	42	12	12	12	6	0
1	3.2.4	<i>Trifolium trichocalyx</i>	4	Agencies, WG	42	12	12	12	6	0
1	3.2.5	<i>Cupressus goveniana</i> ssp. <i>goveniana</i>	3	Agencies, WG	42	12	12	12	6	0
		Need 3 Subtotal Cost:			275	75	85	75	35	5
		Need 4: Determine other suitable habitat areas for additional occurrences, reestablishment, or reintroduction of populations								

Priority #	Task #	Task Description	Task Duration (years)	Responsible Party	Total Cost	Cost Estimates (in thousands of dollars)				
						FY1	FY2	FY3	FY4	FY5
2	4.1	Develop predictive models using Geographic Information Systems (GIS) to identify potentially suitable habitat	2	TBD	10	5	5	0	0	0
2	4.2	Survey likely habitat with similar site factors for reintroduction or establishment of new populations, or additional occurrences of listed plants	3	FWS, CDFG, TBD	TBD					
2	4.2.1	<i>Astragalus tener</i> var. <i>titi</i>	3	FWS, CDFG, TBD	30	10	10	10	0	0
2	4.2.2	<i>Piperia yadonii</i>	3	FWS, CDFG, TBD	15	5	5	5	0	0
2	4.2.3	<i>Potentilla hickmanii</i>	3	FWS, CDFG, TBD	30	10	10	10	0	0
2	4.2.4	<i>Trifolium trichocalyx</i>	3	FWS, CDFG, TBD	30	10	10	10	0	0
2	4.3	Implement reintroduction or establishment of <i>Astragalus tener</i> var. <i>titi</i> , <i>Potentilla hickmanii</i> and <i>Trifolium trichocalyx</i> to suitable sites	10-15	FWS, CDFG, TBD	260+	40	40	40	20	20
2	4.3.1	Additional considerations for <i>Astragalus tener</i> var. <i>titi</i>	5	FWS, TBD	8	2	2	2	1	1

Priority #	Task #	Task Description	Task Duration (years)	Responsible Party	Total Cost	Cost Estimates (in thousands of dollars)				
						FY1	FY2	FY3	FY4	FY5
2	4.3.2	Additional considerations for <i>Potentilla hickmanii</i>	5	FWS, TBD	8	2	2	2	1	1
		Need 4 Subtotal Cost:			391	84	84	79	22	22
		Need 5: Use research results in addition to monitoring current populations, reintroduced populations, and potential threats to determine effectiveness of management actions.								
3	5.1	Monitor occurrences to evaluate trends in population dynamics	continuous	FWS, DFG, CDPR, PBC, NGOs	100+	10	10	10	10	10
3	5.1.1	Utilize recent mapping of density and individual performance of <i>Astragalus tener</i> var. <i>titi</i> plants within the 17-Mile Drive enclosure	1	PBC, Agencies	2	2	0	0	0	0
3	5.1.2	Monitor existing <i>Astragalus tener</i> var. <i>titi</i> population via areal extent of populations due to above-ground plants being highly erratic from year-to-year	5	PBC	10	2	2	2	2	2

Priority #	Task #	Task Description	Task Duration (years)	Responsible Party	Cost Estimates (in thousands of dollars)					
					Total Cost	FY1	FY2	FY3	FY4	FY5
3	5.1.3	Monitor survival, seed protection, and recruitment of <i>Potentilla hickmanii</i> from year-to-year	5	Agencies, DMFF, PVT	25	5	5	5	5	5
3	5.2	Monitor effects of the reduction of threats and review research results	ongoing	Agencies, CDPR, NGOs	25+	5	5	5	5	5
3	5.2.1	Evaluate effectiveness of methods used to reduce threats	ongoing	Agencies	25+	5	5	5	5	5
3	5.2.2	Evaluate research results and use in future management	ongoing	Agencies	25+	5	5	5	5	5
2	5.3	Establish an <i>ex situ</i> seed bank for seed representing each of the populations of the five listed plants	3	PBC, RSABG	25	10	10	5	0	0
		Need 5 Subtotal Cost:			237	44	42	37	32	32
	Need 6: Coordinate recovery actions to benefit other listed species and species of concern									

Priority #	Task #	Task Description	Task Duration (years)	Responsible Party	Cost Estimates (in thousands of dollars)					
					Total Cost	FY1	FY2	FY3	FY4	FY5
3	6	Coordinate recovery actions to benefit other listed species and species of concern	ongoing	Agencies, CDPR, CITY, COUNTY, DMFF, NGOS, PBC, PVT	20+	2	2	2	2	2
		Need 6 Subtotal Cost:			20+	2	2	2	2	2

Priority #	Task #	Task Description	Task Duration (years)	Responsible Party	Total Cost	Cost Estimates (in thousands of dollars)				
						FY1	FY2	FY3	FY4	FY5
Need 7: Develop and implement an education outreach program										
3	7.1	Inform and coordinate with lead agencies	5	FWS, TBD	30	6	6	6	6	6
3	7.2	Inform and educate the public	5	Agencies, TBD	25	5	5	5	5	5
3	7.2.1	Hold public meetings	2	FWS, CDFG, CDPR, CITY, COUNTY, PBC	4	2	2	0	0	0
		Need 7 Subtotal Cost:			59	13	13	11	11	11
Need 8: Re-evaluate recovery criteria and revise recovery plan on knowledge obtained from research, monitoring and management										
3	8.1	Re-evaluate recovery criteria	2	FWS, CDFG	4	0	0	0	2	2
3	8.2	Revise recovery plan	2	FWS, CDFG	8	0	0	0	3	5
		Need 8 Subtotal Cost:			12	0	0	0	5	7
		TOTAL COSTS:			1346+ TBD	275+ TBD	283+ TBD	235+ TBD	138+ TBD	110+ TBD

APPENDIX A. Explanation of Recovery Priority System

The Recovery Priority System uses the criteria of degree of threat, recovery potential, and taxonomy (level of genetic distinctiveness) to assign all listed species a number (1-18). A fourth factor, conflict, is a supplementary element in determining what actions are to be implemented for species recovery. This factor gives priority, within each category, in preparation of recovery plans to species that are, or may be in conflict with construction or development projects. Thus, the species retains its numerical rank and acquires the letter designation of “C”, indicating conflict (1C-18C). A detailed discussion of the Recovery Priority System can be found in 48 FR 51985.

Degree of Threat	Recovery Potential	Taxonomy	Priority	Conflict
High	High	Monotypic genus	1	1C 1
	High	Species	2	2C 2
	High	Subspecies	3	3C 3
	Low	Monotypic genus	4	4C 4
	Low	Species	5	5C 5
	Low	Subspecies	6	6C 6
Moderate	High	Monotypic genus	7	7C 7
	High	Species	8	8C 8
	High	Subspecies	9	9C 9
	Low	Monotypic genus	10	10C 10
	Low	Species	11	11C 11
	Low	Subspecies	12	12C 12
Low	High	Monotypic genus	13	13C 13
	High	Species	14	14C 14
	High	Subspecies	15	15C 15
	Low	Monotypic genus	16	16C 16
	Low	Species	17	17C 17
	Low	Subspecies	18	18C 18

**Appendix B. Threats Identified for *Astragalus tener* var. *titi*, *Piperia yadonii*,
Potentilla hickmanii, *Trifolium trichocalyx*, and *Cupressus goveniana* ssp.
*goveniana*¹, and Recovery Plan Recommended Management Actions**

<i>Astragalus tener</i> var. <i>titi</i> (coastal dunes milk vetch)			
<i>Threat</i>	<i>Recovery Action</i>	<i>Listing Factor</i>²	<i>Recovery Criteria</i>
Alteration of habitat from trampling associated with recreational activities, such as hiking, picnicking, ocean viewing, wildlife photography, equestrian use, and golfing	Inform landowners (Task 1.1). Secure and protect existing sites (Task 1.0, 1.3, 1.4, 1.4.1). Minimize threats (Task 2.0, 2.1, 2.1.1). Establish a working group to develop and implement recovery guidelines (Task 3.1, 3.1.1). Use research results and monitoring data to determine effectiveness of mgt. actions (Task 5.0, 5.2). Develop an education outreach program and educate the public (Task 7.0, 7.2, 7.2.1).	E	1(a), 1(b), 1(d), 1(e)
Fragmentation of habitat resulting in more vulnerability to extinction from random events	Secure and protect existing sites (Task 1.0, 1.3). Determine other suitable sites and implement reintroduction or establishment of more populations (Task 4.0, 4.2, 4.3, 4.3.1). Establish a seed bank (Task 5.3). Develop an education outreach program and educate the public (Task 7.0, 7.2, 7.2.1).	A, D	1(a), 1(b), 1(c), 1(f)
Competition from alien plants (<i>Carpobrotus</i> and <i>Plantago</i> , * <i>Carex</i>)	Minimize threats (Task 2.0, 2.1.1). Obtain life history data to properly manage the threatened species (Task 3.2.1). Use research results and monitoring data to determine effectiveness of mgt. actions (Task 5.0, 5.2).	E	1(a), 1(b), 1(d), 1(e)
*Urban development and coastal military activities for historical occurrences	Establish a working group to develop and implement recovery guidelines (Task 3.1). Determine other suitable areas for additional populations and implement reintroduction/establishment (Task 4.0, 4.2, 4.2.1, 4.3, 4.3.1). Develop an education outreach program and educate the public (Task 7.0, 7.2, 7.2.1).	A, D	1(a), 1(c)
*Modifications in hydrology from improvements and maintenance activities along 17-Mile Drive	Inform landowners and consult with planning departments for proper mgt. (Task 1.1, 1.2). Use research results and monitoring data to determine effectiveness of mgt. actions (Task 5.0, 5.2).	A, D	1(a), 1(d), 1(e)

1 - Threats marked with an asterisk were identified following the Federal Register final ruling (63 FR 43100) or not mentioned in the final ruling. All other threats are addressed in the final ruling.

2 - Listing factors are as follows: (A) the present or threatened destruction, modification, or curtailment of its habitat or range; (B) overutilization for commercial, recreational, scientific, or educational purposes; (C) disease or predation; (D) the inadequacy of existing regulatory mechanisms; or (E) other natural or manmade factors affecting its continued existence.

***Piperia yadonii* (Yadon's piperia)**

<i>Threat</i>	<i>Recovery Action</i>	<i>Listing Factor</i>	<i>Recovery Criteria</i>
Habitat loss and fragmentation due to urbanization and recreational (golf course) development	Inform landowners (Task 1.1). Secure and protect existing sites (Task 1.0, 1.3, 1.4, 1.4.2). Minimize threats (Task 2.0, 2.1, 2.1.2). Establish a working group to develop and implement recovery guidelines (Task 3.1, 3.1.1). Use research results and monitoring data to determine effectiveness of mgt. actions (Task 5.0, 5.2). Develop an education outreach program and educate the public (Task 7.0, 7.2, 7.2.1).	A, D	2(a), 2(b), 2(c)
Competition from alien species	Minimize threats (Task 2.0, 2.1, 2.1.2). Use research results and monitoring data to determine effectiveness of mgt. actions (Task 5.0, 5.2). Establish a working group to develop and implement recovery guidelines (Task 3.1, 3.1.1). Develop an education outreach program and educate the public (Task 7.0, 7.2, 7.2.1).	E	2(b), 2(c)
Roadside maintenance (mowing); *a fire directive requesting removal of roadside vegetation for prevention of wildfires;	Inform landowners and planning departments for proper mgt. (Task 1.1, 1.2). Minimize threats (Task 2.0, 2.1, 2.1.2). Use research results and monitoring data to determine effectiveness of mgt. actions (Task 5.0, 5.2). Develop an education outreach program and educate the public (Task 7.0, 7.2, 7.2.1).	A, D	2(b), 2(c)
Potential increase in deer grazing of flowering stems	Inform landowners (Task 1.0, 1.1, 1.2). Minimize threats (Task 2.0, 2.1, 2.1.2). Obtain specific data to manage the listed species (Task 3.2, 3.2.2).	C	2(b), 2(c)
*Roadway circulation improvement at Monterey Peninsula Airport	Consult with agencies (Task 1.2). Protect habitat (Task 1.4.2). Manage land to control threats (Task 2.0). Coordinate with lead agency (Task 7.1).	A, D	2(a), 2(b)
*Proposed realignment of U.S. Route 101 near Prunedale(?)	Consult with agencies (Task 1.2). Protect habitat (Task 1.4.2). Manage land to control threats (Task 2.0). Coordinate with lead agency (Task 7.1).	A, D	2(a), 2(b)
Collection of plants by horticulturists/researchers	Inform landowners (Task 1.1). Secure and protect existing sites (Task 1.0, 1.3, 1.4, 1.4.2). Minimize threats (Task 2.0, 2.1, 2.1.2). Develop an education outreach program and educate the public (Task 7.0, 7.2, 7.2.1).	A	2(a), 2(b)

***Potentilla hickmanii* (Hickman's potentilla)**

<i>Threat</i>	<i>Recovery Action</i>	<i>Listing Factor</i>	<i>Recovery Criteria</i>
Recreational activities and maintenance of recreational area	Inform landowners (Task 1.1). Secure and protect existing sites (Task 1.0, 1.3, 1.4, 1.4.3). Minimize threats (Task 2.0, 2.1 2.1.3). Establish a working group to develop and implement recovery guidelines (Task 3.1, 3.1.1). Use research results and monitoring data to determine effectiveness of mgt. actions (Task 3.2.3, 5.0, 5.1.3, 5.2). Develop an education outreach program and educate the public (Task 7.0, 7.2, 7.2.1).	A, D, E	3(a), 3(b), 3(d)
Residential development (potential alteration of hydrology)	Secure, protect and properly manage existing sites (Task 1.0, 1.3, 1.4, 1.4.3, 2.0). Minimize threat (2.1.3). Establish a working group to develop and implement recovery guidelines (Task 3.1, 3.1.1).	A, D	3(a), 3(b), 3(d)
Competition from invasive alien plants	Minimize threats (Task 2.0, 2.1, 2.1.3). Use research results and monitoring data to determine effectiveness of mgt. actions (Task 3.2.3, 5.0, 5.1.3, 5.2).	E	3(c), 3(d)
Small population size makes the species vulnerable to extirpation from random events (genetic drift, poor years of reproduction, tree fall)	Secure and protect existing sites (Task 1.0, 1.3, 1.4, 1.4.3). Determine other suitable sites to reintroduce or establish more populations (Task 4.0, 4.2, 4.2.3, 4.3, 4.3.2). Develop mgt. strategies through research to obtain species specific data to better manage the populations (Task 3.0, 3.2, 3.2.3). Monitor the populations for survival, seed production and recruitment (Task 5.1.3). Establish a seed bank (Task 5.3). Develop an education outreach program and educate the public (Task 7.0, 7.2, 7.2.1).	E	3(a), 3(b), 3(d), 3(e)
*Browsing by deer; snail and slug damage	Inform landowners (Task 1.0, 1.1, 1.2). Minimize threats (Task 2.0, 2.1, 2.1.3). Obtain specific data to manage the listed species (Task 3.2, 3.2.3).	C	3(a), 3(c), 3(d)
*Vole herbivory and soil inundation	Minimize threats (Task 2.0, 2.1, 2.1.3). Obtain specific data to manage the listed species (Task 3.2, 3.2.3).	A, C	3(a), 3(c), 3(d)
*Proposed State Route 1 bypass and development at Montara pop.	Inform landowners and consult with agencies (Task 1.0, 1.1, 1.2, 7.1). Protect habitat (Task 1.4.3). Manage land to control threats (Task 2.0).	A, D	3(a), 3(b), 3(d)

***Trifolium trichocalyx* (Monterey clover)**

<i>Threat</i>	<i>Recovery Action</i>	<i>Listing Factor</i>	<i>Recovery Criteria</i>
Alteration of natural fire cycles/ fire suppression	Manage land to control threat (Task 2.0). Obtain specific data to manage the listed species (Task 3.2, 3.2.4). Monitor populations for survival, seed production and recruitment (Task 5.1.3). Determine other suitable sites where fire can occur and implement reintroduction or establishment of more populations (Task 4.0, 4.2, 4.2.4, 4.3).	A, E	4(a), 4(b), 4(c)
Residential and recreational development	Inform landowners (Task 1.1). Secure, protect and properly manage existing sites (Task 1.0, 1.3, 1.4, 1.4.4, 2.0). Minimize threats (2.1.4). Establish a working group to develop and implement recovery guidelines (Task 3.1, 3.1.1). Use research results and monitoring data to determine effectiveness of mgt. actions (Task 5.0, 5.2). Develop an education outreach program and educate the public (Task 7.0, 7.2, 7.2.1).	A, D	4(a), 4(b)
Small population size makes the species vulnerable to extirpation from random events; ephemeral nature of the plant's reappearance after fires	Secure and protect existing sites (Task 1.0, 1.3, 1.4, 1.4.4). Determine other suitable sites and implement reintroduction or establishment of more populations (Task 4.0, 4.2, 4.2.4, 4.3). Develop mgt. strategies through research to obtain species specific data to better manage the populations (Task 3.0, 3.2, 3.2.4). Monitor occurrences to evaluate trends in population dynamics (Task 5.1). Establish a seed bank (Task 5.3). Develop an education outreach program and educate the public (Task 7.0, 7.2, 7.2.1).	E	4(a), 4(b), 4(c), 4(d)

***Cupressus goveniana* var. *goveniana* (Gowen cypress)**

<i>Threat</i>	<i>Recovery Action</i>	<i>Listing Factor</i>	<i>Recovery Criteria</i>
Habitat alteration due to residential and recreational (golf course) development	Inform landowners (Task 1.1). Secure and protect existing sites (Task 1.0, 1.3, 1.4, 1.4.5). Minimize threats (Task 2.0, 2.1, 2.1.5). Establish a working group to develop and implement recovery guidelines (Task 3.1, 3.1.1). Use research results and monitoring data to determine effectiveness of mgt. actions (Task 5.0, 5.2). Develop an education outreach program and educate the public (Task 7.0, 7.2, 7.2.1).	A, D	5(a), 5(b)
Disruption of natural fire cycles	Minimize threats (Recent research has suggested fire is not necessary for regeneration; Task 2.0, 2.1, 2.1.5). Develop mgt. strategies through research and implement alternative management practices critical for continued existence of forests (Task 3.0, 3.2, 3.2.5). Use research results and monitoring data to determine effectiveness of mgt. actions (Task 5.0, 5.2). Develop an education outreach program and educate the public (Task 7.0, 7.2, 7.2.1).	A, E	5(a), 5(b), 5(c)
Competition from invasive alien plants (<i>Cortaderia</i> , <i>Genista</i> , and <i>Erechtites</i>)	Establish a working group to develop and implement recovery guidelines (Task 3.1, 3.1.1). Minimize threats (Task 2.0, 2.1, 2.1.5). Use research results and monitoring data to determine effectiveness of mgt. actions (Task 5.0, 5.2).	E	5(a), 5(b)
*Small population size/stochasticity	Establish an <i>ex situ</i> seed bank (Task 5.3).	A, E	5(d)

APPENDIX C. Explanation of Marine Terraces and Glossary of Technical Terms

Explanation of marine terraces

Six marine terraces were identified as part of a U.S. Geological Survey study for the Department of the Interior (Dupré 1990). Jones and Stokes Associates utilized these descriptions in their research conducted on the Monterey Peninsula in identifying habitat and population locations for the plant taxa outlined in this recovery plan. This recovery plan does not include the marine terrace concept in the descriptions, although Jones and Stokes Associates (1996) did use the terrace concept when describing existing population locations and potential reintroduction or establishment sites for future populations of these species. A summary of the terrace descriptions is outlined below, and a complete description can be found in Jones and Stokes Associates (1994).

Under this marine terrace naming system, intervening slopes between terraces are defined by the terraces that surround them. The present intertidal coastal terrace at sea level is "Terrace 0". Terrace 0 is composed of bare granite or other bedrock without an overlaying soil and supports tidepool plants and animals.

1st Marine Terrace *Lighthouse Coastal Terrace*. This terrace is the first one up from sea level and is the youngest of the Pleistocene marine terraces at Monterey. Elevation range is from 3 to 12 meters (10 to 40 feet). It runs in a nearly continuous band along the coastline from near Del Monte Lake in the Naval Postgraduate School in Monterey to the south side of Point Lobos. This terrace has been continually eroded by ocean waves since the rise in sea level following the last ice age.

2nd Marine Terrace *Ocean View Coastal Terrace*. This terrace generally ranges in elevation from 12 to 37 meters (40 to 120 feet). A less continuous band of this terrace forms around the peninsula, much of which is covered by the oldest sand dunes. A large segment of this terrace remains undeveloped at Point Lobos.

3rd Marine Terrace *Peninsula College Coastal Terrace.* This terrace ranges in elevation from 43 to 67 meters (140 to 220 feet). It extends in a continuous band from near the intersection of State Route 1 and State Route 68 to Pebble Beach on the south side of the Monterey Peninsula. Most of this terrace has been developed and landscaped.

4th Marine Terrace *Silvan Coastal Terrace.* This terrace generally ranges from 73 to 91 meters (240 to 300 feet). It extends as a continuous band from south of Monterey Peninsula Airport to north of Pebble Beach between Spyglass Hill and Poppy Hills Golf Courses. It is divided into many segments by canyons and riparian corridors. Few remnants of Terrace 4 with natural vegetation remain on the Peninsula.

5th Marine Terrace *Monte Vista Coastal Terrace.* The terrace generally ranges in elevation from 97 to 165 meters (320 to 540 feet). It forms a partially continuous band around Huckleberry Hill with an extension south to the east side of Carmel. Another segment also occurs on the inland hill slopes of Lobos Ranch east of Point Lobos. Terrace 5 is cut by stream canyons but is not covered by old sand dunes.

6th Marine Terrace *Huckleberry Coastal Terrace.* This terrace generally ranges in elevation from 183 to 244 meters (600 to 800 feet). It forms the summit cap in several segments on Huckleberry Hill. Most of this terrace has been developed, but remnant natural areas remain.

Glossary of Technical Terms²

abiotic	not biological; not involving or produced by organisms
alkaline	to have a pH value greater than 7
annual	living less than 1 year and completing the entire life cycle from seed germination to seed production in a single growing season
Antioch soils	loamy fine sands that become moist in some or all parts between depths of 10 to 30 centimeters (4 to 12 inches) about late November, remaining moist all the time until late May or early June and dry the rest of the year; the upper surface is light brownish gray or brown; upper surface is medium acid with moderately alkaline clay and clay loam beneath
biotic	the part of the environment or an organism that results from its inter-relationship with other organisms
bract	small leaf- or scale-like structure associated with an inflorescence or cone
calyx (calyces)	the outermost or lowermost whorl of flower parts, generally green and enclosing the remainder of the flower in the bud
Cieneba soils	consist of shallow and somewhat excessively drained soils that formed in material weathered from granitic rock; consist of a loamy upper surface that is dark grayish brown to light brown; somewhat excessively drained with low to medium

² Soil series descriptions were obtained from the following source:
U.S. Department of Agriculture. 2001. Natural Resources Conservation Service, Soil Survey Division. Official Soil Series Descriptions.
<http://www.statlab.iastate.edu/soils/osd/>

runoff; moderately rapid permeability in the soil, but much slower in the weathered granite

- claypan soils** a cemented or compacted soil layer that consist mainly of clay and is impenetrable by roots
- corolla** the whorl of flower parts that are inside or above the calyx; often large and brightly colored
- cyme** branched inflorescence in which the central or uppermost flower opens before the peripheral or lowermost flowers on any axis
- dehiscent** splitting open (as of a fruit or other structure) to release reproductive bodies within
- endemic** native to a well defined geographic area and restricted to that area
- foliate** shaped like a leaf
- genetic drift** random changes in gene frequency especially in small populations when leading to preservation or extinction of particular genes
- hardpan soils** a cemented or compacted and often clayey layer in soil that is impenetrable by roots, often being referred to as the fundamental part of bedrock (the solid rock underlying unconsolidated surface materials)
- inbreeding depression** breeding by mating of closely related and genetically similar individuals, which can lead to the appearance of harmful recessive characteristics

inflorescence	an entire cluster of flowers and associated structures (<i>e.g.</i> , axes, bracts, pedicels); generally excluding full-sized foliage leaves
involucre	group of bracts more or less held together as a unit, subtending a flower, fruit or inflorescence
lanceolate	narrowly elongate, widest in the basal half, often tapered to an acute tip
lacinate-toothed	cut into deep, irregular usually pointed tooth-shaped lobes
legume	1. In Fabaceae family, a dry or somewhat fleshy one- to many-seeded fruit from a simple pistil, typically dehiscent longitudinally along two sutures and splitting into halves that remain joined at the base, sometimes dehiscent or breaking crosswise into one-seeded segments. 2. A plant with such a fruit.
Narlon loamy fine sand	poorly drained soils that are light brownish gray and pale brown; typically have a medium to strongly acidic loamy sand upper surface with a very strongly acidic clay or sandy clay layer beneath; somewhat poorly drained; found on partially dissected terraces of nearly level to moderate slopes
obcordate	the sides of a leaf adjacent to the petiole are concave (opposite of cordate)
oblanceolate	a leaf blade that is widest above the middle (opposite of lanceolate)
obovate-cuneate	a narrow, triangular-shaped leaf with the narrower, acute angle toward the base
outcrossing	to cross fertilize with a relatively unrelated individual

palmate	radiating from a common point; generally said of veins, lobes or leaflets of a leaf
pedicel	a small stalk bearing a single flower in an inflorescence
pilose	covered with usually soft hair
pinnate	feather-like, with two rows of structures on opposite sides of an axis; generally said of veins, lobes, or leaflets arranged in two dimensions along either side of an axis
perennial	living more than 2 years or growing seasons; generally plants that are essentially nonwoody aboveground
polymorphic	the existence of more than one form of individual in the same species
protogynous	receiving pollen first; said of a flower (or plant with unisexual flowers) in which stigma receptively precedes and does not overlap pollen release
pubescent	covered with fine, soft, short hairs
raceme/racemose	unbranched inflorescence of pediceled flowers that open from the bottom to the top
recruitment	the process of adding new individuals to a population or subpopulation (as of breeding individuals) by growth, reproduction, immigration, and stocking
reestablished population	to bring a plant into an area within its range of existence where a natural occurrence of that plant is not known, but the

surrounding environment is suitable for a population of that plant to persist

reintroduced population

to bring plants into an area within its range where they once existed naturally, but for various reasons, the plant currently does not grow there

Santa Ynez soils

consist of deep, moderately well drained soils that formed in material weathered in alluvium from shale, sandstone and granite; consist of fine sandy loams that are grayish brown; moderately well drained with slow to rapid runoff and slow permeability; found on terraces and footslopes, generally with a slope of 0 to 50 percent; usually dry from late April until December and moist in some or all parts during the rest of the year; rock fragments are occasionally found in the form of shale fragments in the upper and lower surfaces; more field study is needed on this soil

selfing or self-fertilization

fertilization of a female gamete by a male gamete from the same individual

sepal

individual member of the calyx, whether fused or not; generally green

Sheridan soils

consist of coarse sandy loams that are dark grayish brown to very dark brown; soils are well-drained with medium to very heavy runoff and have moderately rapid permeability; the upper surface ranges from medium acidic to neutral; 1 to 5 percent organic matter is found in all parts to a depth of more than 51 centimeters (20 inches); found on hills that are moderately sloping to very steep; formed from weathered granite, schist, and related rocks

stamen	male reproductive structure of the flower, typically composed of a stalk-like filament and a terminal, pollen-producing anther
stigma	the part of a pistil on which pollen is normally deposited; generally terminal and elevated above the ovary on a style; generally sticky or hairy; sometimes lobed
style	stalk-like portion that connects ovary to stigma in many pistils
subcapitate	1) forming a head; 2) almost having an abruptly enlarged and globose end or head
subglobose	nearly spherical
symbiotic	partnership between different kinds of organisms, both of which benefit
tepal	three petal-like leaves that comprise a calyx and three petals, which are the modified often brightly colored leaves of the corolla of a flower

APPENDIX D. Special status species known to occur on the Monterey Peninsula or within the vicinity of Monterey, California.

Species	Listing Status Fed/State/CNPS	Habitat	Distribution	Threats
PLANTS				
<i>Allium hickmanii</i> Hickman's onion	-/-/1B	Closed-cone conifer forest, chaparral, coastal prairie, coastal scrub, valley and foothill grassland	MNT, SLO: Monterey Peninsula, Fort Ord, Monterey Airport, coastal San Luis Obispo County	urbanization, grazing, road construction
<i>Arctostaphylos edmundsii</i> Little Sur manzanita	-/-/1B	Coastal bluff scrub, chaparral	MNT: northwest coastal MNT Co.	foot traffic, nonnative plants
<i>Arctostaphylos hookeri</i> ssp. <i>hookeri</i> Hooker's manzanita	-/-/1B	Closed-cone conifer forest, chaparral, coastal scrub	MNT, SCR: extensive at Fort Ord, Prunedale Hills, Larkin Valley, scattered on Monterey Peninsula	agriculture, development, fire suppression, competition w/ introduced <i>Eucalyptus</i>
<i>Arctostaphylos montereyensis</i> Monterey manzanita	-/-/1B	Chaparral, cismontane woodland, coastal scrub	MNT: Fort Ord, Toro Mountain, Northwest MNT	
<i>Calandrinia breweri</i> Brewer's calandrinia	-/-/4	Chaparral, coastal scrub, disturbed sites, burns	CCA, LAX, MEN, MNT, MPA, MRN, NAP, SBA, SBD, SCL, SCR, SCZ, SRA, SDG, SLO, SMT, SON, VEN, BA	
<i>Castilleja latifolia</i> Monterey indian paintbrush	-/-/4	Coastal dunes, coastal sage scrub	MNT, SCZ	urbanization

Species	Listing Status Fed/State/CNPS	Habitat	Distribution	Threats
<i>PLANTS, continued</i>				
<i>Ceanothus cuneatus</i> var. <i>rigidus</i> Monterey ceanothus	-/-/4	Closed-cone conifer forest on sandy hills and flats, maritime chaparral, coastal scrub	MNT, SLO, SCR: extensive in North coastal Monterey County	coastal development
<i>Chorizanthe pungens</i> var. <i>pungens</i> Monterey spineflower	E, PCH/-/1B	Coastal dunes, coastal scrub	MNT, SCR: Monterey Pen., Fort Ord, Pebble Beach, Manresa, Sunset, Salinas Riv., near Soquel, Asilomar Beaches, Prunedale	coastal development, agriculture, hikers, equestrian activities
<i>Cordylanthus rigidus</i> var. <i>littoralis</i> seaside bird's-beak	-/E/1B	Closed-cone conifer forest, chaparral, cismontane woodland, coastal dunes, coastal scrub	MNT, SBA: coastal in both counties, Fort Ord, Monterey Airport, Elkhorn Slough, Burton Mesa	coastal development
<i>Corethrogyne leucophylla</i> branching beach aster	-/-/4	Closed-cone conifer forest, coastal dunes	MNT, SCR, SLO	coastal development
<i>Cupressus macrocarpa</i> Monterey cypress	-/-/1B	Closed-cone conifer forest	MNT: coast on Monterey Peninsula and Point Lobos	coastal development
<i>Elymus californicus</i> California bottle-brush grass	-/-/4	North coast conifer forest	MNT, MRN, SCR, SMT, SON	coastal development
<i>Ericameria fasciculata</i> Eastwood's goldenbush	-/-/1B	Closed-cone conifer forest, maritime chaparral, coastal dunes, coastal scrub	MNT: Fort Ord, Monterey Airport, Monterey Peninsula, Toro Regional Park, Prunedale Hills	coastal development

Species	Listing Status Fed/State/CNPS	Habitat	Distribution	Threats
<i>PLANTS, continued</i>				
<i>Erysimum ammophilum</i> coast wallflower	--/1B	Coastal dunes	MNT, SCR, SMT, SRO	coastal development, nonnative plants
<i>Erysimum menziesii</i> Menzies' wallflower	E/E/1B	Coastal dunes	MEN, MNT: Pt. Piños south to Cypress Pt., Marina Dunes, (extant occurrences at Pacific Grove, Spyglass Hill, Bird Rock Road), Ft. Bragg north to Ten Mile River	nonnative plants, habitat degradation, industrial and residential development
<i>Gilia tenuiflora</i> ssp. <i>arenaria</i> sand gilia	T/E/1B	Coastal dunes, coastal scrub	MNT: Spanish Bay, Asilomar State Beach, Fort Ord, Moss Landing to Monterey	nonnative plants, trampling by equestrian activities, residential development
<i>Grindelia hirsutula</i> var. <i>maritima</i> San Francisco gumplant	--/1B	Coastal bluff scrub, coastal scrub, valley foothill grasslands	MNT, MRN, SCR, SFO, SLO, SMT	coastal development, nonnative plants
<i>Layia carnosa</i> beach layia	E/E/1B	Coastal dunes	HUM, MNT, MRN, SBA, SFO: largest occurrences in HUM Co., Asilomar State Beach and Spyglass Hill in MNT Co.	coastal development, vehicles, recreation nonnative plants,

Species	Listing Status Fed/State/CNPS	Habitat	Distribution	Threats
<i>PLANTS, continued</i>				
<i>Linanthus grandiflorus</i> large-flowered linanthus	-/-/4	Coastal bluff scrub, closed-cone conifer forest, cismontane woodland, coastal dunes, coastal prairie, coastal scrub, valley foothill grasslands	ALA, KRN, MAD, MER, MNT, MRN, SBA, SCL, SCR, SFO, SLO, SMT, SON	development
<i>Lomatium parvifolium</i> small-leaved lomatium	-/-/4	Closed-cone conifer forest, chaparral	MNT, SCR, SLO	development
<i>Lupinus tidestromii</i> Tidestrom's lupine	E/E/1B	Coastal dunes	MNT, MRN, SO: Monterey Peninsula, northwest Marin Co. to the Russian River, Abbotts Lagoon to Point Reyes	residential and recreational development, trampling, nonnative plants, cattle grazing
<i>Monardella undulata</i> curly-leaved monardella	-/-/4	Chaparral, coastal dunes, coastal scrub, Lower montane conifer forest (ponderosa pine sandhills)	MNT, MRN, SBA, SCR, SFO, SLO, SMT, SON	coastal development, sand mining, nonnative plants
<i>Pedicularis dudleyi</i> Dudley's lousewort	-/R/1B	Maritime chaparral, North coast conifer forest, valley foothill grasslands	MNT, SCR, SLO, SMT	trampling, potentially by development
<i>Pinus radiata</i> Monterey pine	-/-/1B	Closed-cone conifer forest on poor soils in fog zone	MNT, SCR, SLO, SMT, BA: coastal areas near MNT, Año Nuevo and Cambria; 2 islands near Baja	genetic contamination, development, fragmentation, feral goats on Baja Islands

Species	Listing Status Fed/State/CNPS	Habitat	Distribution	Threats
PLANTS, continued				
<i>Piperia michaelii</i> Michael's rein orchid	-/-/4	Coastal bluff scrub, closed-cone conifer forest, cismontane woodland, lower montane conifer forest	ALA, CCA, HUM, MNT, MRN, SBT, SCR, SCZ, SFO, SLO, SMT	
<i>Trifolium polypodon</i> Pacific Grove clover	-/R/1B	Closed-cone conifer forest, coastal prairie, meadows	MNT: Monterey Peninsula and Point Lobos	urbanization, trampling
INVERTEBRATES				
<i>Euphilotes enoptes smithi</i> Smith's blue butterfly	E/-	Coastal dunes with the larval host plant <i>Eriogonum parvifolium</i>	MNT: Marina Dunes, Seaside,	coastal development
AMPHIBIANS				
<i>Ambystoma macrodictylum croceum</i> Santa Cruz long-toed salamander	E/E	mammal burrows and root systems of upland chaparral and woodland areas of Coast live oak or Monterey Pine	SCZ, MNT: Buena Vista, Calabasas, Ellicott, Green's, Rancho Road, Seascape Ponds, Valencia Lagoon in SCZ Co.; Bennett, McClusky, and Moro Cojo Sloughs, and McClusky pool in MNT Co.	predation, contaminants, loss of habitat, urbanization, vehicles, salt- water intrusion, urban and agricultural runoff
<i>Rana aurora draytonii</i> California red-legged frog	T/-	aquatic breeding areas (streams, ponds, creeks, marshes, lagoons) within a matrix of riparian and upland dispersal habitats	coastal drainages from Marin County, California, south to northern Baja California, Mexico	elimination or degradation of habitat from land dvlpmnt and land use activities; habitat invasion by non-native species

Species	Listing Status Fed/State/CNPS	Habitat	Distribution	Threats
BIRDS				
<i>Falco peregrinus anatum</i> American peregrine falcon	-/E	nest almost exclusively on cliff ledges that are associated with suitable foraging areas, also on structures in heavily urbanized areas	historically nested from the North American boreal forest south into Mexico	pesticides, organo-chlorines, shooting, transmission lines, electrocutions, contaminated prey species

KEY

Federally Listed Species Codes

E - Endangered T - Threatened CH - Critical habitat

PE - Taxa proposed for listing as endangered

PT - Taxa proposed for listing as threatened

PCH - Critical habitat has been proposed

C - Candidate species for which we have on file sufficient information on the biological vulnerability and threats to support proposals to list as endangered or threatened.

State Listed Species Codes

E - Endangered T - Threatened P - Protected Species

FP - Fully Protected Species

SCE - State candidate for listing as Endangered

SCT - State candidate for listing as Threatened

CSC - California Special Concern Species

California Native Plant Society (CNPS) Codes

1A - Plants presumed Extinct

1B - Plants Rare, Threatened, or Endangered in California and elsewhere

2 - Plants Rare, Threatened, or Endangered in California, but more common elsewhere

3 - Plants about which we need more information (A Review List)

4 - Plants of limited distribution (A Watch List)

County Abbreviations

ALA - Alameda, BA - Baja, Mexico, CCA - Contra Costa, HUM - Humboldt, KRN - Kern, LAX - Los Angeles, MAD - Madera, MER - Merced, MEN - Mendocino, MNT - Monterey, MPA - Mariposa, MRN - Marin, NAP - Napa, SBA - Santa Barbara, SBD - San Bernardino, SBT - San Benito, SCL - Santa Clara, SCR - Santa Cruz, SCZ - Santa Cruz Island, SDG - San Diego, SFO - San Francisco, SLO - San Luis Obispo, SMT - San Mateo, SON - Sonoma, SRA - Santa Rosa Island