

Recovery Plan for Five Plants from Monterey County, California

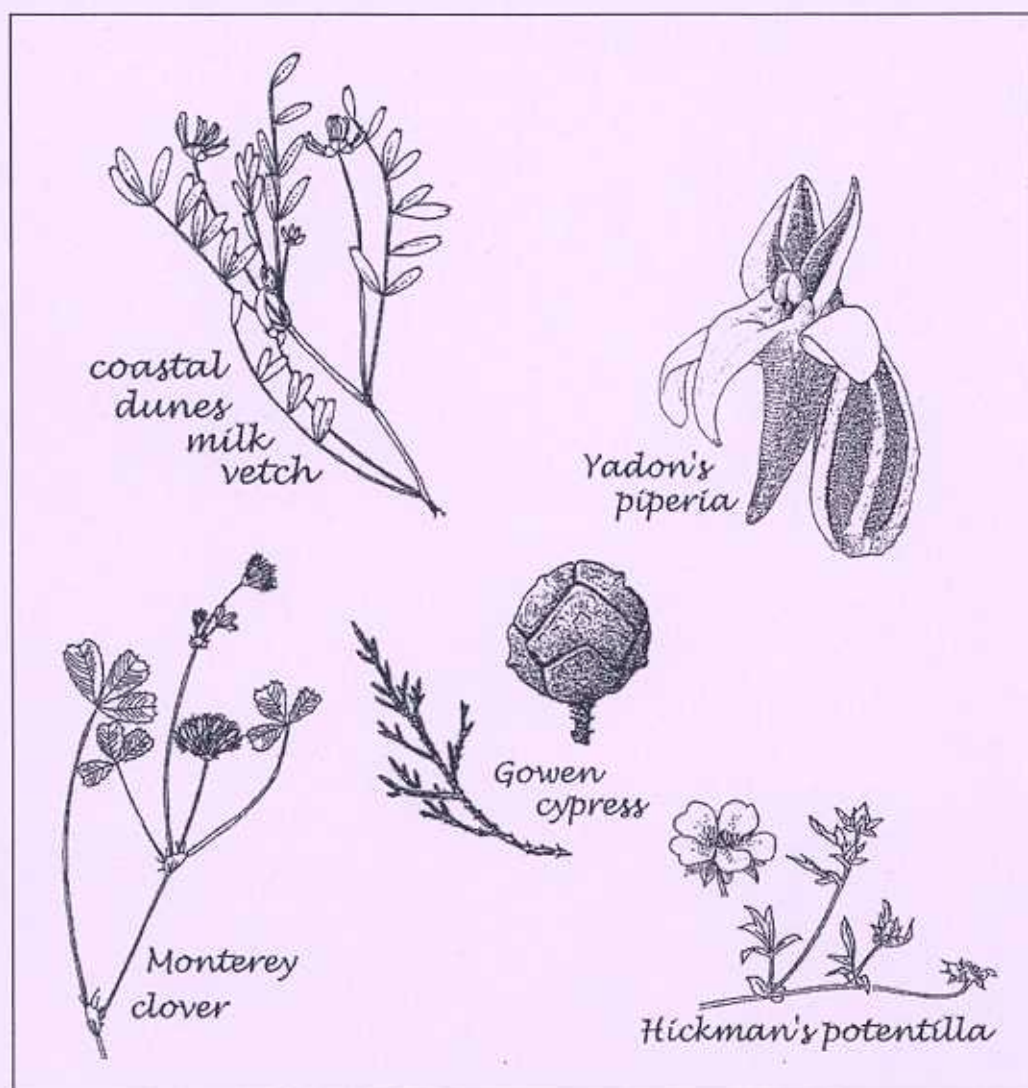
Astragalus tener var. *titi* (Coastal dunes milk-vetch)

Piperia yadonii (Yadon's piperia)

Potentilla hickmanii (Hickman's potentilla)

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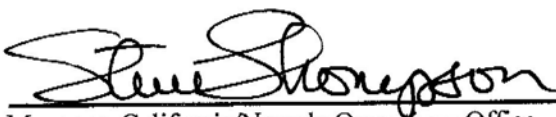
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Region 1
U.S. Fish and Wildlife Service
Portland, Oregon

Approved: 

Manager, California/Nevada Operations Office,
Region 1, U.S. Fish and Wildlife Service

Date: 8/19/2004

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DISCLAIMER

Recovery plans delineate reasonable actions that are believed to be required to recover and/or protect listed species. We, the U.S. Fish and Wildlife Service, publish recovery plans, sometimes preparing them with the assistance of recovery teams, contractors, State agencies, and other affected and interested parties. Recovery teams serve as independent advisors to us. Plans are reviewed by the public and submitted to additional peer review before they are adopted by us. Objectives of the recovery plan will be attained and necessary funds made available subject to budgetary and other constraints affecting the parties involved, as well as the need to address other priorities. Recovery plans do not obligate cooperating or other parties to undertake specific tasks, and may not represent the views nor the official positions or approval of any individuals or agencies involved in the recovery plan formulation, other than our own. They represent our official position **only** after they have been signed by the Director, Regional Director, or California/Nevada Operations Manager as **approved**. Approved recovery plans are subject to modification as dictated by new findings, changes in species status, and the completion of recovery actions.

Literature citation of this document should read as follows:

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An electronic version of this recovery plan will also be made available at <http://pacific.fws.gov/ecoservices/endangered/recovery/default.htm> and <http://endangered.fws.gov/recovery/index.html>

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EXECUTIVE SUMMARY

Current Species Status: This recovery plan addresses 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 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 on the west side of 17-Mile Drive in 1999 with none of these plants flowering in 2000.
- *Piperia yadonii* (Yadon's piperia) is centrally distributed within large undeveloped tracts of *Pinus radiata* (Monterey pine) forest. Its range extends from the Los Lomos area near the Santa Cruz County border 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.
- *Potentilla hickmanii* (Hickman's potentilla) currently occurs 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. Between 2,000 and 3,000 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, two locations in the Huckleberry Hill area 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) on 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).

Habitat Requirements and Limiting Factors: All 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 historically occurred in both Los Angeles and San Diego Counties.

Astragalus tener var. *titi* occurs on sandy soil 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. These five plant taxa are threatened by one or more of the following factors: alteration, destruction, and fragmentation of habitat resulting from urban development and recreational activities (*i.e.*, golf course development and ongoing maintenance, equestrian activities, etc.); 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: Our objective is to recover these species sufficiently 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:

Downlisting criteria for *Astragalus tener* var. *titi*, *Piperia yadonii*, *Potentilla hickmanii*, and *Trifolium trichocalyx* are summarized below. Delisting criteria should be provided for these species in future revisions of this recovery plan when additional information about their biology is available.

- Provide permanent protection of habitat presently occupied by the species and the surrounding ecosystem upon which they depend. Include long-term commitments to conserve the species and provide funding for long-term management.
- In protected habitat, provide successful control of invasive, nonnative plants and successful management of other threats, including but not limited to snails, deer, pedestrians, recreation, and fire suppression activities. Management success must be demonstrated through at least 12 years (based on a 12-year weather cycle) of biological monitoring. This amount of time (and possibly more) is needed to observe management effectiveness, making adjustments as necessary.
- Develop management strategies based on life-history research and quantification of species' responses to vegetation management.
- Conduct successful reintroductions or establishment of populations of *Astragalus tener* var. *titi*, *Potentilla hickmanii*, and *Trifolium trichocalyx*.
- Conduct monitoring that demonstrates long-term viability of existing populations, including successful recruitment and reproduction.
- Establish seed banks for the taxa at a recognized institution.

Delisting criteria for *Cupressus goveniana* ssp. *goveniana* include:

- Monitoring of both populations over at least 10 years shows long-term reproductive success, and protected habitat is of adequate size to support ecosystem function and allow population expansion.
- Monitoring shows successful recruitment has caused an increase in population size in both populations.
- A prescribed burn plan or successful alternative management strategy is implemented.
- A seed bank is established at a recognized institution.

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 history characteristics and 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 a public outreach program.
8. Reevaluate recovery criteria and revise recovery plan in the future based on Actions 1 through 7.

Recovery Costs: \$1,645,000 over the next 12 years, 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*. Funding opportunities and management would need to be developed between landowners, regulatory agencies, nonprofit organizations, and other interested parties.

Date of Recovery: Meeting the recovery objective for *Astragalus tener* var. *titi*, *Piperia yadonii*, *Potentilla hickmanii*, and *Trifolium trichocalyx* (whose current objectives are downlisting to threatened status) depends on 1) how soon habitat can be secured and monitoring programs begin; 2) assurances that ecosystem and community processes of surrounding habitat are maintained; and 3) establishment of additional populations of *A. tener* var. *titi*, *P. hickmanii*, and *T. trichocalyx* that are successfully reproducing. At least 12 years (based on a 12-year weather cycle) of monitoring would be needed to assure that site management benefits these plants. If the recovery criteria have been met by 2016, these species may be considered for downlisting.

For *Cupressus goveniana* ssp. *goveniana*, the speed with which delisting objectives can be met depends on determining effective means of managing secured areas and improving the surrounding habitat, and monitoring to determine whether successful recruitment has caused an increase in the overall size of both populations. Twelve years of monitoring or more may be needed to assure that site management is appropriate. If the recovery criteria have been met by 2016, 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 on August 12, 1998 (U.S. Fish and Wildlife Service 1998). The five taxa are found primarily along the coast of northern Monterey County, California (Figures 1, 2, and 3). Additionally, *Potentilla hickmanii* occurs in San Mateo County with a historical occurrence in Sonoma County (Figures 1 and 2). *Astragalus tener* var. *titi* has historical occurrences in Los Angeles and San Diego Counties (Figure 1).

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, biology, and threats for each species. The plan recommends: 1) measures for a program that will develop and implement strategies for effective management of existing populations; 2) surveys for identifying additional populations; and 3) establishment of 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.

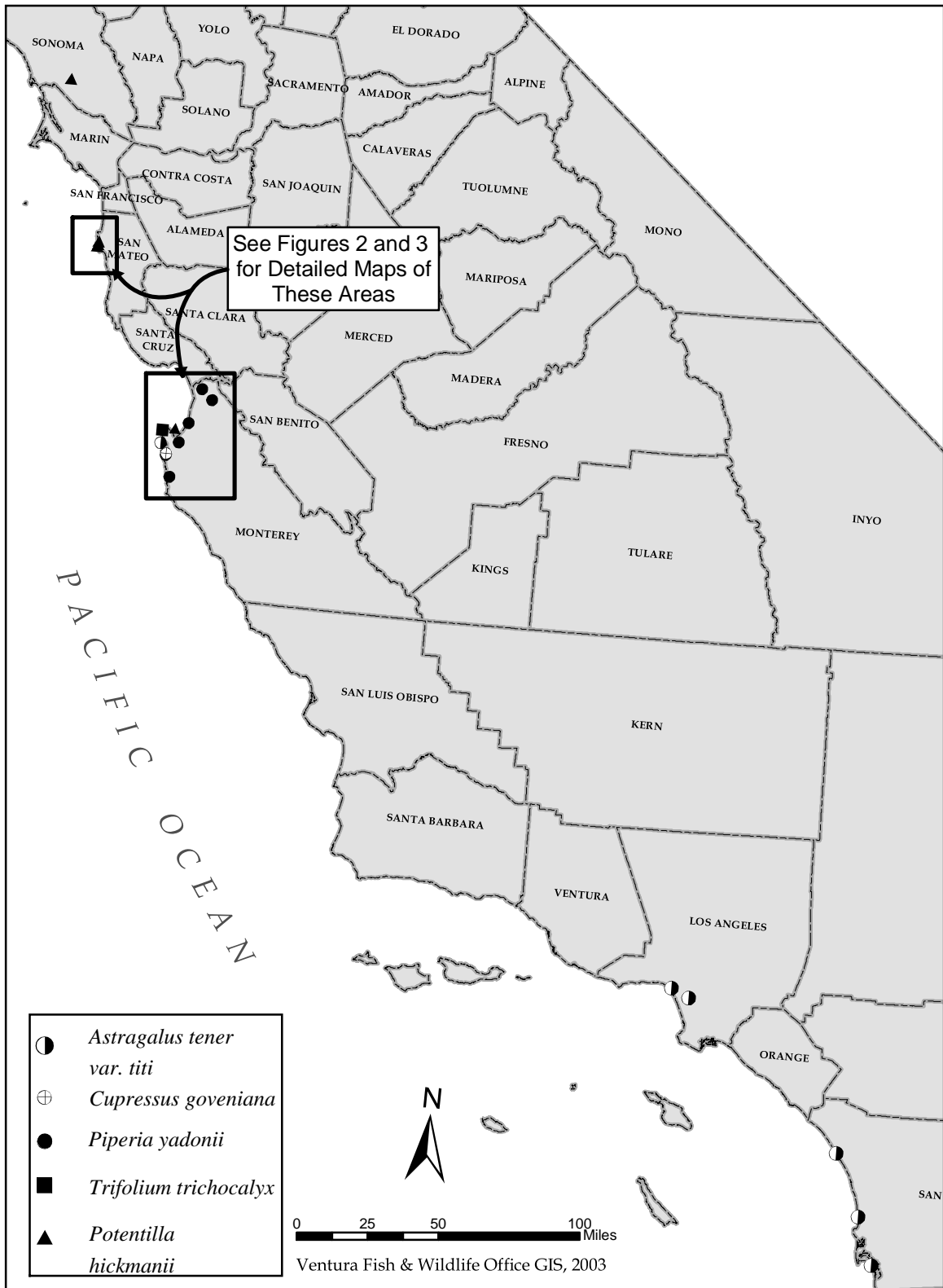


Figure 1. Historical Distribution of *Astragalus tener* var. *titi*, *Cupressus goveniana* ssp. *goveniana*, *Piperia yadonii*, *Potentilla hickmanii*, and *Trifolium trichocalyx*.

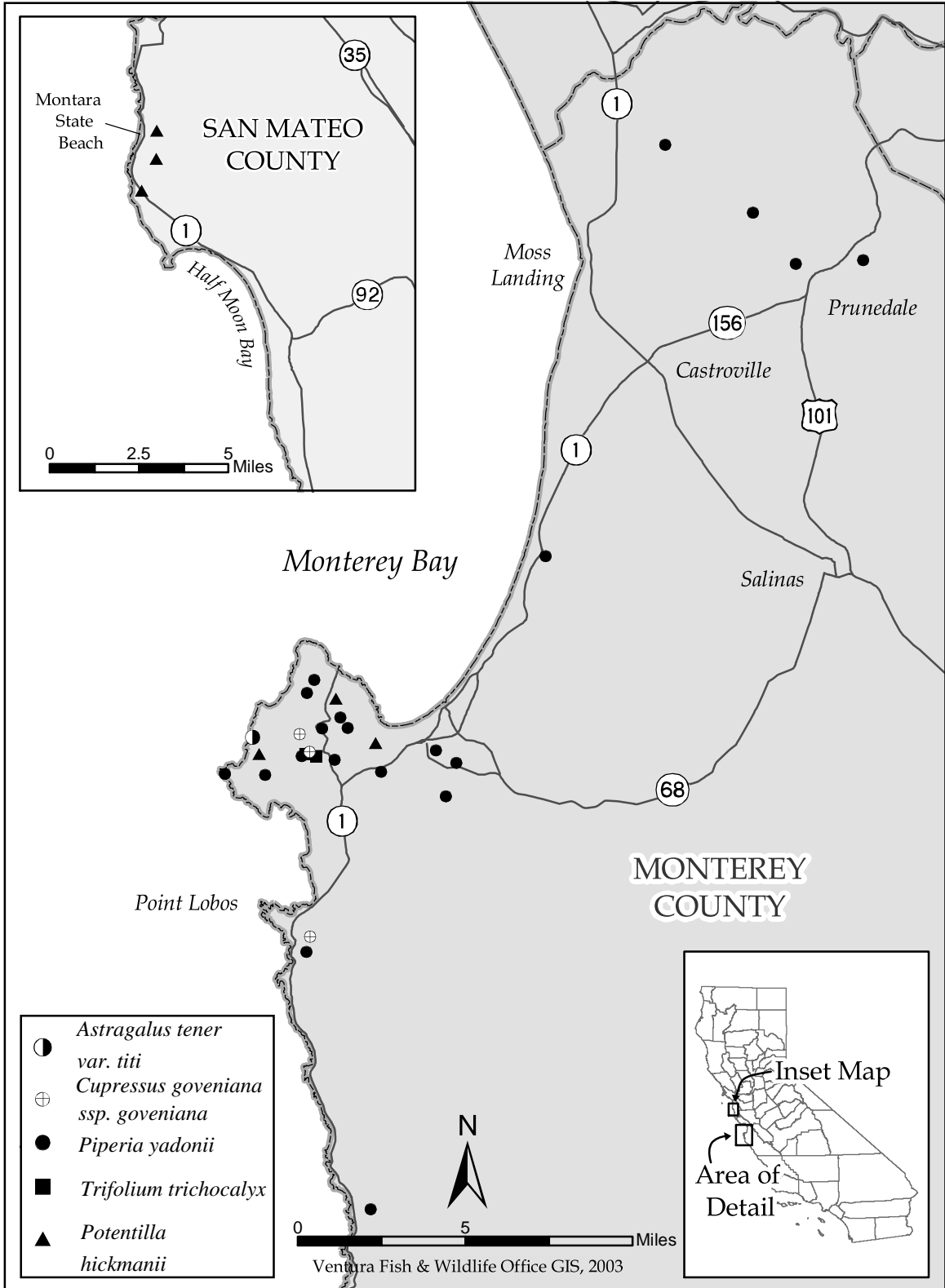
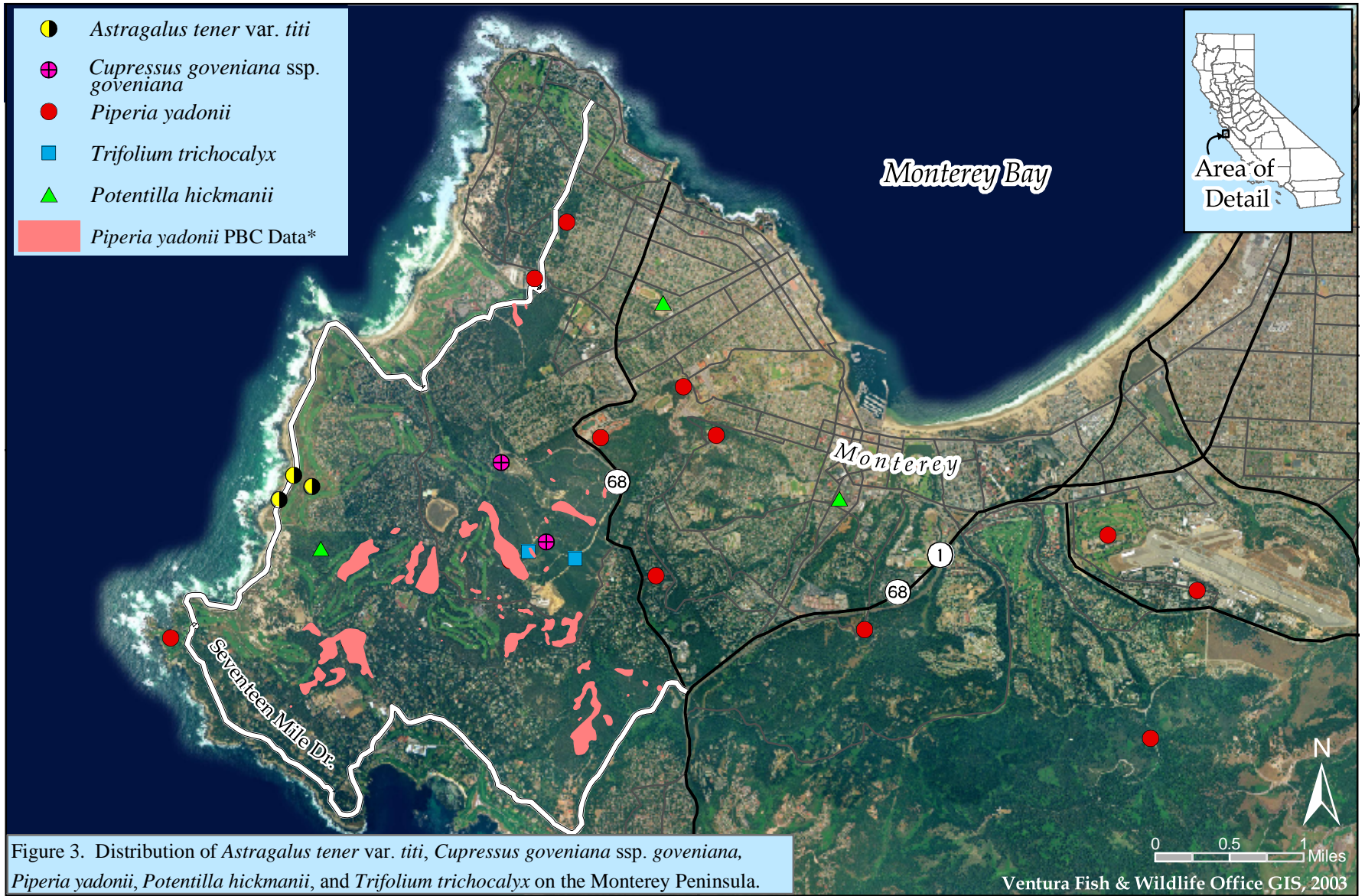


Figure 2. Current Distribution of *Astragalus tener* var. *titi*, *Cupressus goveniana* ssp. *goveniana*, *Piperia yadonia*, *Potentilla hickmanii*, and *Trifolium trichocalyx*.



Data Sources: Aerial Imagery by AirPhoto USA, April 2000, California Natural Diversity Database November, 2002.* Pebble Beach Company Data, 2003 (unpublished).

Three appendices included in this recovery plan provide additional information for the reader. Appendix B provides a summary of comments on the draft recovery plan from peer reviewers and the public. Appendix C details management actions outlined in this recovery plan and relates them to a list of the threats identified for each of the species as documented in the listing final rule (U.S. Fish and Wildlife Service 1998). Appendix D provides a glossary of technical terms mentioned throughout this recovery plan.

B. General Description of the Monterey Area¹

1. History

The earliest known inhabitants of the Monterey Peninsula were a Hokan-speaking primitive people called the Essalen. 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. However, 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 (*i.e.*, the Presidio of Monterey). The mission was later moved to Carmel. Additionally, a few people began living outside the Presidio in ranchos by the early 1840's. By this time the Presidio was 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, in addition to settlements by Japanese abalone divers and Portuguese whalers off Carmel Bay. Tourism took precedence over whaling during the late 1800's while sardine harvesting began in the 1920's, thus developing the famed Monterey Cannery Row. By the end of the 1940's, sardines began to disappear, pollution worsened, and the fisheries industry was lost. The sardines later vanished in the early 1950's. Today, the economy depends on tourism and

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

exclusive, affluent property. Increasing conversion of ranches and farms has recently spread into Monterey County, although the County has insulated itself from development pressures found in other parts of California. The Monterey area (including the Peninsula) harbors the cities of Monterey, Pacific Grove, Carmel-by-the-Sea, Seaside, Sand City, and Marina, and the unincorporated Del Monte Forest area of Monterey County (including Pebble Beach Company property).

2. Landscape

The ocean cut terraces into the coastal Monterey landscape during glacial times (see Appendix E), placing beach deposits over the area as ocean waters retreated. 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, which includes the Cities of Monterey and Pacific Grove and the community of Pebble Beach. The landscape of the Monterey area has been converted from thick Monterey pine forests, pristine coastal dunes, and beaches to scattered pine forests mixed with golf courses and developed coastal areas to accommodate its growing human population. A number of fairly pristine, protected areas have been established, including the Point Lobos State Reserve, the Samuel F.B. Morse Botanical Reserve, the Huckleberry Hill Preserve, and 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). Temperatures increase significantly approximately 14 kilometers (9 miles) from Monterey Bay

inland toward the City of Salinas. The coastal area is foggy with a wet, marine layer that usually dissipates by late afternoon during summer months.

4. Habitats

The Monterey area is rich in endemic species. This area represents the northern or southern limit of many plant species ranges. This “range limit” for these plant species may be directly related to the geologic morphology of the area, such as the extremely deep, underwater canyon that occurs in Monterey Bay. This deep canyon has branch canyons to the north and south that reach close to shore, causing sites of intense upwelling of colder water that provide greater fog frequency. 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*) (see Appendix E for more detailed information on vegetation communities). Scientists have debated why Monterey’s Monterey pine forest (constituting *Pinus radiata*, *Pinus muricata* [Bishop pine], *Cupressus macrocarpa* [Monterey cypress], and *Cupressus goveniana* ssp. *goveniana*) is isolated from other closed-cone pine forests in Año Nuevo to the north and Cambria to the south. Both of these forests harbor only *Pinus radiata*. 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).

The Monterey area also has marshy areas, remnant patches of coastal prairies, and extensive 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. Additionally, shoreline mesas and cliffs that harbor many flowering plants (e.g., *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. Regions around the Monterey area include humid coastal canyons, coastal mountains, and fertile valley lands, resulting in a floristically rich area.

Periodic fires are a natural component of healthy Monterey pine forests, coastal sage scrub, and chaparral communities. During 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 periods of time. Today, homes and villages occur throughout the Monterey Peninsula and other areas along coastal California that historically burned. Fire suppression is a common practice because of the potential loss to persons and property. A tremendous amount of money and effort go into protecting the communities from being destroyed by fire. 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. Monterey pine cones can open without fire, resulting in modest recruitment of trees. However, optimum conditions for reestablishment of Monterey pines and other understory species occur with fire.

II. SPECIES ACCOUNTS

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

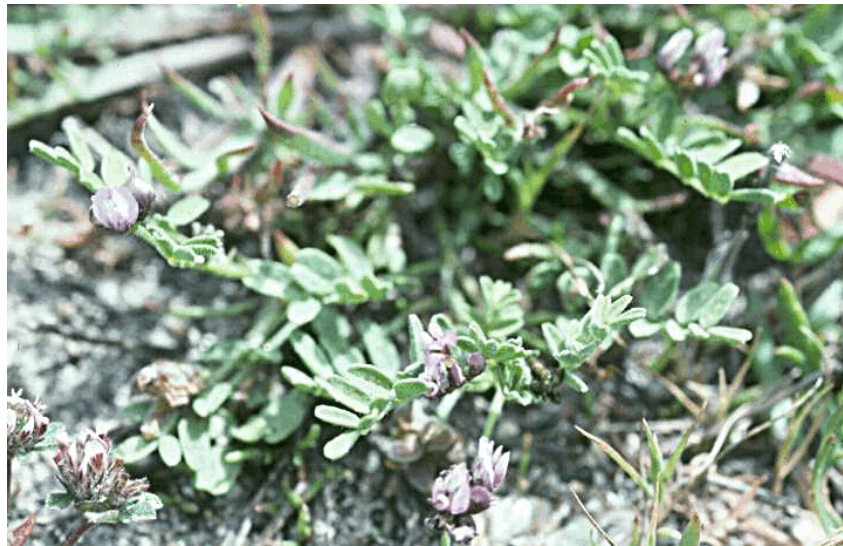
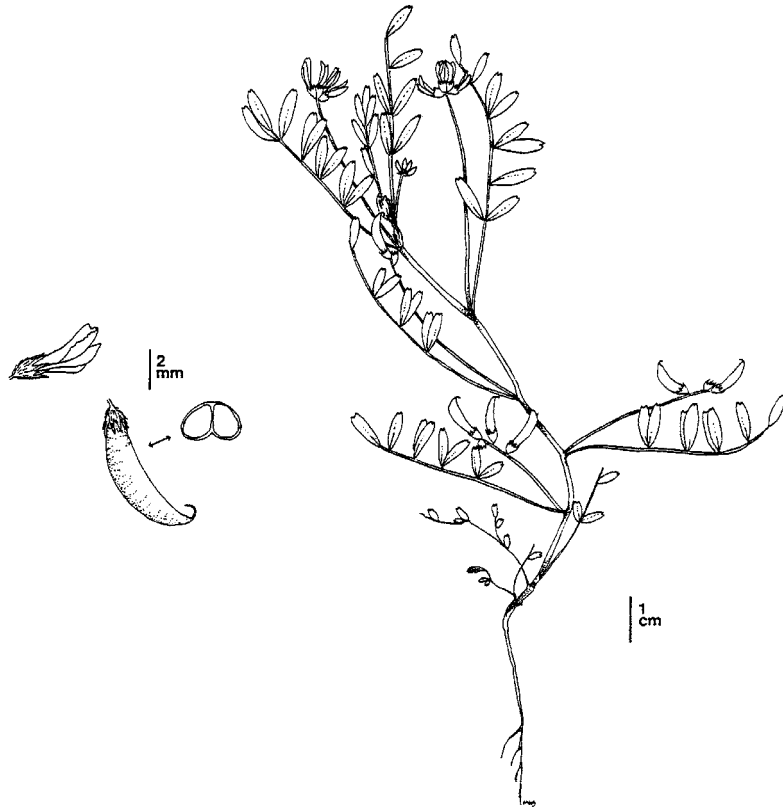
(Recovery Priority Number: 6C)

1. Taxonomy and Description

Astragalus tener var. *titi* (Figure 4) was first collected by Mrs. Joseph Clemens in 1904. It was first described by Alice Eastwood as *Astragalus titi* based on those specimens collected by Clemens near Moss Beach, Monterey (Eastwood 1905). Eastwood named the plant *A. 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. tener* var. *titi* and confirmed two different plants, 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. *Astragalus tener* var. *tener* is native to alkaline grass flats in the Central Valley, San Francisco Bay region, and the lower Salinas Valley (Barneby 1950). Additionally, crossing studies and enzyme electrophoresis concluded that *A. tener* var. *titi* is a valid taxon (Liston 1992).

Astragalus tener var. *titi* is a small annual herb from the legume family (Fabaceae). Stems are slightly pubescent and reach 2 to 12 centimeters (0.8 to 4.7 inches) in height, and up to approximately 20 centimeters (8 inches) under cultivation (V. Yadon *in litt.* 2002). 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. Hairs of the peduncle may be white (V. Yadon *in litt.* 2002). An easily seen feature of the plant is copious black-spreading hairs covering the calyces and pedicels, some of which are dark maroon-red on close examination (V. Yadon *in litt.* 2002). Flowers are 5 to 6 millimeters (0.3 inch) long and 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). Additionally, each capsule commonly produces 4 seeds (V. Yadon *in litt.* 2002).

Figure 4. Illustration and photograph of *Astragalus tener* var. *titi* (coastal dunes milk-vetch). Drawing by Mary Ann Showers, used by permission of the California Department of Fish and Game. Photo by Dr. Dean Wm. Taylor, Jepson Herbarium



Individual plants (depending on the amount of competition with other species) may be single- or multi-branched and produce more than 60 pods whose seeds may remain viable for more than 1 year (M. Stromberg, University of California, Hastings Reserve *in litt.* 2002).

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. It is unlikely that suitable habitat exists in those locations today. This taxon has not been collected in Los Angeles County since 1903. Historical habitat in the Silver Strand area is owned by the Department of Defense (Miramar Naval Weapons Center). A portion of this area is used for amphibious vehicle training exercises. Another part of the Silver Strand area is leased by the Navy to the California Department of Parks and Recreation 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 taxon 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 in Monterey County. This site is along 17-Mile Drive on the western edge of the Monterey Peninsula near Bird Rock. 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 single population included approximately 4,000 individuals that were known to occur on both sides of 17-Mile Drive, along Bird Rock Road, and at a horse jumping area on Monterey Peninsula Country Club property (Jones and Stokes Associates 1996).

An enclosure was built by the Pebble Beach Company on the west side of 17-Mile Drive to provide protection to *Astragalus tener* var. *titi* plants on their property. Surveys conducted in this enclosure found hundreds of individuals in 1998, likely fewer than 200 plants in 1999, and no flowering individuals in 2000 (Doak *et al.* 2000). During 2002, no plants were observed in the enclosure while multiple individuals were found to successfully bloom outside the enclosure in areas where light disturbance was evident. Therefore, new management measures (*e.g.*, light pedestrian traffic) may be warranted (V. Yadon *in litt.* 2002).

Additionally, remnant patches of habitat suitable for *A. tener* var. *titi* remain in the vicinity. However, these habitat patches 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

A single population of *Astragalus tener* var. *titi* occurs on relatively flat coastal terrace areas within 30 meters (100 feet) of the ocean beach and 8 meters (25 feet) above sea level. Prior to European settlement, *A. tener* var. *titi* likely occurred adjacent to coastal terrace grassland in vernal wetland areas that became dry in the summer (Stromberg *et al.* 2001). Today, plants occur primarily on Antioch soils, with a few colonies found on compacted Sheridan soils (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 have also been 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 that are 10 to 15 centimeters (4 to 6 inches) tall (Doak *et al.* 2000). Additionally, *A. t.* var. *titi* is likely tolerant of slightly saline soil conditions due to the plants' exposure to ocean sprays and periodic saturation from salt water inundation (Jones and Stokes Associates 1996).

Astragalus tener var. *titi* plants will germinate and grow to healthy maturity in areas of low-level disturbance, such as that caused by gophers or light pedestrian traffic (Doak *et al.* 2000, M. Stromberg *in litt.* 2002). Research conducted on

plants under cultivation confirms that any competition or shading will result in unhealthy plants (V. Yadon, *in litt.* 2002, M. Stromberg *in litt.* 2002).

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 gracilis* (goldfields). The occurrence of *Plantago coronopus* and *Lasthenia gracilis* may be good indicator species of the appropriate habitat conditions needed for *A. tener* var. *titi* (Jones and Stokes Associates 1996). No associations of *A. tener* var. *titi* with other biotic or abiotic variables (*e.g.*, soil moisture, amount of bare ground, percent cover of other plant species) have been found (Doak *et al.* 2000).

4. Life History/Ecology

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

Studies of seed production indicated that the average number of seeds produced per plant was approximately 33, and a statistically significant positive relationship existed between *Astragalus tener* var. *titi* density and number of seeds produced per plant (Doak *et al.* 2000). This result may indicate that 1) significant competition exists between plants when plants are at high densities; or, 2) 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). However, several populations of this plant have been observed in greenhouse conditions, under which variation in seed production between years was evident (M. Stromberg *in litt.* 2002). Additionally, wild populations may produce no seeds during dry years

(M. Stromberg *in litt.* 2002), potentially resulting in a lower density of individuals in subsequent years.

Under cultivation, seed capsules may burst and throw their seeds up to 2 meters (6.5 feet) (V. Yadon *in litt.* 2002). Many capsules are not dehiscent and simply drop to the soil where they may float to other areas to colonize if those areas become flooded during winter rains (V. Yadon, *in litt.* 2002). Additionally, plants may hold their capsules well into summer months, with some remaining green into late July (V. Yadon, *in litt.* 2002).

5. Reason for Listing

Astragalus tener var. *titi* was federally listed as endangered on August 12, 1998 (U.S. Fish and Wildlife Service 1998). 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 modifications in hydrology (resulting from improvements or maintenance activities along 17-Mile Drive) and alteration of habitat from trampling associated with recreational activities (*e.g.*, hiking, picnicking, ocean viewing, wildlife photography, equestrian use, golfing). Additionally, early mowing of grasses (as they begin to brown) to accommodate single-purpose fire regulations may seriously affect this species (V. Yadon *in litt.* 2002). The current population of *A. tener* var. *titi* in Monterey County is also highly fragmented. The small population size and 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 (*e.g.*, change in surface water flow due to golf course watering) that could negatively affect a significant portion of the remaining plants. *Astragalus tener* var. *titi* is also threatened with competition from nonnative *Carpobrotus edulis*, *Plantago coronopus*, and *Carex pansa* (Pansa

sedge). These species are spreading both within and outside of the fenced protective enclosure along 17-Mile Drive (Jones and Stokes Associates 1996; H. Crowell, pers. obs. 2001). Additionally, nonnative *Hainardia cylindrica* (unnamed grass), *Distichlis spicata* (salt grass), and *Juncus* spp. (rush) occur in target locations. No germination or growth of *A. tener* var. *titi* was found to occur during 1999 and 2000 (Doak *et al.* 2000) or in 2002 (V. Yadon, *in litt.* 2002) in existing *Carex pansa* areas or in a mixed vegetative area within the enclosure. These surveys also indicate that in years with heavy rainfall, this protective enclosure may not contain the best habitat for the species (Doak *et al.* 2000).

Predation of seeds and herbivory by animal and insect species may reduce survivorship of *Astragalus tener* var. *titi*. California voles (*Microtus californica*) are known to harvest seeds of many species along 17-Mile Drive, including along the edge of the Monterey Peninsula Country Club (V. Yadon, *in litt.* 2002). Earwigs, snails, slugs, lepidopteran larvae (specifically cabbage butterfly [*Pieris rapae*] larvae), and aphids are documented to feed on cultivated *A. tener* var. *titi* (V. Yadon, *in litt.* 2002, M. Stromberg *in litt.* 2002). A lack of native predators that normally prey on species such as voles and butterfly larvae may have resulted in larger numbers of these animal and insect species. Additionally, the excessive number of deer (up to 100 individuals per square mile) on the Monterey Peninsula are likely affecting reproduction of this species (M. Stromberg *in litt.* 2002).

Astragalus tener var. *titi* occurring on the east side of 17-Mile Drive (*i.e.*, Monterey Peninsula Country Club property) are vulnerable to ongoing equestrian use along trails, recreational golfing activities, and likely effects of fertilizers and pesticides. Individuals of *A. tener* var. *titi* are known to occur within 1 meter (approximately 3 feet) of the managed turf (*i.e.*, golf areas to include the rough, fairway, and green) (Ferreira 1995).

6. Conservation Measures

Studies of *Astragalus tener* var. *titi* were conducted in 1998 and 1999 by Doak *et al.* (2000), supported by funds received through section 6 of the Endangered Species Act. The focus of these studies was 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 the fenced protective enclosure in 1989 as a condition of permit approval by the California Coastal Commission to conduct various construction-related activities in the area. The enclosure was built on the west side of 17-Mile Drive to reduce inadvertent trampling from both passive and active recreational activities. It includes a narrow buffer zone and protects approximately 930 square meters (10,000 square feet) of the terrace from foot and vehicle traffic. The Pebble Beach Company has been managing and monitoring the population within the enclosure for several years (M. Zander, Zander Associates, *in litt.* 1996). Additionally, the Pebble Beach Company planted approximately 380 plants along 17-Mile Drive in 1993, with plans to cultivate additional *Astragalus tener* var. *titi* in their nursery for eventual establishment (M. Zander *in litt.* 1996). Success measures from these plantings have not yet been reported to us.

As of 1996, no new development activities had been proposed for areas that support *Astragalus tener* var. *titi* on Pebble Beach Company property. The Company's stated long-term goal is to preserve and enhance the existing population (M. Zander *in litt.* 1996). The Pebble Beach Company has also implemented a directed program to eradicate invasive, nonnative species (*e.g.*, *Carpobrotus edulis*) (Ferreira 1995, M. Zander *in litt.* 1996). However, no information is available on the effects of Pebble Beach Company's exotic species removal activities as there are no records for when or where weed removal activities are conducted (R. Spruance, Environmental Programs, Pebble Beach Company, pers. comm. 2003).

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

(Recovery Priority Number: 2C)

1. Taxonomy and Description

Piperia yadonii (Figure 5) was first collected by Leroy Abrams in 1925 in open pine forest near Pacific Grove. It was originally identified as a polymorphic (having or occurring in several distinct forms), wide-ranging species in the

Figure 5. Illustration and photographs of *Piperia yadonii* (Yadon's piperia). Drawing used with permission by James D. Ackerman, Ph.D., and Lindleyana Scientific Journal of the American Orchid Society.

- A = entire plant
- B = fully open flower, 3/4 view
- C = dorsal sepal
- D = lateral sepal
- E = petal
- F = lip
- G = column, with anther and extended stigma

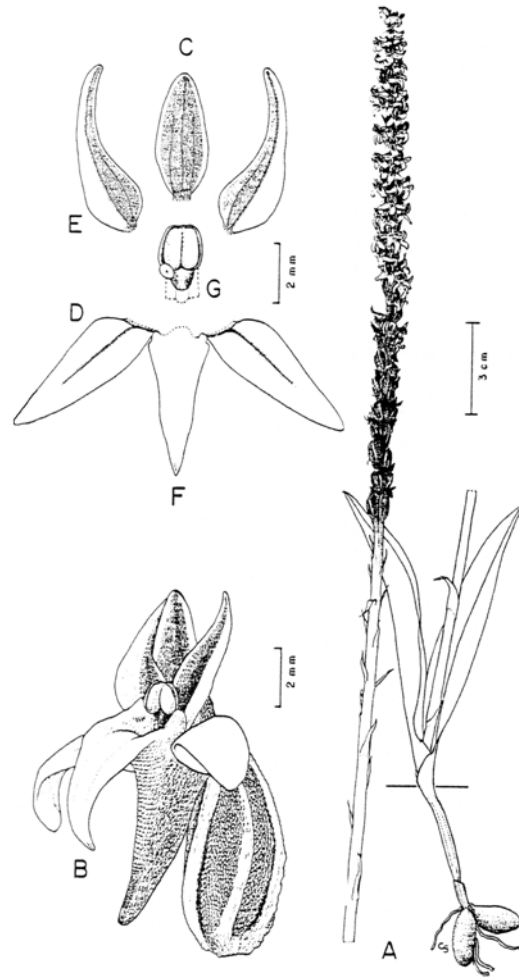


Photo taken by Luis Acevedo



Photo taken by John Game

western United States known as *Piperia unalascensis* (Morgan and Ackerman 1990). At least two naturalists (*i.e.*, George Henry Grinnel and Leroy Abrams) who collected from the Monterey region in the 1920's noted the uniqueness of the plants from this locality (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 (which would eventually include *P. yadonii*). 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 (*i.e.*, *Piperia yadonii*) was named after Vernal Yadon, Director Emeritus 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 2 or 3 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 typically 20 to 50 centimeters (8 to 20 inches) tall, with some reaching as high as 80 centimeters (31 inches) (A. Graff *in litt.* 2002). Spikes have an average of 56 flowers spirally arranged along the axis (A. Graff *in litt.* 2002). Flowers are arranged in a dense narrow-cylindrical raceme (unbranched cluster). Up to 100 flowers have been observed under cultivation, each consisting of 3 petal-like sepals and 3 petals (together referred to as tepals) (V. Yadon *in litt.* 2002). The most easily distinguished characteristic of *P. yadonii* are green and white upper three tepals and white lower three tepals. However, flowers appearing late in the flowering season may be entirely creamy white and not show green features (V. Yadon *in litt.* 2002). The lower-most 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 such that the tip nearly touches the spur (2.5 millimeters [0.09 inch] long) of the flower (Morgan and Ackerman 1990). *Piperia 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. *Piperia yadonii* extends from the Los Lomos area in the north, near the border of Santa Cruz County (Allen 1996; V. Yadon, Pacific Grove Museum of Natural History, *in litt.* 1997), south to Palo Colorado Canyon, approximately 25 kilometers (15 miles) south 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). Plants have also been found east of Point Lobos State Reserve and east of the Monterey Peninsula. The most southerly location, near Palo Colorado Canyon, supported approximately 38 individuals in maritime chaparral when it was last surveyed a decade ago (J. Norman *in litt.* 1995). *Piperia 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 (located 16 to 24 kilometers [10 to 15 miles] inland) was searched, and four unidentified *Piperia* sp. plants were found. However, the habitat was reported to not be that favored by *P. yadonii* (Allen 1996).

During rangewide surveys conducted in 1995 and 1996, and funded by the Pebble Beach Company, Allen (1996) reported a total of 82,712 individuals over approximately 144 hectares (355 acres). During the 1995 and 1996 surveys, the greatest concentrations of *P. yadonii* (approximately 57,000 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 occurred 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). The remainder

occurred in large stands and remnants of the Del Monte Forest, owned primarily by the Pebble Beach Company. Plants were often densely clustered, with 100 to 200 plants per square meter (9 to 19 per square foot) (Allen 1996). A more thorough census was conducted in 2004 of the Del Monte Forest areas that support *P. yadonii* and are proposed for development and as mitigation for development. The census reconfirmed that the two largest occurrences of *P. yadonii* on the Monterey Peninsula are at the sites referred to as MNOUV, consisting of about 116 acres of Monterey pine forest, and at PQR, consisting of about 233 acres of Monterey pine forest (Monterey County PBID 2004). In 2004 MNOUV supported about 57,200 *P. yadonii* plants and PQR supported about 56,100 *P. yadonii* plants (Ecosystems West Associates 2004). Together these areas supported about 87 percent of all the plants found in the censused parcels. While the numbers of plants at these locations were about three times greater than those identified in 1996, their distribution across the parcels did not appear strikingly different from 1996 (Service interpretation of maps provided by Zander Associates and WWD Corporation 2004). Of the 14 smaller sites censused in 2004, 9 also supported greater numbers of plants than identified in 1996 surveys and 5 supported fewer plants. The specific effects of increases or decreases in numbers of above-ground plants on population viability are difficult to assess for plants which have seed banks or other dormant underground structures that cannot easily be counted (such as the tubers of *P. yadonii*) (Given 1994, Doak *et al.* 2002).

A number of other locations have been identified as harboring *Piperia yadonii*. East of the Monterey Peninsula, approximately 3,000 individuals have been identified on or near the Monterey Peninsula Airport (B. Leitner, Environmental Science Associates, *in litt.* 2001), including 1,419 individuals at the Sky Park Self Storage West facility (RCHR 2003). More than 2,350 plants have been identified at the Naval Postgraduate School in Monterey (Greening Associates 1999). Approximately 15,000 *P. yadonii* individuals were found inland and to the north on chaparral covered ridges north of Prunedale (Allen 1996). Approximately 8,000 of these individuals are on lands that receive some protection at Manzanita County Park and The Nature Conservancy's Blohm Ranch parcel, while the remainder are on private lands that are not protected (*e.g.*, along Tucker Road and Vierra Canyon). Approximately 7,500 plants have been found south of the

Peninsula (Allen 1996) on: 1) State Park properties at Point Lobos Ranch; 2) surrounding land (*i.e.*, Riley Ranch) slated to be transferred to California Department of Parks and Recreation in the future (Nikki Nedef, Big Sur Land Trust, pers. comm. 2001); and 3) a smaller parcel that has remained in private ownership.

3. Habitat Requirements

Piperia yadonii has been found in two primary habitat types: 1) Monterey pine forest with an herbaceous, sparse understory; and 2) 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 among sparse herbaceous vegetation. In areas where plant succession or other factors change the bare understory to thick *Toxicodendron diversilobum* (poison oak), *P. yadonii* appears not to be present (V. Yadon *in litt.* 2002). *Piperia yadonii* grows in filtered sun on soils (sandy, podzolic, or decomposed granite when associated with Monterey pine and manzanitas) with a shallow clay hard pan that becomes very dry during the flowering season. However, these soils include cracks and tubes derived from root penetration that fill with clay and remain moist for long periods of time (V. Yadon *in litt.* 2002). Overall, this species favors a well drained sandy soil substrate with podzolic conditions, areas that retain moisture during the rainy season but are not subject to inundation (V. Yadon *in litt.* 2002). In some Monterey pine forest locations, *P. yadonii* plants occur among dense stands of the nonnative annual grass *Briza maxima* (quaking grass) (Doak and Graff 2001).

In maritime chaparral habitat in northern Monterey County, plants grow on sandstone ridges where soils are shallow. They are commonly found under the edges of prostrate mats of *Arctostaphylos hookeri* and, on the Monterey Peninsula, with an overstory of Monterey pine. Additionally, *P. yadonii* is associated 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).

As noted above, several other species of *Piperia* occur together with or in the vicinity of *Piperia yadonii*. Biologists have confirmed it is impossible to identify *P. yadonii* based on morphology without mature flowers (M. Stormberg *in litt.* 2002, V. Yadon *in litt.* 2002).

Piperia yadonii can occur in some locations where disturbance has occurred previously (but that are not regularly affected by recreation, development, landscaping, etc.), such as abandoned dirt roads or cut slopes created by road construction (Allen 1996). Like 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

Germination of *Piperia yadonii* seeds likely involves a symbiotic relationship with a fungus, as has been observed with other orchids (V. Yadon *in litt.* 2002). Plants may produce only vegetative growth for several years before first producing flowers (Rasmussen 1995). Basal leaves of mature *P. yadonii* typically emerge sometime after fall or winter rains and wither by May or June when plants produce a single flowering stem. The blooming season is fairly short. The first flowers are dependent on age and/or tuber size and open mid- to late-June (Coleman 1995, Doak and Graff 2001). Blooming is generally completed by early August. Plants will continue to produce new flowers as older flowers on the same stalk mature and produce seed (M. Stromberg *in litt.* 2002). Plants are dormant from September to December until winter rains stimulate root and leaf bud development.

The age structure of populations is unknown because size and flowering are not always age-dependent. However, older plants will be larger both above ground and below even though size and flowering may not always be directly correlated. Additionally, an estimate of population size structure will aid in identifying age structure, whether the population is senescing with few or no seedling individuals, or whether good evidence of recruitment exists (M.A. Matthews *in litt.* 2002).

Recent data suggest that only a small percentage (typically 2 to 5 percent) of individuals in a population may flower in any year (Allen 1996, V. Yadon *in litt.* 2000). However, studies conducted by Doak and Graff (2001) suggest a wide among-year, among-population, and possibly among-habitat variation in the proportion of plants that flower (A. Graff *in litt.* 2002). For example, surveys in 1999 at Pescadero Canyon found 6 percent of plants flowering in pine forest habitat on Pebble Beach Company property and 4 percent of plants flowering on Blohm Ranch in chaparral habitat (A. Graff *in litt.* 2002). In contrast, surveys in 2000 indicate that 17 percent of plants flowered in pine forest habitat at Pescadero Canyon and 0.4 percent of plants flowered at Blohm Ranch (A. Graff *in litt.* 2002, Doak and Graff 2001). 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. As a result, an unknown proportion of a population may be dormant in any given year, thus making it difficult to track population dynamics through monitoring of population size (Wells 1981, Rasmussen 1995, A. Graff *in litt.* 2002).

Reproduction of *Piperia yadonii* is accomplished through both outcrossing and insect-facilitated selfing. Recent research results indicate virtually no fruit and seed production in plants that are not visited by pollinators (Doak and Graff 2001). Self-pollinated flowers produced fewer seeds per fruit than outcrossed flowers, indicating that inbreeding depression occurs at the level of seed set (Doak and Graff 2001). Additionally, individual flowering stalks may produce seeds as late as September.

A number of different floral visitors were identified during recent studies, including species from the following families: Pyralidae (snout moths), Geometridae (geometer moths), Noctuidae (noctuid moths), and Pterophoridae (plume moths). Additionally, although only one species of diurnal visitor has been documented to date (*i.e.*, bumble bees [*Bombus* sp.]), it has been noted at more than one location (A. Graff *in litt.* 2002).

Herbivory and disease appear to adversely affect reproductive success of *Piperia yadonii*. Plants appear to be preyed upon by deer, rabbit, and possibly rodents (Doak and Graff 2001), in addition to snails, slugs, earwigs, and aphids (V.

Yadon *in litt.* 2002). A fungal disease (*i.e.*, *Rhizoctonia* sp.) has also been documented to adversely affect *P. yadonii* plants. Only a small number of diseased plants set fruit compared to healthy plants, and 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 (U.S. Fish and Wildlife Service 1998). 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).

Numerous historical collections reported from the Pacific Grove area suggest that many *Piperia yadonii* populations have been extirpated from the Monterey Peninsula (U.S. Fish and Wildlife Service 1998). 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, State Parks (*e.g.*, Riley Ranch), and an undetermined number of other private landowners (Jones and Stokes Associates 1996). The largest populations occur on property owned and managed by the Pebble Beach Company (Jones and Stokes Associates 1996). Although large numbers of plants have been reported throughout its range (Allen 1996, Jones and Stokes Associates 1996, M. Zander *in litt.* 1996), these individuals are concentrated in small areas and connectivity between plant locations is compromised.

A number of other threats to *Piperia yadonii* have been reported. These threats include: 1) competition from nonnative plants; 2) mowing of vacant properties (V. Yadon *in litt.* 2002, M. Stromberg *in litt.* 2002); 3) roadside maintenance and a fire directive allowing mowing/brushing (within 6 to 8 inches of the ground surface) of habitat along roadways in the Pebble Beach area (V. Yadon *in litt.* 2002, M. Stromberg *in litt.* 2002); 4) loss of viable habitat (*i.e.*, functioning ecosystems that support stable or increasing populations of plants) due to changes

in vegetation structure within sites following fire suppression (although further research is needed to verify this) (A. Graff *in litt.* 2002); 5) loss of an inland population of plants due to a proposed realignment of U.S. Route 101 near Prunedale; and 6) loss of plants 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). The fragmented nature of all remaining sites makes management difficult and local extinctions of this species probable. *Piperia yadonii* is also threatened by predators, such as snails, slugs, earwigs, aphids, rabbits, and deer. Over the past few decades, populations of deer on the Monterey Peninsula have increased dramatically to numbers high enough that sensitive plant species are negatively affected by deer browsing on flowering stems. Researchers have noticed orchid reproduction has been affected, and at least one population of *P. yadonii* was browsed so heavily during 2000 that no plants successfully produced seed capsules (V. Yadon *in litt.* 2000).

6. Conservation Measures

The Blohm Ranch Nature Preserve is owned by The Nature Conservancy and is stewarded by the Elkhorn Slough Foundation. The *Piperia yadonii* population within this protected property supported approximately 2,500 plants in 1995 (Jones and Stokes Associates 1996).

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

In 1995, over 7,600 plants of *Piperia yadonii* were known to occur on lands 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 a 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. However, 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). As of 1996, approximately 17 percent of the known *P. yadonii* plants were found to occur on protected (*i.e.*, no development threats) lands (Jones and Stokes Associates 1996). These areas include the Samuel F.B. Morse Botanical Reserve, Huckleberry Hill Natural Area, Huckleberry Hill Preserve, George Washington Park, Crocker Cypress Grove, Veterans Memorial Park, Manzanita County Park, and the Blohm Ranch Preserve (Jones and Stokes Associates 1996). Additionally, the Riley Ranch property was recently purchased by Big Sur Land Trust and is in the process of being transferred to State Parks as another area protected from residential development threats (A. Graff *in litt.* 2002).

Due to the severely fragmented habitat supporting most of the remaining patches of plants throughout the species range and the lack of information on its life history, both reproductive and pollination ecology studies of *P. yadonii* were carried out at eight locations in 1999 (Doak and Graff 2001). We provided funding for this 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 work in August, 2001, to develop a monitoring protocol for this species [D. Steck, pers. comm. 2003]. The draft monitoring protocol is currently being reviewed and tested.

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

(Recovery Priority Number: 5C)

1. Taxonomy and Description

Potentilla hickmanii (Figure 6) was described by Alice E. Eastwood based on her 1900 collection along a road to Cypress Point, Monterey County (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 that are 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 2 to 4 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). *Potentilla 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 petals.

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: 1) Moss Beach, San Mateo County, 1.1 kilometers (0.7 mile) south of Point Montara near Half Moon Bay in 1905 discovered by Katherine Brandegee and in 1933 by Mrs. E.C. Sutcliffe (Ertter 1993); 2) Monterey Peninsula, approximately 800 meters (0.5 mile) east of Seal Rock at a picnic area, Pebble Beach, Monterey County; 3) Pacific Grove, near a

Figure 6. Illustration and photographs of *Potentilla hickmanii* (Hickman's potentilla). The illustration is reprinted from The Jepson Manual, J. Hickman, Ed., 1993, with permission from the Jepson Herbarium. © Regents of the University of California.

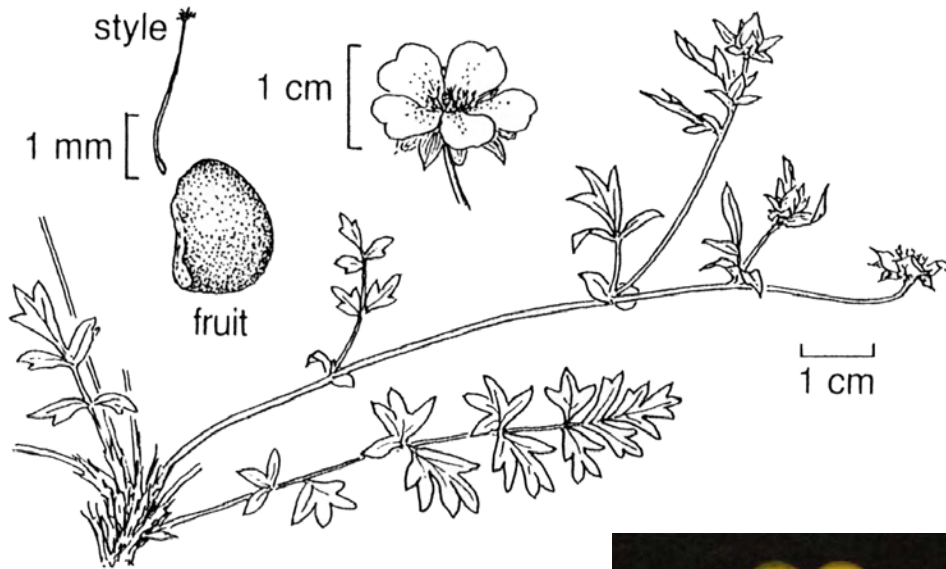


Photo taken by Beatrice F. Howitt,
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Photo © 1997 by
Tony Morosco

reservoir supplying Pacific Grove, on the road to Cypress Point, Monterey County; and 4) within the Two Rock Quadrangle in Sonoma County (Ferreira 1995, California Natural Diversity Data Base 2001). 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 the Indian Village picnic area on the Monterey Peninsula on lands owned by the Del Monte Forest Foundation. Both of these populations occur within the historical locality of the species.

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). The site was surveyed on two occasions in 1995, with only 21 plants found (Jones and Stokes Associates 1996). Surveys in 1999 indicated that likely fewer than 40 plants remained (Doak *et al.* 2000). Of the approximately 50 plants that were planted in 2001 by Dr. Vern Yadon and Pebble Beach Company, only 8 to 10 of these individuals survived (M. Stromberg *in litt.* 2002). Very few *P. hickmanii* plants remain into 2002 due to excessive water that has been diverted from an adjacent golf operation. Additionally, excessive overgrowth of *Holcus lanatus* (velvet grass) and *Festuca arundinacea* (tall fescue) are threatening remaining plants.

The San Mateo County (Montara) population grows on grassland slopes of privately owned land near Devil's Slide and covers an area between 65 and 130 hectares (0.25 and 0.5 square mile) (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).

A greenhouse experiment on reproduction of *P. hickmanii* involved placing pollen from Montara plants onto Indian Village plants. Results indicated only 47 percent of ovules on Indian Village plants given Montara pollen produced seed, as opposed to 62 percent treated with Indian Village pollen (Doak *et al.* 2000). This difference was marginally significant, suggesting that the Indian Village and Montara populations may not be fully compatible and there may be genetic divergence (Doak *et al.* 2000).

3. Habitat Requirements

The Monterey Peninsula population of *Potentilla hickmanii* is found in loamy fine, sandy soils in coastal terrace prairie habitat. The area supports 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). Nonnative species that dominate the area include *Avena barbata* (slender oats), *Bromus mollis* (soft chess brome), *Bromus diandrus* (ripgut brome), *Hordeum murinum* ssp. *leporinum* (wild barley), and *Briza minor* (little rattlesnake grass) (Jones and Stokes Associates 1996). Principal native species include *Deschampsia cespitosa* ssp. *cespitosa* (tufted hairgrass), *Danthonia californica* (California oatgrass), *Agrostis pallens* (bent grass), *Elymus glaucus* (blue wildrye), *Grindelia latifolia* (coast gumplant), *Geranium dissectum* (common geranium), *Rumex crispus* (curly dock), *Vulpia* sp. (annual fescues), and the rare State listed species *Trifolium polypodon* (Pacific Grove clover).

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) and *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. Plants may produce little to no seeds in drier years, especially among early-blooming flowers (Jones and Stokes Associates 1996, B. Ertter *in litt.* 1997). This lack of seed set might be due to the observed absence of pollinators during blooming time of dry years. Natural population increases appear during wet years, although these population increases may not occur during dry years (Doak *et al.* 2000). Additionally, recent greenhouse research indicates that some plants previously counted as up to five individuals may have been one single plant with a branched caudex (V. Yadon *in litt.* 2002).

Research was conducted during 1998 and 1999 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 (*i.e.*, a small beetle). Additionally, this 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).

Potentilla hickmanii will grow and bloom year-round under cultivated conditions. However, cultivated flowers that bloom later in the year tend not to set seed (V.

Yadon *in litt.* 2002). Plants with early flowers that were grown in a hot house set seed apparently without benefit of pollinators (V. Yadon *in litt.* 2002).

5. Reason for Listing

Potentilla hickmanii was listed as endangered on August 12, 1998 (U.S. Fish and Wildlife Service 1998). 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 to include approximately 38 residential sites versus the original proposal of 300 homes. Species experts also believe that changes in hydrology have occurred as a result of the Spyglass Hill Golf Course remodeling efforts that were conducted in the late 1990's (M.A. Matthews, *in litt.* 2002). Extra water that drains into the meadow remains longer into the year, thus supporting invasive species such as *Festuca arundinacea*, *Holcus lanatus* ssp. *balticus*, and *Juncus* sp., resulting in a very small population of *P. hickmanii*. These invasive species appear to be competing with and crowding out *P. hickmanii*, thus suppressing the survival and reproductive performance of young *P. hickmanii* plants (M.A. Matthews *in litt.* 2002, H. Crowell pers. obs. 2001, Doak *et al.* 2000). An enclosure exists around most of the population at Indian Village. Mowing and heavy recreational use of suitable habitat surrounding the enclosure appears to prevent *P. hickmanii* from expanding (Jones and Stokes Associates 1996, H. Crowell pers. obs. 2001). However, surveys indicate that gopher activity in the area may possibly improve habitat for *P. hickmanii* by removing competing vegetation (Jones and Stokes Associates 1996).

Predation by a number of animal or insect species are ongoing threats to *Potentilla hickmanii*. Browsing by deer likely reduces survivorship and reproduction (Jones and Stokes Associates 1996). High vole herbivory and soil inundation may also cause adult plant mortality (Doak *et al.* 2000). 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). 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 at 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). Currently, competition from nonnative species, grazing by livestock, low fecundity, potential future development, and alteration of fire frequency and intensity threaten survival of this unprotected population (T. Morosco *in litt.* 1997, B. Ertter *in litt.* 1997). However, some level of cattle grazing likely benefits this species (V. Yadon *in litt.* 2002). Therefore, removal of grazing from this site could result in a reduction of plants.

6. Conservation Measures

The Pebble Beach Company has maintained management responsibilities for the Monterey population at Indian Village, although ownership of the land was transferred to the Del Monte Forest Foundation many years ago. This Indian Village 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 recreation 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). However, recreational impacts continue surrounding this fenced area. 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 outplantings with clones and seedlings in both the picnic area and at Carmello Meadows, 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 (Doak *et al.* 2000). However, five individuals were planted at a single, less favorable 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 along Allen Road on land (*i.e.*, Riley Ranch) belonging to Big Sur Land Trust that 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 Indian Village site. *Potentilla hickmanii* that originated from the Indian Village population is being grown successfully by the Pebble Beach Company and Vern Yadon. Seeds 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.

D. *Trifolium trichocalyx* (Monterey clover)

Recovery Priority Number: 5C

1. Taxonomy and Description

Trifolium trichocalyx (Figure 7) was first collected by Amos A. Heller in 1903 following a fire 2 years earlier "in sandy pine woods about Pacific Grove" (Heller 1904). The species was described by Heller the following year (Heller 1904). Laura F. McDermott considered the taxon a variety of *T. oliganthum* in her treatment of the genus (McDermott 1910), although this classification was not recognized in subsequent floras. Axelrod (1982) reported at least one researcher who suggested that Monterey clover was a sporadic hybrid between *T. microcephalum* and *T. variegatum* and recommended removing it from the list of Monterey endemic taxa. This view was challenged by V. Yadon (*in litt.* 1983) who had grown *T. trichocalyx* and observed it consistently producing up to seven

Figure 7. Illustration and photographs of *Trifolium trichocalyx* (Monterey clover). Drawing by Mary Ann Showers (used with permission by the California Department of Fish and Game); photographs by Ronald Branson.



seeds per pod, while both putative parent plants were two-seeded taxa. *Trifolium 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. Numerous flowers are clustered into heads subtended by a laciniate-toothed involucre. The involucre is quite small and star-shaped with each division sharp-pointed and deeply cut (V. Yadon *in litt.* 2002). The calyces are 7 millimeters (0.3 inch) long, toothed, and conspicuously pilose. Purple corollas scarcely equal the length of the calyx and 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. However, branches may reach a length of 20 to 30 centimeters (8 to 12 inches) with favorable conditions (Abrams 1944). Branches from one large plant may spread through forest litter and give the appearance of many plants. Most plants found in the wild are depauperate with notched leaves and a reduced number of flowers within the head (V. Yadon *in litt.* 2002).

2. Distribution

The total distribution of *Trifolium trichocalyx* is not well known due to: 1) no information having been collected at current known sites following most of the historical fires prior to the plant being identified, and 2) few biologists being comfortable in identification of clover species (V. Yadon *in litt.* 2002). Currently, *T. trichocalyx* is found in only one area within the central portion of the Monterey Peninsula (*i.e.*, the Del Monte Forest at Huckleberry Hill). The mapped area

covers approximately 16 hectares (40 acres) (Ferreira 1995). Only scattered individuals were reported within forest openings or edges in this area by Theodore Niehaus in 1973 and 1979, and by V. Yadon in 1980 (California Natural Diversity Data Base 1997a). A number of plants are presumed to have been extirpated when Poppy Hills Golf Course was developed in 1980. Other *T. trichocalyx* 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 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 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. *Trifolium trichocalyx* becomes scarce when the forest canopy closes, persisting primarily as a seed bank in the soil while shade and competition increase during succession of the forest community.

The majority of *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). Following the 1987 fire, all healthy

populations were under dead Monterey pines in well-drained, deep soils (V. Yadon *in litt.* 2002). 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 *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

Trifolium trichocalyx appears to regenerate in large numbers during spring following a fire that removes the dense vegetative cover that shelters its seed bank. *Trifolium trichocalyx* populations will decline as shrubs and seedlings overshadow the plants as the forest begins to recover following a fire. *Trifolium trichocalyx* appeared after the 1901 fire and again after the 1987 fire, thus possibly harboring a seed bank capable of surviving more than 90 years. Recent studies indicate light as the only germination requirement (Doak *et al.* 2000). However, seeds buried in the soil at Huckleberry Hill may require different germination cues than those seeds used in germination experiments because experimental seeds were never buried (Doak *et al.* 2000).

Trifolium trichocalyx flowers between April and June. Small bees are likely pollinators as they are with other *Trifolium* clover species, although no pollinators were observed in previous studies (Jones and Stokes Associates 1996). Additionally, scarification may stimulate some *Trifolium trichocalyx* to bloom between fires (V. Yadon *in litt.* 2002).

5. Reason for Listing

Trifolium trichocalyx was listed as endangered on August 12, 1998 (U.S. Fish and Wildlife Service 1998). 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 has been the loss of potential habitat from urban and recreational (*e.g.*, golf course) development. Further research is needed to determine the extent of the remaining suitable habitat that may harbor a seed bank. 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). This acreage figure was estimated using data from Jones and Stokes Associates (1994), which examined vegetation and soils on different geomorphic surfaces of the Monterey Peninsula. Additionally, fire suppression is a serious concern. Natural fire cycles are suppressed due to close proximity of residential buildings to the current population. For this fire-follower to survive between fire cycles, the plant's habitat and seed bank must remain relatively intact and undisturbed. Extinction of *T. trichocalyx* is very possible due to the small amount of remaining habitat and the ephemeral nature (*i.e.*, the short vegetative and flowering state) 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 within the Del Monte Forest. Because of the species' rarity, the location where *Trifolium trichocalyx* plants were last found was excluded from a development proposal submitted by the Pebble Beach Company to Monterey County in July 2001 (T. Grove, California Coastal Commission *in litt.* 2000, D. Messenger, Lombardo and Gilles, PLC, *in litt.* 2002). Since the Pebble Beach Company's initial proposal, new information has been developed and the project description has changed (D. Messenger *in litt.* 2002). However, additional unprotected, surrounding lands with the appropriate habitat conditions may possibly harbor a seed bank for this species. Therefore, additional research to determine the extent of a seedbank is necessary to determine if the loss of this potential habitat is not a threat to the species.

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 (the U.S. Fish and Wildlife Service) through the California Department of Fish and Game. The studies have included determination of germination requirements, tests for presence of seed banks, experimental establishment of new populations, and seed sowing techniques (Doak *et al.* 2000). Additionally, Dr. Vern Yadon has successfully grown plants from seed in pots without the use of heat treatment (Jones and Stokes Associates 1996). This method could aid in experimental plantings in suitable habitat areas.

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

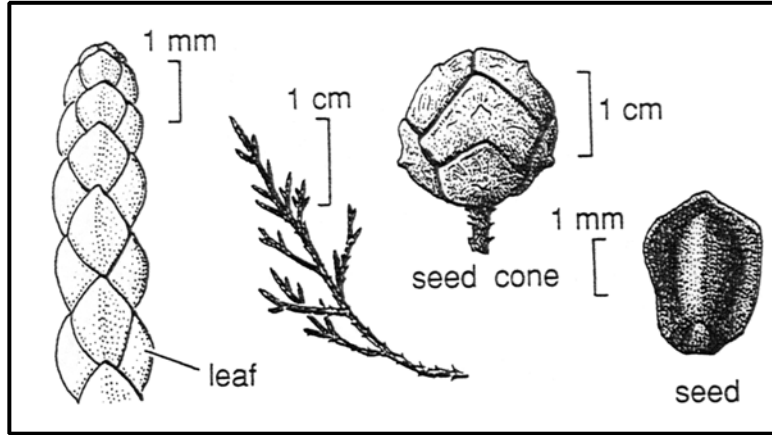
Recovery Priority Number: 9C

1. Taxonomy and Description

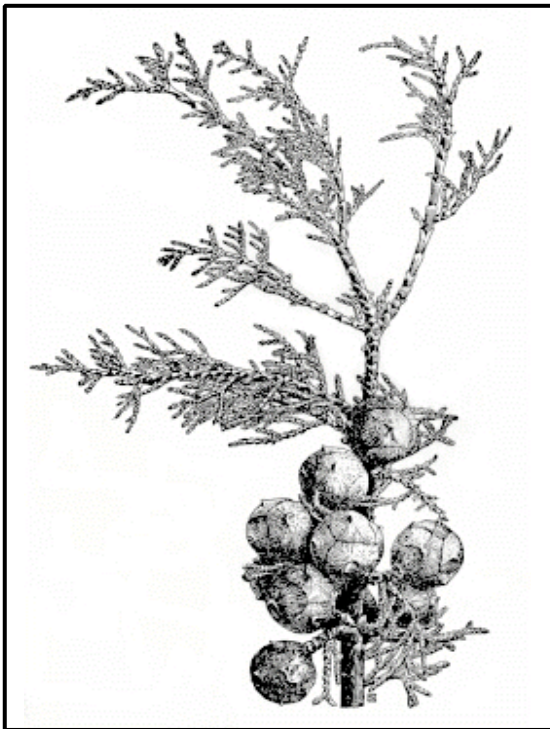
Cupressus goveniana ssp. *govoniana* (Figure 8) and its close relative *C. goveniana* ssp. *pigmaea* (Mendocino cypress) were historically distributed along the coast from Mendocino County to the mountains of San Diego County. *Cupressus goveniana* was discovered in 1846 by Karl Theodor Hartweg who arrived in California on a British expedition. *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). *Cupressus goveniana* ssp. *govoniana* is distinguished from its close

Figure 8. Illustrations and photograph of *Cupressus goveniana* ssp. *goveniana* (Gowen cypress). Illustrations reprinted from 1) *The Jepson Manual*, J. Hickman, Ed., 1993, with permission from the Jepson Herbarium, © Regents of the University of California.; and 2) *Manual of the Trees of North America*, public domain.



The Jepson Manual



The Manual of Trees of North America



Photo taken by Beatrice F. Howitt,
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relative *C. g. 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).

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) 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 lands designated as permanent open space for preservation of native habitat. However, scattered groups of trees (due to fragmentation by golf courses and residential 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). Some of these trees were planted by the Pebble Beach Company in the early 1990's as part of a restoration project (D. Messenger *in litt.* 2002).

The Del Monte Forest stand is the largest stand and 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 by the Pebble Beach Company as the Samuel F.B. Morse Botanical Reserve 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 land (*i.e.*, Riley Ranch) purchased by the Big Sur Land Trust from a private owner.

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 muricata* (Bishop pine), *Pinus radiata*, and chaparral shrubs such as *Arctostaphylos tomentosa*, *A. hookeri*, and *Vaccinium ovatum* (Jones and Stokes Associates 1996). *Cupressus 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). These soil surfaces tend to be podzolic, stabilized sand dunes with a caliche-like, impermeable layer (M. Stromberg *in litt.* 2002).

Cupressus goveniana ssp. *goveniana* is a fire-adapted species. Although there is only general information available on the phenology and seed production of this species, observations indicate that cones open and release seeds in response to intense heat (*e.g.*, fire) and during periods of hot, dry weather. Additionally, some researchers suggest that cones open with age (Doak *et al.* 2000). Studies

during 1998 and 1999 indicated that the important role of fire is to remove vegetation to bare mineral soil (Doak *et al.* 2000), allowing light to penetrate the area and allow for seedling establishment. At least three fires have burned portions of the Del Monte Forest stand in the last 100 years: 1) a large fire burned most of the stand in 1901 (Coleman 1905, Dunning 1916 as cited in Vogl *et al.* 1988), 2) the northern portion of the stand apparently burned in 1959 (California Natural Diversity Data Base 1997b), and 3) the most recent fire burned the south central portion of the population in 1987. Regeneration of *C. goveniana* ssp. *goveniana* occurred after each of these fire events.

4. Life History/Ecology

Cupressus goveniana ssp. *goveniana* is a fire-adapted species. Regeneration is generally rapid and prolific with thousands of seedlings covering the ground surface the spring following a fire (V. Yadon *in litt.* 2002). The likely effects of fire that are relevant to natural regeneration include soil mineralization, increase of light penetration to the forest floor, removal of competing vegetation, synchronized opening of many cones (*i.e.*, abundant and synchronized seed release from many parent trees), changes in soil pH, and soil sterilization (D. Rogers *in litt.* 2002).

Cupressus goveniana ssp. *goveniana* possesses cones that remain sealed and attached to trees following a second season when seeds are mature. Seeds are dispersed upon mechanical removal from the tree, death of the tree or supporting branch, when heat from fire breaks the cones' resinous seal and allows seeds to escape, or during hot, dry weather. *Cupressus goveniana* ssp. *goveniana* is also wind pollinated. Natural seed dispersal occurs during September and October, although seeds are not light enough to be carried far from the parent plant (Sudworth 1967). Light and bare mineral soils are also needed by *C. goveniana* ssp. *goveniana* for seedling establishment (Vogl *et al.* 1988). Seedling mortality is higher due to fungal infections in areas with herbaceous cover (Vogl *et al.* 1988).

Recent studies were conducted to examine the species' range, recruitment patterns, and age structure (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. *goveniana* grows slowly when trees are in close proximity to each other or 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, possibly a result of early growth during warm winters followed by the usual expected growth of wood during spring (Doak *et al.* 2000). However, most of these “false” rings could be distinguished.

A number of trees were cored at different sites to better understand demography across the different habitats. Results of this study showed fairly distinct differences between age structure of trees in the mixed pine and chaparral habitats. Trees (representing most age classes including younger trees) in the mixed pine habitat were more even-aged than those in chaparral habitat (Doak *et al.* 2000). The chaparral habitat harbored *Cupressus goveniana* ssp. *goveniana* in older age classes, with approximately 30 percent of the population between the age of 75 and 85 years (Doak *et al.* 2000). Observations of seedling and sapling recruitment showed a similar trend. Although recruitment was evident in all mixed pine sites, less than half the chaparral sites had recruitment of any kind (Doak *et al.* 2000). This result indicates that chaparral plant communities most likely limit the amount and extent of recruitment potential. The maximum age of trees at Huckleberry Hill and the Gibson Creek sites were approximately 85 to 127 years as estimated in 1998 and 1999 (Doak *et al.* 2000), suggesting that management for disturbances to allow recruitment should occur a minimum of every 85 years (although these longevities may be site and habitat specific) (Doak *et al.* 2000).

No information is available on the genetic diversity of this species. However, there are genetic studies for several congeneric species that can offer some insight. Genetic studies of *Cupressus macrocarpa*, a species with similar distribution to *C. goveniana* ssp. *goveniana*, revealed considerable genetic diversity (Kafton 1976, Conkle 1987). Additionally, *C. macrocarpa* shows considerable genetic differentiation between the two populations and between groups of stands within these populations (*e.g.*, genetic differences between the western and eastern stands within the Point Lobos population) (Conkle 1987). A

study of *C. forbesii* (tecate cypress) suggested genetic diversity within this species is somewhat lower than in *Pinus radiata*, which occurs in close proximity to *C. goveniana* ssp. *goveniana*. The study also showed strong genetic differentiation among populations and subpopulations, as well as a positive correlation between genetic diversity and mean fire interval of the subpopulations (Truesdale and McClenaghan 1998). In the absence of direct information for *C. goveniana* ssp. *goveniana*, some reasonable inferences about its genetic diversity could be made. Specifically and until shown otherwise, researchers believe the two populations of *C. goveniana* ssp. *goveniana* should be managed as genetically distinct (D. Rogers *in litt.* 2002). The different soil types and vegetative associations of the two populations give further suggestion that there may be genetic differences. Additionally, there may be significant genetic differentiation among some stands within populations, particularly where *C. goveniana* ssp. *goveniana* grows in two differing habitats in the Point Lobos population (*i.e.*, in mixed pine and chaparral habitats). Studies from the two congeneric species demonstrate that genetic differentiation over short spatial scales is possible within the genus.

5. Reason for Listing

Cupressus goveniana ssp. *goveniana* was listed as threatened on August 12, 1998 (U.S. Fish and Wildlife Service 1998). 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).

This species is threatened by habitat alteration due to the influence of continued urban development in Pebble Beach, induced drainage of its podzolic soils, and the disruption of natural fire cycles resulting from fire suppression activities. Additional threats may include urban edge effects, ongoing impacts from air pollution and climate change, possible genetic contamination from planted native, local (and possibly nonlocal) trees, current and increasing presence of nonnative invasive plant species, and risk of mortality from introduced insects or disease.

Despite measures taken to protect the stand of *Cupressus goveniana* ssp. *goveniana* at the Del Monte Forest (e.g., establishment of the Samuel F.B. Morse Reserve), opportunities for maintaining a viable long-term population (i.e., a population that is stable or increasing based on multiple years of monitoring) of this taxon may be compromised by the site's close proximity to urbanization. A portion (i.e., approximately 840 trees) of the Del Monte Forest stand was removed during the early 1980's for construction of the Poppy Hills Golf Course (U.S. Fish and Wildlife Service 1998). Although the lands on which the majority of the remaining *C. goveniana* ssp. *goveniana* trees grow will not be developed, potential residential development that may occur on all sides of the stand could reduce the opportunity for functioning ecosystem processes that are needed for stand regeneration. Also, maintenance of existing fire roads within the Del Monte Forest stand could potentially reduce the current *C. goveniana* ssp. *goveniana* population by destroying seedlings or adult trees. However, the Pebble Beach Company currently is unaware of any pending projects requiring expansion of existing fire roads (D. Messenger *in litt.* 2002).

Due to the physical inaccessibility of the Point Lobos stand and the Reserve's mandate to protect sensitive plant taxa, this stand is less affected by human disturbance than the Del Monte Forest stand. However, public access to this area may occur in the future.

Stands of *Cupressus goveniana* ssp. *goveniana* at both locations have been invaded by aggressive nonnative species, including *Cortaderia* sp., *Genista monspessulana*, 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. Additionally, threats exist due to: 1) the small population size, 2) potential impacts from insects or diseases that the species may have little natural resistance or tolerance, and 3) intercrossing between individuals from stocks adapted to other localities (D. Rogers *in litt.* 2002).

Tree species in coastal California habitats tend to contribute to the habitat of other species through provision of moisture (e.g., fog condensation, shade, etc.)

(Dawson 1998). Thus, loss of *Cupressus goveniana* ssp. *goveniana* could critically affect understory species where cypress is the only or predominant overstory species.

6. Conservation Measures

Both occurrences of *Cupressus goveniana* ssp. *goveniana* are located on fairly protected sites (*i.e.*, little to no human disturbance associated with development) that are largely conservation-oriented. However, some of the Del Monte Forest stand occurs on unpreserved lands owned by the Pebble Beach Company. Whereas 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 Pebble Beach Company’s most recent initiative (*i.e.*, the Del Monte Forest Preservation and Development Plan, July 2001) was redesigned to affect a smaller portion of the *C. goveniana* ssp. *goveniana* population at Del Monte Forest than was previously proposed (T. Grove *in litt.* 2000).

III. 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 (*i.e.*, protected in perpetuity, for example through conservation easements), 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 C links recovery criteria to the five listing factors and the recovery actions.

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 avoided, 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 all of the following criteria have been achieved:

- a) At least five viable populations (*i.e.*, populations that are stable or increasing based on multiple years of monitoring, including at least two populations in San Diego or Los Angeles Counties) occur on suitable

habitat with few to no nonnative competitors, and no threats from trampling. The area surrounding each population should allow for movement and expansion.

- b) A minimum of five populations are on land that is permanently protected from development (*e.g.*, residential, commercial, recreational, etc.) including the population that currently exists on Pebble Beach and Monterey Peninsula Country Club property. 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 (*i.e.*, hydrologic regime, food webs, pollinator fauna, coastal dune community associates, and associated species) are maintained, and an adequate diversity of sites exist 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 for a minimum of 3 consecutive years.
- f) A seed bank has been established at a recognized institution that is certified by the Center for Plant Conservation.

2. *Piperia yadonii*

The current recovery objective for *Piperia yadonii* is reclassification to threatened status. Further loss of existing plants and the species' habitat should be avoided,

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 size and viability, habitat requirements, and fragmentation effects.

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

- a) Secure and protect areas throughout the present range of *Piperia yadonii* that contain populations of sufficient size to ensure the long-term survival and recovery of the species. In the draft recovery plan, we stated that areas should be established that encompass and protect metapopulations of the *P. yadonii*; however, the information needed to define and delineate metapopulations is not available at this time. Until sufficient information is available for a metapopulation approach to *P. yadonii* conservation (see Recovery Strategy section), we have identified areas and populations of plants that need to be protected to accomplish the goal of downlisting the species. To facilitate the identification of these areas and populations, we have divided the current range of the species into five geographic areas based on the known distribution of the plant (California Natural Diversity Data Base 2004): the Monterey Peninsula (Area 1), the area interior of the Monterey Peninsula (Area 2), northern Monterey County-Prunedale-Elkhorn (Area 3), the area east of Point Lobos State Reserve-Point Lobos Ranch (Area 4), and Palo Colorado Canyon (Area 5). The goal is to protect self-sustaining populations of *P. yadonii* in each of these five areas. By doing so, we will ensure both the preservation of the plant throughout its range and its representation in both of the community types in which it is known to occur (Monterey pine forest and maritime chaparral). A minimum of 12 populations will require protection: four in Area 1, three each in Areas 2 and 3, and one each in Areas 4 and 5. The two largest populations of *P. yadonii* occur in Area 1, and both of these populations should be protected to the maximum extent feasible. However, if this is not feasible, additional protected areas may be required in Area 1. These additional areas would be necessary to ensure an adequate number of individuals are protected and that Monterey Pine

Forest habitat occupied by *P. yadonii* is adequately represented. The protected areas must be of adequate size and configuration to ensure the following: 1) maintenance of ecosystem and community processes and constituent species (*e.g.*, hydrologic regime, drainage patterns, proximity to pollinator habitat, Monterey pine forest and maritime chaparral community associates); 2) continued, unimpeded gene flow between populations, either through wind-dispersed seed or animal-mediated pollen exchange; 3) an adequate diversity of sites for population expansion and for colonization of new areas as microhabitat conditions change; and 4) the persistence of *P. yadonii* populations throughout the full range of environmental conditions they are likely to encounter (*e.g.*, extended drought, wildfire). Protected areas should be as large as possible (*e.g.*, hundreds of acres) and configured such that they preserve ecosystem function and minimize the adverse influences of adjacent development. Protected areas of greater than a hundred acres will not be feasible at all locations; therefore, the ability of smaller areas to fulfill the criteria should also be considered. Adequate, long-term funding should be available for these protected areas to allow for their maintenance.

- b) Protected areas are adequately maintained, such that encroachment by non-native plants (*e.g.*, *Genital monspessulana*, *Cortaderia jubata*), excessive herbivory (from deer and rabbits), edge effects from road maintenance, fuel modification activities, or other threats do not directly or indirectly adversely affect *Piperia yadonii* and its habitat.
- c) Results of monitoring activities have determined that the protected populations of *Piperia yadonii* are of adequate size to be self-sustaining and to ensure their long-term persistence. Because this species is a perennial that exhibits dormancy, spending an undetermined period underground between seed germination and emergence of first leaf above-ground, it is likely that a minimum of 10 to 15 years of monitoring will be needed in order 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 avoided, 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 all of the following criteria have been achieved:

- a) At least five viable populations (*i.e.*, populations that are stable or increasing based on a minimum of 10 years of monitoring) 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. As determined by research, protected habitat must be of adequate size (large enough to support a functioning ecosystem [*e.g.*, species present to support seed dispersal and pollination, areas that support fluctuating distributions, areas that harbor suitable unoccupied habitat for population expansion]) 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 exist for population expansion and for colonization of new areas as microhabitat conditions change. One of these protected sites should be the Indian Village population; another 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 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 certified by the Center for Plant Conservation.

4. *Trifolium trichocalyx*

The status of this species is so critical that the immediate objective is to prevent extinction. Further losses of existing plants and its habitat should be avoided, 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 all of the following criteria have been achieved:

- a) At least five viable populations (*i.e.*, populations that are stable or increasing based on a minimum of 12 years of monitoring) occur in suitable habitat. One of these populations is the Huckleberry Hill population.
- 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. As determined by research, protected habitat must be of adequate size (large enough to support a functioning ecosystem [*e.g.*, species present to support seed dispersal and pollination, areas that support fluctuating distributions, areas that harbor suitable unoccupied habitat for population expansion]) 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 loss of existing trees and their habitat should be avoided, and threats to the species survival should be eliminated. If these steps are not achieved, reclassification to endangered status may be warranted. Although two separate stands are managed with conservation objectives, many of the threats (*e.g.*, fire suppression, exotic invasive plant species, edge effects, introduced diseases, etc.) remain and future negative impacts (*e.g.*, effects from public access, new invasive exotic plant species, etc.) are likely. The cumulative impact from these influences, plus random natural occurrences, could cause extirpation of this subspecies. Delisting for *C. goveniana* ssp. *goveniana* can be considered when all of the following criteria have been achieved:

- a) Monitoring of the Del Monte Forest population and the Point Lobos population for a minimum of 10 years (or longer if needed) shows long-term reproductive success in both populations. As determined by research, protected habitat must be of adequate size (large enough to support a functioning ecosystem, including areas that support suitable unoccupied habitat for population expansion and fluctuations in

distribution) to ensure that ecosystem and community processes and associated species (*e.g.*, hydrologic regime, fire, food webs, 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) Twelve or more years (or possibly as much as one generation) of monitoring have determined that successful recruitment has caused an increase in overall size of both populations. Regeneration success should be measured in terms of abundant natural regeneration (with parental contributions from many trees for genetic purposes) and measured directly with genetic analysis if possible.
- 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 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. Seeds should represent the remaining genetic diversity of the species and the viability (*i.e.*, germination percentage) of the seed collection should be determined.

B. Recovery Strategy

The taxa addressed in this recovery plan are restricted both geographically and by available habitat. The distribution of *Piperia yadonii*, *Potentilla hickmanii*, *Trifolium trichocalyx*, and *Cupressus goveniana* ssp. *goveniana* are overlapping, while *Astragalus tener* var. *titi* occurs within 30 meters (100 feet) of the ocean surf zone. In general, 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.

Because these taxa exist primarily on privately owned land, cooperation with the landowners is critical to their conservation. Habitat acquisition and/or appropriate management agreements will be necessary to protect habitat areas from loss to urban or recreational development. Various other threats (*e.g.*, browsing, unsuitable regimes of disturbance through fire or trampling, hydrologic alterations, competition from native or non-native plants) affect particular taxa and need to be addressed in management plans. Where suitable management methods to address threats are uncertain, research should be undertaken to identify methods as appropriate. Concurrently, monitoring programs should be implemented to track population trends and threats and evaluate recovery progress relative to benchmarks. Suitable habitat in the area should be surveyed to identify any undiscovered populations. Recommendations resulting from research and monitoring should be adaptively incorporated into management plans and future revisions of this recovery plan. Because known populations of *Astragalus tener* var. *titi*, *Potentilla hickmanii*, and *Trifolium trichocalyx* are particularly few and small, they are vulnerable to extinction through environmental and demographic variability. Therefore unoccupied habitat in the area should be assessed for its suitability for reintroduction efforts, and new populations should be established where appropriate. To contact private landowners and encourage conservation of these taxa, public outreach efforts that include land management recommendations should be implemented in conjunction with city and county governments.

The actions needed to achieve recovery are as follows:

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

Trifolium trichocalyx and most *Astragalus tener* var. *titi* plants currently exist within unsecured habitat on Pebble Beach Company and/or Monterey Peninsula Country Club property. Additionally, according to Allen (1996), 67 percent of the *Piperia yadonii* population is found on land owned by the Pebble Beach Company and Del Monte Forest Foundation, 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) to ensure that habitat is secured and protected from development 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 to ensure that future development does not affect habitat for these taxa, including the use of conservation easements and other tools. In addition to regulating future activities, all interested parties, including us; the 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, Carmel-by-the-Sea, and Pacific Grove; Pebble Beach Company; and other nongovernmental organizations (*e.g.*, the California Native Plant Society, Big Sur Land Trust, the Del Monte Forest Foundation) 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.

The immediate objective for these species (in particular *Astragalus tener* var. *titi*, *Potentilla hickmanii*, and *Trifolium trichocalyx*) is to prevent extinction. Populations and their habitats on both private and protected lands should be managed to ensure that ecosystem processes vital to the long-term survival of the taxa are maintained. This management should include eliminating threats that are directly or indirectly affecting each of the species to such a degree that successful reproduction and seedling survival are not impaired. Although the Del Monte Forest Land Use Plan and Open Space Advisory Committee guidelines have already been developed for the Pebble Beach area, these documents should be

revised to reflect ongoing and new threats for each of the listed species. Additionally, species-specific management plans should be developed that identify management activities that maintain ecosystem functioning. These activities include prescribed burns, control of nonnative plants, control of herbivory, maintenance of appropriate hydrology, and control of residential and recreational activities that would cause soil erosion and adverse effects from herbicide or pesticide runoff.

3. Stimulate research on the biology of these species. Develop management strategies based on life-history research and species responses to vegetation management.

Research (*e.g.*, autecology, fire ecology, genetics, etc.) 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. For *Piperia yadonii*, research should focus on developing a metapopulation approach to the conservation of the species. 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. Additionally, other potentially suitable habitat areas in the range of the taxa should be identified and considered for establishment of new populations. Consideration should be given to acquiring adjacent lands to allow dispersal opportunities for existing plants through natural processes. Reestablishment should be considered throughout the historic range of the plant taxa to include sites of suitable habitat areas 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 the plant taxa is necessary for long-term management to be effective in conservation of these five plant species.

Population monitoring 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 a public outreach program.

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

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

Recovery criteria for each of the taxa should be revised in the future based on effectiveness of efforts to preserve and manage habitat and the information resulting from research.

C. Narrative Outline

1. Secure and protect existing species habitats that occur on private or unprotected lands. Listed species (addressed in this recovery plan) that occur on private lands should be secured and protected through mechanisms such as acquisition of property from willing sellers, acquisition of property rights or fee

title purchase (*i.e.*, development rights or timber harvest rights), open space and conservation easements, or 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.
- b) *Potentilla hickmanii*: Del Monte Forest Foundation, unknown landowner in San Mateo County.
- c) *Piperia yadonii*: Pebble Beach Company, First United Methodist Church in Pacific Grove, Monterey Peninsula Airport, and numerous other unknown private landowners.
- d) *Trifolium trichocalyx*: Pebble Beach Company.
- e) *Cupressus goveniana* ssp. *goveniana*: Pebble Beach Company, Del Monte Forest Foundation; other unknown private landowners.

1.2 Consult and coordinate with agencies and partners involved with recovery activities. Planning departments for the County of Monterey, and Cities of Monterey, Pacific Grove, Carmel-by-the-Sea, Seaside, Sand City, and Marina should be consulted regarding conservation opportunities for easements and acquisition opportunities, and to determine if there are existing easements that we are unaware of. Coordinate with the planning departments to appropriately use and manage land to preserve and manage these plants and their habitat. Our partners involved with recovery activities in the region covered by this recovery plan include 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, the Del Monte Forest Foundation, 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, and individuals. Support from local lead agencies for the protection of habitat for these five species is essential for their recovery.

Development proposals are routinely sent to California Department of Fish and Game for review in sensitive species habitat (D. Messenger *in litt.* 2002). We should also review any development proposals in potential habitat for the five listed plants and comment on the adequacy of the protective measures for those 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 Secure sites through 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 Secure sites through 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. These easements also offer the landowner an economic incentive of reduced property taxes. Easements may be accepted by the State, cities, counties, or nonprofit organizations whose primary purpose is to preserve and protect land in its natural condition. An advantage to an easement 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 large concentrations of these five listed plant species, although populations of *Piperia yadonii*, *Potentilla hickmanii*, and *Cupressus goveniana* ssp. *goveniana* and a portion of *Astragalus tener* var. *titi* occur on lands owned by other agencies, organizations, or private landowners. To promote recovery of these species, protected habitat for the plants should be contiguous and have a low perimeter-to-area ratio. This pattern would minimize the effects of surrounding land use practices that could potentially be detrimental to the taxa (e.g., 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 should be fully-preserved due to low numbers of individuals and its status as the only current wild population. Plants in this population occur on Pebble Beach Company property (west side of 17-Mile Drive) and the Monterey Peninsula Country Club Golf Course property (east side of 17-Mile Drive). A 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 a portion of *Astragalus tener* var. *titi*. This

enclosure may need to be removed (with approval from the California Coastal Commission) 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, erection of low fencing to discourage vehicular traffic and allow for minimal foot traffic should be established in place of the fenced enclosure along existing coastal access roads as well as along pedestrian and 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 activities (if needed in the future), ongoing maintenance activities (including weed whacking), parking lot activity, golfing, and horseback riding. Late (*i.e.*, September until on-set of the first significant rains greater than 0.1 inches) mowing of grasses in *A. tener* var. *titi* habitat would likely be beneficial to the species by removing overstory thatch and allowing rodents and other seed predators to be more vulnerable to predators in the area (V. Yadon, *in litt.* 2002).

The long-term survival of this species likely depends on restoring the physical conditions and plant community on which this species depends. Achieving this end will involve restoring vernal wet areas adjacent to coastal terrace prairie habitat (M. Stromberg, *in litt.* 2002). Soils must be allowed to dry in summer months to reflect conditions necessary for the original mix of native grasses

and forbs in these areas (M. Stromberg *in litt.* 2002). This restoration will require both an observational and experimental approach. Successful restoration efforts of dominant grasses in coastal terraces has been conducted (Stromberg *et al.* 1996).

1.4.2 Protect habitat for *Piperia yadonii*. A number of *Piperia yadonii* populations are secured from development (*i.e.*, approximately 17 percent of total known plants). However, many populations have land-use designations that do not provide protection from development (*i.e.*, 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. Additionally, plants should be protected in maritime chaparral habitats, focusing on large tracts that maintain ecosystem processes and function. The most recent proposed initiative (*i.e.*, the Del Monte Forest Preservation and Development Plan, July 2001) submitted by the Pebble Beach Company for the Del Monte Forest Area Land Use Plan calls for rezoning to residential and recreational open space 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* and is coordinating with regulatory agencies regarding potential impacts that may be associated with proposed projects.

Many of the unprotected *Piperia yadonii* populations exist in areas with native vegetation that harbor native soil with fungal spores needed for the plants survival. Protection should be given to spring sources for proper soil drainage, and appropriate habitat for pollinators. Surrounding land use practices should allow for *P. yadonii* expansion. Large populations should be chosen that are close enough to one another so pollinators can affect gene flow and reduce potential inbreeding depression. This will also 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 made up of two slopes south of Martini Creek, San Mateo County. Acquiring this site or permanently protecting it by entering into a conservation easement should be pursued.

The majority of the Monterey Peninsula population is encompassed within a 104 square meter (1,117 square foot) enclosure. Additionally, 18 plants northeast of the enclosure were recently caged. However, these plants may no longer be alive. 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 (*i.e.*, horseshoe pits, volleyball/badminton courts, and equestrian horse tie posts) currently in place adjacent to the enclosure. The entire meadow opening and the surrounding areas should be protected to ensure that ecosystem and community processes are maintained. The soils should be kept dry to reflect what was likely a coastal *Deschampsia* grassland (M. Stromberg *in litt.* 2002). Additionally, populations that represent the entire genome for the species at Indian Village should be secured in several greenhouses, outdoor gardens, and shade houses.

- 1.4.4 Protect habitat for *Trifolium trichocalyx*.** The only known population of *Trifolium trichocalyx* exists at Huckleberry Hill and the 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. Additionally, a seedbank is likely to occur in the soil between Haul Road and Costanilla Way where *T. trichocalyx* was last seen in 1988. Minimal protection is provided for this area, and the area is not fully protected from human-induced disturbance. The current proposed initiative (*i.e.*, the Del Monte Forest Preservation and Development Plan, July

2002) 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. This area 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. However, scattered groups of trees that radiate out from the Del Monte Forest stand are located on unprotected property owned by the Pebble Beach Company. Some of these trees are expected to be removed according to the current proposed initiative (*i.e.*, the Del Monte Forest Preservation and Development Plan), which calls for rezoning largely forested land on Pebble Beach Company property and establishing 15 residential development units, relocating an equestrian center, and establishing a new golf course. The plan also calls for protecting additional forested areas as open space. Additionally, the possibility exists that trees located on Riley Ranch (purchased by Big Sur Land Trust and slated as a State Parks acquisition) could be open to the public (D. Rogers *in litt.* 2002). 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*. Stands of trees should be carefully evaluated for potential adverse impacts resulting from the provision of public access.

2. Manage private and secured lands to control or eliminate threats to existing populations and their habitat. Habitat destruction due to development and recreational activities is the highest threat affecting each of these taxa. Collaboration among landowners, affected agencies, and a 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, thus ensuring

a functioning ecosystem with critical species interactions.

Nonnative species invasions are threatening each of the listed taxa. Control of nonnative species is necessary to recover these species. The Pebble Beach Company has been conducting exotic species removal throughout their 2,145-hectare (5,300-acre) property for approximately 15 years. These removal activities are conducted depending on time and weather conditions.

Unfortunately, no information is available that documents where removal has occurred, success of nonnative removal activities, or on the effects of removal activities on threatened and endangered species (R. Spruance, Environmental Programs, Pebble Beach Company, pers. comm. 2003). Primary focus of the weed eradication program has been in the dune areas for *Genista monspessulana*, *Cortaderia* sp., *Cirsium vulgare* (bull thistle), and *Carpobrotus edulis* (iceplant). It is recommended that nonnative removal activities in areas where listed plants are found be recorded and revisited to determine effectiveness and whether additional weed removal is necessary to lessen the threats to those listed plant species.

2.1 Minimize threats to *Astragalus tener* var. *titi*. Threats identified to date for *Astragalus tener* var. *titi* include encroachment and competition from *Carex pansa*, *Carpobrotus edulis*, and *Plantago coronopus*; exposure to and destructions from roadside maintenance activities; and, trampling caused by recreational activities (*e.g.*, golfing, horseback riding, and dog-walking). Once this population (including plants on both Pebble Beach Company and Monterey Peninsula Country Club property) is secured, the plants should be managed to prevent further loss of individuals. Additionally, all habitat disturbance and degradation should be prevented. The short-term goals for recovery of this species must include adaptive management of the existing population.

Controlling *Carex pansa*, *Carpobrotus edulis*, and *Plantago coronopus* by use of hand pulling should be conducted within and surrounding the enclosure on Pebble Beach Company property. Light mowing or grazing outside of critical growth periods (*e.g.*, flowering and prior to seed set) will likely benefit this species (M. Stromberg *in litt.* 2002). Additionally,

control of these nonnatives on the east side of 17-Mile Drive (*i.e.*, Monterey Peninsula Country Club property) should be conducted in habitat currently known to harbor the species as well as in adjacent suitable habitat. Control efforts should be prioritized and consideration should be given to: 1) the aggressiveness of the invader, 2) the nonnative's potential to alter the composition of the native community, and 3) future plans for the site. Although nonnative plant control is currently conducted as part of the Pebble Beach Company's ongoing weed control program, weed control activities may need to be increased and/or revised to aid in providing a stable or increasing population.

Threats from ongoing roadside maintenance activities (*e.g.*, 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. This objective may be accomplished through educational opportunities for workers, timing of maintenance activities, and possibly additional measures. Pebble Beach Company and Monterey Peninsula Country Club should designate the area of 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. Additionally, the current roadside drainage system is likely causing negative impacts to existing habitat by increasing the rate of water run-off. Future modifications (*e.g.*, using additional ground water for golf course maintenance) 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 (*e.g.*, gopher activity, minimal foot traffic) may be advantageous to this plant's survival, possibly by opening germination sites through reduction of competing nonnative plants species, or other mechanisms. Successful reproduction of this species will likely not occur with high levels of

ground disturbance caused by activities such as horseback riding and golfing. 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 should occur with the Monterey Peninsula Country Club Golf Course to discuss development of a timing schedule for various golf and equestrian activities. As mentioned in Action 1.4.1, erection of low fencing should be established to 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.

2.2 Minimize threats to *Piperia yadonii*. Threats identified to date for *Piperia yadonii* include urban, residential, and recreational (e.g., golf courses) development, browsing by deer and rabbits, competition from nonnative plants (*Genista monspessulana* and *Cortaderia* sp.), 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 (U.S. Fish and Wildlife Service 1998).

Urban, residential, and recreational (most importantly golf course) development on the Monterey Peninsula is an immediate threat to this species. In particular, the Pebble Beach Company's Pescadero Canyon and the area just north of the Pebble Beach Equestrian Center harbors a high percentage of existing plants (54 percent of the known individuals, according to Jones and Stokes Associates [1996]). These populations should be protected from development as they could serve as valuable locations that would ensure the long-term viability of this species. Many other *Piperia yadonii* sites on private property may be difficult to manage for recovery due to habitat fragmentation and bordering residential and recreational practices. 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. Landowners and key players should participate in developing a humane form of deer population control in forested areas where the majority of *Piperia yadonii* are found (M. Matthews, *in litt.* 2002). 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 flowering, seed production, and dispersal can occur. Caging plants has been successful with *Erysimum menziesii* var. *menziesii* (Menzies' wallflower) at Asilomar State Park (M. Matthews, *in litt.* 2002). However, this method is labor intensive. Without cages, herbivores can reduce successful flowering to less than 5 percent (Allen 1996).

Genista monspessulana and *Cortaderia* sp. are nonnative weedy species that are currently posing a high threat to *Piperia yadonii* through competition. Herbicides should be applied to control these weedy, invasive species. However, these chemicals should be applied such that drift would not affect the surrounding vegetation. *Cortaderia selloana* and *C. 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. Although Pebble Beach Company has an ongoing weed removal program, efforts for *Genista monspessulana* and *Cortaderia* sp. removal should concentrate around *Piperia yadonii* and other federally listed species. Control efforts should be prioritized, with consideration being given to the most aggressive competitor plant, effectiveness of the control method, future plans for the site, and potential for reinvasion from surrounding sources.

The city and county should establish environmentally sensitive areas where *Piperia yadonii* grows along road rights-of-way. Although road maintenance workers from Pebble Beach Company and the Pebble Beach Community Services District have been informed of *Piperia yadonii* in the

past, further coordination is needed to advise workers of species occurrences at designated areas and the need for them to avoid those areas (M.A. Matthews, *in litt.* 2002). Fire regulators in the Pebble Beach area should ensure that mowing of vacant properties and roads within protected areas are not conducted until plants have set seed, or mowing should be limited to only firebreaks. The extent of roadside sites should be mapped and the cities and counties should modify their mowing schedules and other road maintenance activities so the flowering and fruiting season for *P. yadonii* can be avoided. Field crews should be advised (as discussed in Action 7.2) on the biology and threats to the species and sensitive species maps should be provided to all maintenance workers.

Disposal of chipped clippings (used to control soil erosion) are likely introducing a host of unwanted nonnative plant species. Clippings should only come from very local sources in areas that support *Piperia yadonii*.

2.3 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. Additionally, habitat disturbance and degradation should be eliminated.

Recreational use at the Del Monte Forest Foundation Indian Village picnic 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 potential *P. hickmanii* habitat at this site, including individual plants that were transplanted to this site during a 1998 study (Doak *et al.* 2001), should be fenced to discourage pedestrian and equestrian activities. Efforts should be made to immediately correct the drainage into the Indian Valley area and remove competing weedy species. Immediate efforts

should include establishing a garden or greenhouse population of plants, and removing water flow into the site, possibly by installation of a drain and pipe along the edge of the golf course.

Threats from potential development or rerouting 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. This type of intensive management is necessary due to the extremely small population persisting at this site. Additionally, the habitat should be managed to keep *Pinus radiata* from establishing in the meadow and producing excessive shade. Careful mowing may be critical to the existence of this species (V. Yadon *in litt.* 2002).

High levels of herbivory by nonnative predatory snails and slugs on both vegetative and reproductive structures has been observed at the Indian Village picnic site (Doak *et al.* 2000). It is possible that this predation is causing a lack of survival and reproduction of *Potentilla hickmanii* plants. Use of pesticides to control 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 Indian Village picnic area should also be caged to exclude vertebrate predators.

2.4 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 recreational (*e.g.*, golf courses, equestrian activities) development pose further threats to the *T. trichocalyx* seed

bank. The largest known historical occurrence of *T. trichocalyx* exists in an area that is not fully protected from possible future development (*i.e.*, Huckleberry Hill tract, Area G of Pebble Beach Company's Del Monte Forest Preservation and Development Plan, July 2002) owned by the Pebble Beach Company. The voter approved initiative known as "Measure A" requested a change in the land use designation from residential to open space/forest. This change has the potential to aid in preservation of this site. The area, however, is still unprotected and requires additional management to recover this species. 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. An experiment (*e.g.*, using dry slash to create a ground fire) could be devised to remove a small number of trees within areas where *T. trichocalyx* are known (M. A. Matthews *in litt.* 2002). Fire is an essential process in *T. trichocalyx* habitat because it exposes bare mineral soils by removing forest canopy and shrubs. A mosaic of small burned areas should be maintained to allow the plant to flower on a 5- to 10-year cycle.

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). Further germination research will likely be required to confirm these recent studies. Additionally, scarification conducted the first spring following a fire when thousands of plants may be present may help stimulate plants to bloom (V. Yadon *in litt.* 2002).

2.5 Minimize threats to *Cupressus goveniana* ssp. *goveniana*. Threats identified to date for *Cupressus goveniana* ssp. *goveniana* include loss of habitat, induced soil drainage, and fire suppression. Fire prevention has caused continuous canopy closure, increased fungal presence, altered soil nutrient regime, increased understory competition, and exposed mineral soils that are needed to maintain *C. goveniana* ssp. *goveniana* populations. Consideration must be given to developing and implementing a burn plan or alternative measure to reduce high fuel loads while avoiding risk to life and property from surrounding developed areas. Prescribed burns should

be conducted at 50- to 70-year intervals to reduce overstory competition (V. Yadon *in litt.* 2002). Mechanical removal of ground cover and opening the canopy in numerous areas (to avoid a genetic bottleneck through regeneration of only a few trees) should be investigated as a means of supplementing the role of fire. Although recent research indicates that fire may not be needed for regeneration to occur (Doak *et al.* 2000), an alternative practice to promote regeneration would need to be developed to ensure continued existence of the species. Research should first determine if those aspects of a natural fire that would be missing in mechanical removal (*e.g.*, nutrient conversion, soil alteration, etc.) are critical to continued existence of the forest. Additionally, care should be given that mechanical gap creation does not limit other factors (*e.g.*, soil pH, soil mineralization, etc.) that *C. goveniana ssp. goveniana* may depend on for reproductive success (D. Rogers *in litt.* 2002).

Removal of invasive weed species (*e.g.*, *Eucalyptus* sp., *Acacia* sp.) will aid in this species recovery. Other invasive species spreading in the vicinity of *Cupressus goveniana ssp. goveniana* are candidates for invasions into this species' habitat in the near future (See Appendix F). These nonnative plants will likely adversely affect plant composition and *C. goveniana ssp. goveniana* regeneration (D. Rogers *in litt.* 2002).

The genetic integrity of the two populations may have been compromised because trees have been planted outside of the stock origin. *Cupressus goveniana ssp. goveniana* trees should not be planted outside of the stock areas to prevent genetic diversity issues and contamination of the native populations.

Mulched chips containing introduced seeds of *Cupressus macrocarpa* have recently been spread in *C. goveniana ssp. goveniana* habitat. The seedlings of *C. macrocarpa* should be removed and any chips spread in the habitat of *C. goveniana ssp. goveniana* should be site-specific.

2.6 Identify and address any newly identified threats. Any additional threats should be addressed as focused research is conducted, or as

additional populations are discovered, reintroduced, or established. Management actions should be implemented to reduce or eliminate effects of new threats identified for these species.

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

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

3.1.1 Develop specific recovery guidelines through working group.

Specific recovery guidelines should be developed for the following tasks: 1) establish a stakeholder collaborative group to develop resource management guidelines for parcels of land that support *Astragalus tener* var. *titi*, *Piperia yadonii*, *Potentilla hickmanii*, *Trifolium trichocalyx*, and/or *Cupressus goveniana* ssp. *goveniana*; 2) evaluate parcel-specific best management practices for each of the plants populations, 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 Indian Village picnic site, and nonnative plant control for *A. tener* var. *titi*, *P. yadonii*, *P. hickmanii*, and *C. goveniana* ssp. *goveniana*; 3) prepare management guidelines that include buffer zones against noncompatible adjacent land uses; 4) develop monitoring strategies to evaluate effects from adjacent land use practices; and 5) define appropriate and inappropriate management activities, such as seeding or revegetating for erosion control following controlled burning. Additionally, specific management recommendations for each plant should be based upon results of studies conducted in Action 3.2 as well as 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. 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. This plan may need to be updated.

3.1.2 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, Monterey County Parks, volunteer/donated labor, or a combination thereof.

3.2 Assemble or develop life history profiles and obtain species specific data to manage listed plants. Collect data on species life-histories. Additionally, provide recommendations on management strategies that may aid in the recovery of the species, including providing solutions on threats to the species.

3.2.1 Life history and management research on *Astragalus tener* var. *titi*. Research is needed on the effects of *Carex pansa* and *Carpobrotus edulis* removal to assess: 1) the role of competition by both native and nonnative plant species, and 2) effects from applied disturbance to *Astragalus tener* var. *titi* populations and how this disturbance may affect the overall health and persistence of this species. Additionally, information on this species' breeding system and pollinator activity is needed. Data on local hydrology, reproduction, and seedling survival will help define where critical problems occur with the management of this species.

3.2.2 Life history and management research on *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) transplanting experiments to determine if large populations can be successfully transplanted (Doak and Graff 2001). Research should also focus on defining and delineating metapopulations and on determining the optimum configuration and size of protected areas that will support a functioning ecosystem (*e.g.*, species present to support seed dispersal and pollination, areas that support fluctuating distributions, areas that harbor suitable unoccupied habitat for population expansion).

3.2.3 Life history and management research on *Potentilla hickmanii*.

Species-specific data on all life history stages of *Potentilla hickmanii* should be examined, with special emphasis on effects of competition and herbivory on recruitment. Understanding this species exact habitat requirements is needed to fully understand its life history and to determine what factors are limiting population expansion. The Indian Village area population on Del Monte Forest Foundation property historically has poor recruitment. This issue should 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 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 Action 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) have recommended collecting

the following data: 1) genetic analysis to determine the degree of differentiation or similarity between the Montara population and the Indian Village 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 Indian Village population on the Monterey Peninsula; 2) research to determine extent of *P. hickmanii* seed dispersal; and 3) research to determine what pollinator limitations may exist to assist in efforts of establishing self-sustaining populations of *P. hickmanii*. Additionally, greenhouse techniques need to be developed to amplify seed for application in the field. Plants should 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 (*e.g.*, caging individual plants to reduce herbivory, and possibly providing supplemental watering to enhance fruit and seed production while the population is in a critical state).

3.2.4 Life history and management research on *Trifolium*

***trichocalyx*.** Research needs to be conducted to determine the number and distribution of populations that remain. This action is difficult because it is a “fire-follower” (*i.e.*, this species persists as a seed bank 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) conduct trials mimicking natural soil conditions and germination cues, including treatments that simulate different potentially important fire effects; 2) test suitability of experimentally cleared areas for *T. trichocalyx* germination; and 3) conduct burn box experiments to expand surveys for seed banks.

3.2.5 Life history and management research on *Cupressus goveniana* ssp. *goveniana*.

Studies should be conducted on the ecology and genetics of this species, including examining 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). However, short-term reproductive success in the absence of fire may result in loss of genetic variability (D. Rogers, Conservation Geneticist, U.C. Davis, *in litt.* 2002). Researchers should not assume that seed germination and short-term seedling survival based on the absence of fire is a replacement for a natural fire event for two reasons (D. Rogers, *in litt.* 2002):

- a. Where fire is a natural disturbance, species are often adapted to a variety of fire effects (*i.e.*, removal of herbaceous species competition, soil sterilization, soil mineralization, changes in soil pH, and light penetration to the forest floor (which is the primary effect sought by mechanical gap creation). Any or all of these effects could be important to the long-term reproductive success and population viability of *Cupressus goveniana* ssp. *goveniana*.
- b. Small amounts of regeneration within mechanically created gaps are not necessarily the equivalent of natural regeneration following fires. Prolific natural regeneration that follows a fire (with concurrent contributions from many parent trees) provides abundant opportunities for natural selection over time and a good basis for population viability. Only a short-term assessment examining the absence of fire to create gaps can be made. This assessment will consider the appearance of some (but not all) seedlings and not the long-term effects of fire suppression.

There is limited information on genetic diversity of this subspecies. However, genetic information available for *Cupressus macrocarpa* may possibly be used in the interim due to its similar distribution (D. Rogers *in litt.* 2002).

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

4.1 Develop predictive models using Geographic Information Systems (GIS) to identify potentially suitable or restorable habitat. Models can be created using GIS to assist in identifying locations for reintroductions, reestablishment, or restoration. Global Positioning System (GPS) data and metadata should be collected by surveyors during all site visits and surveys. Data on suitable habitat areas for reintroductions, reestablishment, or restoration (as well as site locations of all the listed species) should be supplied to us in the NAD83 projection (zone 10). These areas should then be identified and prioritized.

4.2 Survey likely habitat with similar site factors for reintroduction or establishment of new populations, or additional occurrences of listed plants. Distribution of *Astragalus tener* var. *titi*, *Piperia yadonii*, *Potentilla hickmanii*, and *Trifolium trichocalyx* are restricted. Therefore, additional populations are needed to ensure long-term viability of these species. Discoveries or establishment of new populations will reduce the likelihood of reduction or extinction of these taxa from a catastrophic event. Efforts should be made to initiate protective recovery actions for each newly-discovered or newly-established population. Additionally, survey biologists should ensure that new discoveries of these species are reported to the California Department of Fish and Game's Natural Diversity Database.

4.2.1 Survey *Astragalus tener* var. *titi* habitat 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. Additionally, surveys should be conducted on private lands in the general locality of the population along 17-Mile Drive. Dune and coastal sandy areas characterized by small swales and low cover of other vegetation (especially *Deschannpsia cespitosa* ssp. *holciformi* and other

diagnostic herbs) are the likely indicators for finding more populations or for establishing new ones. However, recent studies 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. Additionally, this occurrence may be due to the wetter conditions supplied by El Niño during 1998. Areas where there is light disturbance (*e.g.*, gopher activity) should be surveyed. Other patches of ground in the Bird Rock area should also be opened and scarified to determine if seed banks of *Astragalus tener* var. *titi* exist.

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 along 17-Mile Drive on the Monterey Peninsula and should be examined for unknown populations or establishing new populations. Additional locations for surveys or reintroduction of *Astragalus tener* var. *titi* include the following: 1) coastal areas of San Luis Obispo County, including the Hearst Ranch; 2) Seal Beach National Wildlife Refuge, Ballona Wetlands, and Bolsa Chica in Los Angeles County; and 3) areas north and south of Silver Strand State Beach in San Diego County.

4.2.2 Survey *Piperia yadonii* habitat. Additional surveys should be conducted for new occurrences of plants within Fort Ord property and adjacent potentially suitable habitat. Jones and Stokes Associates (1996) reported 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 Survey *Potentilla hickmanii* habitat. Additional experimental transplants should be conducted in suitable habitat, such as at Carmello Meadows (Point Lobos State Reserve) where transplanted populations did not successfully survive into the year

2000 (see action 4.3.2. below). This site should be used for establishment of new populations as appropriate based on surveys of microhabitat conditions in the area. Transplanting strategies could be improved by using information obtained from monitoring and research studies (see actions 5.1.4, 5.2.1, and 5.2.2) on the current populations of *Potentilla hickmanii*.

4.2.4 Survey *Trifolium trichocalyx* habitat. Suitable soil conditions and habitat are available on the Monterey Peninsula for establishment of *Trifolium trichocalyx* populations (Jones and Stokes Associates 1996). Surveys should 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 the Pescadero Tract on Pebble Beach Company's property, Huckleberry Hill Preserve at the Presidio of Monterey, the Gibson Creek Unit of Point Lobos State Reserve, and 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 to establish new populations of *Astragalus tener* var. *titi*, *Potentilla hickmanii*, and *Trifolium trichocalyx*. These approaches would be valuable in understanding future management requirements that would aid in protecting existing populations and newly discovered or reestablished populations. Our policy guidelines regarding controlled propagation of listed species should be used for reintroduction or establishment of new populations (U.S. Fish and Wildlife Service and National Oceanic and Atmospheric Administration 2000). Reintroduction or establishment to new sites should commence once areas have been identified. Additionally, the following factors should be considered for *A. tener* var. *titi*, *P. hickmanii*, and *T. trichocalyx*.

4.3.1 Reintroduce/establish *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 (providing 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 to allow for long-term success of reintroduced or established populations.

4.3.2 Reintroduce/establish *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), this location is still a good candidate for introduction of new populations. Individual plants should carefully be transplanted to microhabitats with a variety of moisture regimes. Additional experimental transplants should occur, with potential genetic diversity maximized. Transplanting and introduction of new populations could be improved by conducting various ecological surveys at the Montara population in San Mateo County because of its larger population size compared to the Indian Village picnic area site.

4.3.3 Reintroduce/establish *Trifolium trichocalyx*. Controlled burn experiments should be conducted in areas where a seed bank likely occurs. Dry slash could be used to create a ground fire to remove a small number of trees and shrub cover in areas where *Trifolium trichocalyx* are known to occur. Additionally, a mosaic of small

burned areas should be maintained to allow the plant to flower on a 5- to 10-year cycle.

5. Use research results and monitoring of 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. Additionally, success criteria should be developed to examine the effectiveness of reducing the various levels of threats to these species. These standards and success criteria will assist in determining downlisting or delisting status of the five plant taxa.

5.1 Monitor occurrences to evaluate trends in population dynamics.

Monitoring surveys should be conducted to document population dynamics and determine population trends for all five taxa. Standard monitoring methods (such as those in the draft *Piperia yadonii* monitoring protocol currently being prepared and analyzed) should be developed and used to track population data from one year to the next and to compare results between sites. Specific points should be addressed when monitoring populations of *Astragalus tener* var. *titi* and *Potentilla hickmanii*, as indicated below.

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. However, this study was conducted over a short time-frame and may require additional studies to verify seed production output. Results from this study 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 and controlled experiments. Annual monitoring of the 17-Mile Drive plants does not provide an accurate assessment of population increases, decreases, or stability because plants occur erratically each successive year. Therefore, monitoring the 17-Mile Drive population through individual plant performance and areal extent of the population will likely give a better estimate of the population's status on a year-to-year basis (Doak *et al.* 2000).

Controlled experiments with plantings and monitoring should also be conducted. Small patches of soils where no other rare species are found should have surface vegetation removed. Subsequently, these patches should be lightly cultivated and scattered with seeds. Experiments may include, but are not limited to, effects from protection of herbivory, and soil sampling to determine the extent and duration capacity of the soil seed bank (M. Stromberg *in litt.* 2002). Suggested areas for controlled experiments include Point Joe, and immediately south of China Rock west of a public trail. Additionally, changes in micro-topography could be conducted on private lands to provide experimental vernal wet areas. These areas should have appropriate adjacent native perennial grasses and provide adequate conditions to hold water for an extended time period (M. Stromberg *in litt.* 2002).

5.1.3 Monitor existing *Astragalus tener* var. *titi* population for effects of grazing. Varying levels of grazing by deer should be investigated with small, experimental deer exclosures. These data should provide information on what level of grazing this species can tolerate and whether permanent exclusions from deer may be necessary.

5.1.4 Monitor survival, seed production, and recruitment of *Potentilla hickmanii* from year-to-year. Plants in current and any newly established populations need to be monitored for growth, survival, seed production, and recruitment. These data

should be used to support management recommendations for current populations or any additional established populations.

5.1.5 Monitor populations of *Piperia yadonii*.

5.1.6 Monitor populations of *Trifolium trichocalyx*.

5.1.7 Monitor populations of *Cupressus goveniana* ssp. *goveniana*.

5.2 Monitor effects of threat reductions and review research results.

Studies should be conducted to ascertain if methods used for reducing threats for each species are effective. Additionally, a review should be conducted to determine whether research results and management recommendations are beneficial to the recovery of each species. If so, those beneficial threat reduction methods or research recommendations should be incorporated into a 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. For example, monitoring of *Piperia yadonii* should be conducted each year to estimate numbers on each preserve with sufficient precision to detect significant population changes relative to long-term trends.

5.2.2 Evaluate research results and use in future management.

Review and incorporate results of studies into management strategies for the five listed species based on research findings. 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 five listed plant populations. Due to few numbers of populations (and few individuals of *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 (e.g., Rancho Santa Ana Botanic Garden in Claremont, California, or Santa Barbara Botanic Garden in Santa Barbara, California) or at the U.S. Department of Agriculture 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.

Seeds must be collected from many parent plants in all representative populations and stored under suitable conditions to support genetic variability. However, guidance should first be developed prior to collecting seeds. Seeds should also be checked for viability (i.e., germination percentage) periodically. Clear guidelines should be developed for the use and distribution of the seeds to guard against inadvertent loss or inappropriate use. Additionally, a long-term commitment should be made by cooperating parties to establish a garden or greenhouse population of plants that provide diverse seed sources. Although the Pebble Beach Company started a greenhouse propagation program in the 1990's, staff turnover has resulted in little to no training, in addition to staff losses during recent layoffs (M. Stromberg *in litt.* 2002). An annual training program should be established for all employees working for private landowners who conduct ground disturbance activities in sensitive species habitat. The training program would help workers identify the listed species and become familiar with the entire recovery effort.

- 6. Coordinate recovery actions to benefit other listed species and species of concern.** A number of rare and endangered wildlife and plant species occur either on the Monterey Peninsula or within the vicinity of Monterey (Appendix G). Management actions such as herbicide use to remove nonnative plant species may affect these species. Therefore, management actions should be designed to avoid adversely affecting these species and their

habitats.

Habitats should 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 a public outreach program.** An informational outreach 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 (*e.g.*, the California Native Plant Society, the Monterey Pine Forest Ecology Cooperative, the Del Monte Forest Foundation, etc.) should be approached to participate 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 Provide information and coordinate with lead agencies.** Participation from city and county governments is critical for recovery. They are the primary agencies that determine future land use for unprotected occurrences and habitats. It may be necessary for these governments and lead agencies to revise existing land use plans to accurately address the current status of the five listed species.

- 7.2 Provide species information to the public through outreach programs.** Implement an informational public outreach program. Information brochures, roadside kiosks (*e.g.*, displays that discuss the benefits of not mowing or spraying vegetation around sensitive species), and other materials (*e.g.*, videos, slide presentations, Pebble Beach website, ideas for possible deer control measures) should be prepared. These outreach materials should include discussion of the importance of each of the species to the ecosystem, plant identification, plant ecology, and related management issues when appropriate. Additionally,

landowners should be encouraged to landscape with local native plant species. Information should be provided to them that describe the benefits of establishing effective buffer areas between secured areas and intensely used residential or recreational areas. These “restored” 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. Separate brochures could be developed to target youth in public schools and an adult audience. Information brochures and other materials should be distributed through local public schools and directly to private landowners and other interested parties in the local area. A method to monitor effectiveness of the outreach program should be developed.

7.3 Hold public meetings. We, the California Department of Fish and Game, California Department of Parks and Recreation, Monterey County and applicable city government’s 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 based 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 populations or conservation areas should be examined. Additionally, the success or failure of management actions should be evaluated.

8.1 Reevaluate recovery criteria. The criteria for downlisting and delisting the taxa in this recovery plan should be evaluated based on future information gathered from life history studies, research, monitoring, and management actions. If necessary, downlisting or delisting criteria should be refined.

8.2 Revise recovery plan as needed. The recovery plan should be kept current and useful by being updated, amended, or revised based on the expanded knowledge from research and monitoring results and evaluation

of the relative success and failure of the management programs in attaining recovery goals. Management responses should be incorporated into the revised recovery program when potential threats are found to be actual threats.

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 III 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 actions are subject to modification as dictated by new findings, changes in species status, and the completion of recovery actions. The priority for each action 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. Action Number and Description. The action number and description are extracted from the stepdown narrative found in Part III of the recovery plan. Please refer back to this narrative for a fuller description of each action.

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

- Continuous: Action will be implemented on an annual basis once it is begun.

Ongoing: Action 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. For each task, the most logical lead agency or agencies (based on authorities, mandates, and capabilities) has been identified with an asterisk (*). The following abbreviations are used to indicate responsible parties for each recovery action for the five listed species:

CCC	California Coastal Commission
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, Del Monte Forest Foundation, 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 action, 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 actions are projected based on the estimated 12-year timeframe for delisting or downlisting, and were developed in part using timelines and cost estimates for other federally listed species and estimated cost estimates based on site-specific areas in the Monterey Peninsula. The estimated costs include estimated salaries for individuals who would carry out the identified action. 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 actions 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**

Action Priority #	Action #	Action Description	Action Duration (years)	Responsible Party	Cost Estimates (in thousands of dollars)					
					Total Cost	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*, COUNTY, CDFG, CDPR, NGOs, PBC, DMFF	48	4	4	4	4	4
1	1.3.1	Establish protection agreements and secure habitat sites with permission of the landowners: Land acquisition or fee title ownership	TBD	FWS*, CDFG, PBC*, DMFF*, CITY, PVT*, COUNTY	TBD	TBD	TBD	TBD	TBD	TBD
1	1.3.2	Establish protection agreements and secure habitat sites with permission of the landowners: Open space and conservation easements	TBD	FWS*, CDFG, PBC*, DMFF*, CITY, PVT*, COUNTY	TBD	TBD	TBD	TBD	TBD	TBD
1	1.4.1	Protect habitat for <i>Astragalus tener</i> var. <i>titi</i>	2	FWS, CDFG, CCC, PBC*, PVT*	6	3	3	0	0	0

Action Priority #	Action #	Action Description	Action Duration (years)	Responsible Party	Cost Estimates (in thousands of dollars)					
					Total Cost	FY1	FY2	FY3	FY4	FY5
1	1.4.2	Protect habitat for <i>Piperia yadonii</i>	2	FWS, CDFG, PBC*, DMFF*, PVT, CITY	20	10	10	0	0	0
1	1.4.3	Protect habitat for <i>Potentilla hickmanii</i>	2	FWS, CDFG, PBC*, 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*, CDPR*, PVT	6	3	3	0	0	0
		Need 1 Subtotal Cost:			110+	32+	32+	6+	6+	6+
Need 2: Manage private and secured lands to control or eliminate threats to existing populations and their habitat										
1	2.1	Minimize threats to <i>Astragalus tener</i> var. <i>titi</i>	continuous	FWS, CDFG, CCC, PBC*, PVT*	60	5	5	5	5	5
1	2.2	Minimize threats to <i>Piperia yadonii</i>	continuous	FWS, CDFG, PBC*, DMFF*, PVT*, NGOs, CITY, COUNTY	60	5	5	5	5	5

Action Priority #	Action #	Action Description	Action Duration (years)	Responsible Party	Cost Estimates (in thousands of dollars)					
					Total Cost	FY1	FY2	FY3	FY4	FY5
1	2.3	Minimize threats to <i>Potentilla hickmanii</i>	continuous	FWS, CDFG, PBC*, DMFF, PVT	60	5	5	5	5	5
1	2.4	Minimize threats to <i>Trifolium trichocalyx</i>	continuous	FWS, CDFG, CITY, COUNTY, PBC*, DMFF*, PVT	60	5	5	5	5	5
1	2.5	Minimize threats to <i>Cupressus goveniana</i> ssp. <i>goveniana</i>	continuous	FWS, CDFG, CDPR*, PBC*, DMFF*, PVT	60	5	5	5	5	5
3	2.6	Identify and address any newly identified threats	TBD	TBD	TBD					
		Need 2 Subtotal Cost:			300	25	25	25	25	25
		Need 3: Develop management strategies based on the species life histories and the species responses to vegetation management								
1	3.1.1	Develop species management guidelines through working group	3	FWS*, CDFG, PBC, DMFF, CDPR, PVT, CITY, COUNTY	25	15	5	5	0	0

Action Priority #	Action #	Action Description	Action Duration (years)	Responsible Party	Cost Estimates (in thousands of dollars)					
					Total Cost	FY1	FY2	FY3	FY4	FY5
1	3.1.2	Implement species management guidelines	4	TBD	40	0	20	10	5	5
1	3.2.1	Life history and management research on <i>Astragalus tener</i> var. <i>titi</i>	4	WG*	42	12	12	12	6	0
1	3.2.2	Life history and management research on <i>Piperia yadonii</i>	4	WG*	42	12	12	12	6	0
1	3.2.3	Life history and management research on <i>Potentilla hickmanii</i>	4	WG*	42	12	12	12	6	0
1	3.2.4	Life history and management research on <i>Trifolium trichocalyx</i>	4	WG*	42	12	12	12	6	0
1	3.2.5	Life history and management research on <i>Cupressus goveniana</i> ssp. <i>goveniana</i>	4	WG*	42	12	12	12	6	0
		Need 3 Subtotal Cost:			317	75	85	75	35	5

Action Priority #	Action #	Action Description	Action Duration (years)	Responsible Party	Cost Estimates (in thousands of dollars)					
					Total Cost	FY1	FY2	FY3	FY4	FY5
Need 4: Determine other suitable habitat areas for additional occurrences, reestablishment, or reintroduction of populations										
2	4.1	Develop predictive models using GIS to identify potentially suitable or restorable habitat	2	TBD	10	5	5	0	0	0
2	4.2.1	Survey <i>Astragalus tener</i> var. <i>titi</i> habitat	3	FWS*, CDFG, TBD	30	10	10	10	0	0
2	4.2.2	Survey <i>Piperia yadonii</i> habitat	3	FWS*, CDFG, TBD	15	5	5	5	0	0
2	4.2.3	Survey <i>Potentilla hickmanii</i> habitat	3	FWS*, CDFG, TBD	30	10	10	10	0	0
2	4.2.4	Survey <i>Trifolium trichocalyx</i> habitat	3	FWS*, CDFG, TBD	30	10	10	10	0	0
2	4.3.1	Reintroduce/establish <i>Astragalus tener</i> var. <i>titi</i>	10-15	FWS*, TBD	95	15	15	15	7	7
2	4.3.2	Reintroduce/establish <i>Potentilla hickmanii</i>	10-15	FWS*, TBD	95	15	15	15	7	7
2	4.3.3	Reintroduce/establish <i>Trifolium trichocalyx</i>	10-15	FWS*, TBD	95	15	15	15	7	7
		Need 4 Subtotal Cost:			400	85	85	80	21	21

Action Priority #	Action #	Action Description	Action Duration (years)	Responsible Party	Cost Estimates (in thousands of dollars)					
					Total Cost	FY1	FY2	FY3	FY4	FY5
		Need 5: Use research results and monitoring of current populations, reintroduced populations, and potential threats to determine effectiveness of management actions.								
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*, FWS, DFG	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	continual	PBC*	24	2	2	2	2	2
3	5.1.3	Monitor existing <i>Astragalus tener</i> var. <i>titi</i> population for effects of grazing	continual	PBC*	12	1	1	1	1	1
3	5.1.4	Monitor survival, seed protection, and recruitment of <i>Potentilla hickmanii</i> from year-to-year	5	FWS, CDFG, PBC*, DMFF, PVT	60	5	5	5	5	5

Action Priority #	Action #	Action Description	Action Duration (years)	Responsible Party	Cost Estimates (in thousands of dollars)					
					Total Cost	FY1	FY2	FY3	FY4	FY5
3	5.1.5	Monitor populations of <i>Piperia yadonii</i>	5	FWS, DFG, PBC*, DMFF, NGOs	60	5	5	5	5	5
3	5.1.6	Monitor populations of <i>Trifolium trichocalyx</i>	5	FWS, DFG, PBC*, DMFF*, NGOs	60	5	5	5	5	5
3	5.1.7	Monitor populations of <i>Cupressus goveniana</i> ssp. <i>goveniana</i>	5	FWS, DFG, CDPR*, PBC*, DMFF*, NGOs	60	5	5	5	5	5
3	5.2.1	Evaluate effectiveness of methods used to reduce threats	ongoing	FWS*, CDFG	60	5	5	5	5	5
3	5.2.2	Evaluate research results and use in future management	ongoing	FWS*, CDFG	60	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:			423	50	43	38	33	33
Need 6: Coordinate recovery actions to benefit other listed species and species of concern										

Action Priority #	Action #	Action Description	Action 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	FWS*, CDFG*, CDPR, CITY, COUNTY, DMFF, NGOS, PBC, PVT	24	2	2	2	2	2
		Need 6 Subtotal Cost:			24	2	2	2	2	2
Need 7: Develop and implement a public outreach program										
3	7.1	Provide information and coordinate with lead agencies	5	FWS*, TBD	30	6	6	6	6	6
3	7.2	Provide species information to the public through outreach programs	5	FWS*, CDFG, TBD	25	5	5	5	5	5
3	7.3	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

Action Priority #	Action #	Action Description	Action Duration (years)	Responsible Party	Cost Estimates (in thousands of dollars)					
					Total Cost	FY1	FY2	FY3	FY4	FY5
Need 8: Reevaluate recovery criteria and revise recovery plan on knowledge obtained from research, monitoring and management										
3	8.1	Reevaluate recovery criteria	2	FWS*, CDFG	4	0	0	0	2	2
3	8.2	Revise recovery plan as needed	2	FWS*, CDFG	8	0	0	0	3	5
		Need 8 Subtotal Cost:			12	0	0	0	5	7
		TOTAL COSTS:			1645+	282+	285+	237+	138+	110+

Total estimated cost of recovery through projected date of downlisting or delisting in 2016: \$1,645,000 + additional costs that cannot be estimated at this time.

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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
	High	Species	2	1 2C
	High	Subspecies	3	2 3C
	Low	Monotypic genus	4	3 4C
	Low	Species	5	4 5C
	Low	Subspecies	6	5 6C
Moderate	High	Monotypic genus	7	6 7C
	High	Species	8	7 8C
	High	Subspecies	9	8 9C
	Low	Monotypic genus	10	9 10C
	Low	Species	11	10 11C
	Low	Subspecies	12	11 12C
Low	High	Monotypic genus	13	12 13C
	High	Species	14	13 14C
	High	Subspecies	15	14 15C
	Low	Monotypic genus	16	15 16C
	Low	Species	17	16 17C
	Low	Subspecies	18	17 18C

APPENDIX B. Summary of comments and recommendations on the Draft Recovery Plan for Five Plants from Monterey County, California

We solicited comments from appropriate Federal, State, and local agencies, scientific organizations, and other interested parties. Additionally, we invited public comment through the publication of a notice in the Monterey Herald on May 17, 2002, and in the San Mateo County Times on May 18, 2002. We received individually written letters from seven parties. These parties include five private citizens or interested nonprofit organizations, and two of the four individuals we requested to peer review the draft document.

We reviewed all comments received for substantive issues and new information regarding *Astragalus tener* var. *titi*, *Piperia yadonii*, *Potentilla hickmanii*, *Trifolium trichocalyx*, and *Cupressus goveniana* ssp. *goveniana*. Most general or species-specific comments regarding corrections, new information, or recommendations were included in this final plan. Substantive comments or recommendations are also addressed in the following summary:

General Comments or Recommendations for All Species

Comment 1: One commenter recommends that we work with the Pebble Beach Company, the Monterey Peninsula Country Club, and other private landowners within the Pebble Beach jurisdictional area to designate large tracts of protected open space within Del Monte Forest to buffer all the recovery plan species from continued threats. The commenter also believes that large areas of protected habitat will provide the necessary environmental setting for continued investigation and monitoring of these species.

Our Response: We continue to work with the Pebble Beach Company by attending meetings and providing recommendations on project proposals that relate to threatened and endangered species. We also recently provided recommendations to the Monterey Peninsula Country Club on their shore course improvement project as it relates to *Astragalus tener* var. *titi*. We agree and will continue to recommend that private landowners should provide protected areas for various federally listed species on their properties throughout the Monterey

Peninsula.

Comment 2: One commenter questions who will determine where suitable habitat is, as discussed in the recovery strategy for each listed species.

Our Response: Suitable habitat would be determined by researchers, agency experts, species experts, or others (e.g. restoration ecologists) with appropriate expertise on the given species or taxonomic group and their habitat requirements..

Comment 3: One commenter believes a long-term recovery plan should not include specific comments on proposed development plans.

Our Response: We disagree with this comment. Any proposed project that directly or indirectly threatens the continued existence of a listed species should be addressed in a recovery plan. Smaller proposed developments that would have negligible effects on these species are not usually specifically addressed. Recovery plans are intended to identify all threats for a listed species and set forth a strategy to eliminate them.

Comment 4: One commenter states that the draft recovery plan refers to “adequate acreage and size” in connection with recovery strategies and requests a definition of what is “adequate” and who or what determines the numbers and criteria used to establish the definition of “adequate”.

Our Response: Our definition of what we believe is “adequate acreage and size” of the listed plant species pertains to areas that are large enough based on research to support a functioning ecosystem (e.g., species present to support seed dispersal and pollination, the range of habitat variation needed by the species, and areas that harbor suitable unoccupied habitat for population expansion). Research should be designed to determine these parameters. Areas should be configured such that ecosystem and community processes and associated species (e.g., hydrologic regime, food webs, pollinator fauna, forest meadow communities) are maintained.

Comment 5: One commenter states that the draft recovery plan refers to properties as “unsecured” if they are not held in fee title or under a conservation

easement by a nonprofit organization. The commenter believes this assumption is inaccurate.

Our Response: We use the term “unsecured” when discussing the recovery strategy in section III.A.1 of this recovery plan. We state that *Trifolium trichocalyx* and most *Astragalus tener* var. *titi* plants currently exist within “unsecured” habitat on Pebble Beach Company and/or Monterey Peninsula Country Club property. We believe this habitat is “unsecured” because they are not fully protected from development (*e.g.*, recreational activities) threats. A conservation easement is an example of an arrangement where land would be protected in perpetuity from development threats.

Comment 6: One commenter states that the draft recovery plan does not acknowledge the 20+ years of Pebble Beach Company’s invasive plant removal program, leaving the reader to assume this is a new concept recommended by the draft recovery plan. The commenter believes that ongoing efforts of maintenance practices employed by Pebble Beach Company should be mentioned.

Our Response: We have revised the recovery plan to include statements about Pebble Beach Company’s ongoing weed eradication program. This program has the potential to significantly benefit listed plant species in the area. However, these weed removal activities are not conducted on a regular basis. They are conducted depending on time and weather conditions. Additionally, no information is available that documents where removal has occurred, success of nonnative removal activities, or on the effects of removal activities on threatened and endangered species (R. Spruance, Environmental Programs, Pebble Beach Company, pers. comm. 2003). The primary focus of the weed eradication program has been in dune areas for *Genista monspessulana* (french broom), *Cortaderia* sp. (pampas or jubata grass), *Cirsium vulgare* (bull thistle), and iceplant (*Carpobrotus edulis*). We recommend nonnative species removal in areas where listed plants are found. We also believe it is imperative to record and revisit these sites to determine effectiveness of removal activities and apply adaptive management where necessary.

Comment 7: One commenter is confused regarding the following statements we

make in the Disclaimer on page ii: “Objectives of the plan will be attained and necessary funds made available subject to budgetary and other constraints affecting the parties involved. . .” and “Recovery plans do not obligate cooperating or other parties to undertake specific tasks. . .”. The commenter believes these are two competing statements.

Our Response: Recovery plans are strategic-level planning documents prepared by us to assist landowners, agencies, nonprofit organizations, and interested parties in recovery efforts for federally listed species on their property. The document does not legally bind a landowner to conduct the activities outlined. However, it should be used to assist these parties in planning activities and provide information that would guide them to aid in the recovery of listed species.

Comment 8: One commenter inquires where the funding for recovery actions will come from, who will manage the funds, who has oversight of accounting practices, and whether there are secondary costs associated with the administration and management of the funds.

Our Response: Funding could be obtained from individual private landowners, Federal or State agencies, or through grant opportunities. In some cases (*e.g.*, conservation easements), a nonprofit organization may hold an endowment for management and monitoring activities for that property. The source of the funds usually determines how they can be used and administered.

Comment 9: One commenter believes the recovery plan title should be changed to “Five plants in the Del Monte Forest” because the draft plan focuses overwhelmingly on the Del Monte Forest area.

Our Response: Although each of the five listed species occur within or adjacent to the Del Monte Forest, they (with the exception of *Trifolium trichocalyx*) have current or historical occurrences outside of the Del Monte Forest area. Therefore, we believe it would be misleading to change the title of this recovery plan at this time.

Comment 10: One commenter states that the draft recovery plan repeatedly refers

to “unnamed private landowners”, yet the plan is careful to be specific when the Pebble Beach Company (also a private landowner) is involved.

Our Response: We are currently unaware of all the landowners who own property supporting *Piperia yadonii* and *Cupressus goveniana* ssp. *goveniana* in Monterey County, and one population of *Potentilla hickmanii* in San Mateo County. We acknowledge this difficulty in Action 1.1 of the Narrative Outline in the final recovery plan. However, we state private landowner names in those cases where the landowner is known and is an entity rather than an individual. The Pebble Beach Company is well known, owns a large portion of property on the Monterey Peninsula, and we are aware of federally listed species throughout their property. Therefore, we have included their name in sections of the recovery plan that discuss recovery efforts that may be applicable to them.

Comment 11: One commenter states that the recovery strategy in the draft recovery plan refers to a management plan as if one does not already exist. The commenter believes the final recovery plan should include reference to the Del Monte Forest Land Use Plan and Open Space Advisory Committee guidelines that are already in place.

Our Response: We have included reference to the Del Monte Forest Land Use Plan and Open Space Advisory Committee guidelines in the final recovery plan. However, we note that the land use plan and guidelines should be revised to include an adaptive management approach for the listed species addressed in this recovery plan. Permanent protection of habitat and appropriate management activities should be included for these and other federally listed species in the Del Monte Forest area (e.g., California red-legged frog).

Comment 12: One commenter states that prescribed burns are extremely unlikely to be approved for the Del Monte Forest area and therefore any recovery strategy discussing prescribed burning should be eliminated from the final recovery plan.

Our Response: We strongly recommend development of an extremely protective controlled burn plan in portions of the Del Monte forest. Not only is fire a necessary tool for *Trifolium trichocalyx* and *Cupressus goveniana* ssp. *goveniana*

recruitment, but it is also a natural process for the forest on the Monterey Peninsula. We believe a working group could develop a controlled burn plan that would provide protection to homes and facilities, which appears to be the biggest concern for landowners in the Del Monte Forest area. Therefore, we have included prescribed burn management in the final recovery plan.

Comment 13: One commenter states that although they agree with the general goals and statements as put forth in the narrative outline of the draft recovery plan, they believe that a strong recovery team should be assembled and participation should not be limited to regulatory agencies. The recovery team should then be allowed to define the actions required and be involved with the ongoing review of monitoring of such actions. The commenter also states that the recovery plan needs to strengthen species-specific details, including identifying threats and recovery tasks. The commenter states that new management techniques should be tested on experimental populations before implementation on a broad scale and that we should not preclude logical management.

Our Response: We agree that a recovery team should be developed to include qualified third-party scientists and knowledgeable restorationists, as well as representatives from various agencies (*i.e.*, U.S. Fish and Wildlife Service, California Department of Fish and Game, California Coastal Commission, California Department of Parks and Recreation), City and County governments, nonprofit organizations (*i.e.*, Del Monte Forest Foundation, California Native Plant Society, Big Sur Land Trust, The Nature Conservancy, etc.), and interested parties. We have also attempted to strengthen the species accounts with new information, including that provided during the public comment period for the draft recovery plan. When sound experimental studies are developed, we acknowledge that experimental plantings of the listed species may be warranted. However, experimental plantings should not preclude proper management of existing populations and enhancement of the species habitat addressed in this recovery plan.

Comment 14: One commenter recommends that we not consider reintroductions of these species to be a viable alternative when the plant communities they used to inhabit have been so radically altered by historical changes in soils, drainage,

water levels, topography, and flora. The commenter believes the long-term measures of recovery success should then be tied to restoration of these complex plant communities.

Our Response: We agree that reintroductions should not be the only alternative for recovery of these species, and that in some cases prior restoration of the plant community may be necessary before an introduction can be attempted. The recovery plan outlines reintroduction as one component of a broader strategy which also includes full protection of existing habitats, elimination of current threats, and enhancement of occupied and unoccupied suitable habitat.

Comment 15: One peer reviewer believes the designation of critical habitat should seriously be considered. The peer reviewer believes that a critical habitat designation would be an effective way of providing educational opportunities for the public and land use agencies (e.g., California Coastal Commission) on the plight of these species. Additionally, a critical habitat designation would give land trusts, The Nature Conservancy, and other agencies seeking land acquisitions or easements concrete criteria when prioritizing parcels for acquisition.

Our Response: The final rule listing *Astragalus tener* var. *titi*, *Piperia yadonii*, *Potentilla hickmanii*, and *Trifolium trichocalyx* as endangered, and *Cupressus goveniana* ssp. *goveniana* as threatened determined that designation of critical habitat was not prudent for these plant taxa. In the case of *Potentilla hickmanii* and *Piperia yadonii*, regulatory reasons outlined in section 3 and section 4(a)(3) of the Endangered Species Act apply. In the case of *Astragalus tener* var. *titi*, *Cupressus goveniana* ssp. *goveniana*, and *Trifolium trichocalyx*, a designation would not be prudent because it would result in no known benefit to the taxa. Decisions regarding designation of critical habitat are distinct from the recovery planning process.

Comment 16: One commenter states that the California Coastal Commission encourages and requires coastal activities and recreational opportunities near the shoreline. However, they believe this is in direct conflict with our mission to recover *Astragalus tener* var. *titi* or any other listed species that occurs along coastal areas. The commenter believes that Pebble Beach Company's adherence

with the California Coastal Commission's conditions should not be a "reason for listing". The commenter also asks if we intend to require removal of the enclosure and coastal access facilities.

Our Response: Development within the coastal zone must adhere with the California Coastal Act's (Coastal Act) requirements. The Del Monte Forest Land Use Plan (DMF LUP) was certified by the California Coastal Commission and development permits within the Del Monte Forest Coastal Zone became the responsibility of the County of Monterey. However, in some cases the Monterey County planning process does not appear to be implemented in a manner that will maintain the standards developed in the DMF LUP. For example, the Coastal Act defines Environmentally Sensitive Habitat Areas (ESHAs) as "...any area in which plant or animal life or their habitats are either rare or especially valuable...and which could be easily disturbed or degraded by human activities and developments." Monterey County policy identifies ESHAs as those identified in the 1984 DMF LUP. Because *Piperia yadonii* was not recognized taxonomically in 1984, its occurrence in the Del Monte Forest is not addressed as an ESHA in Pebble Beach Company's proposed development (EIP Associates 1995). Additionally, *Astragalus tener* var. *titi* habitat is not identified as an ESHA. These species therefore do not receive the protections afforded by the Coastal Act (EIP Associates 1995). We believe it is important for the DMF LUP to be updated to address these endangered species and provide them the level of protection needed to support recovery. We believe this goal can be accomplished with careful planning while also providing recreational opportunities for the public. In regard to the commenter's concern over the *A. tener* var. *titi* enclosure, as mentioned in this recovery plan, the enclosure may need to be removed because it is likely not providing the best habitat conditions for the plants. However, it is imperative to the survival of this population that Pebble Beach Company not only remove the enclosure, but also address the ongoing threats to the taxon.

Specific Comments for *Astragalus tener* var. *titi*

Comment 17: Two commenters are concerned that *Astragalus tener* var. *titi* habitat along 17-Mile Drive is being incorrectly managed. One of these commenters believes the first priority should be the preservation of its existing habitat because of the species' low numbers and because this location is the only wild population currently known.

Our Response: We agree with the commenter that full protection should be provided to the existing population on the Monterey Peninsula. This recovery action is given a priority of "1" in the implementation schedule found in this recovery plan. This recovery action should be followed by removing any existing threats that may cause further decline of this population on both Pebble Beach Company and Monterey Peninsula Country Club property.

Comment 18: One commenter is concerned about the impacts of the proposed changes in the Monterey Peninsula Shore Course Improvement to the *Astragalus tener* var. *titi* population.

Our Response: We provided comments to the Monterey County Building and Inspection Department in a letter dated December 20, 2001. The letter outlined our concerns with the proposed project on listed plant species in the area. Additionally, our letter outlined those actions that we believed should be conducted prior to any ground disturbing activities, to include 1) conducting thorough surveys for the threatened *Chorizanthe pungens* var. *pungens* (Monterey spineflower), and the endangered *Piperia yadonii* (Yadon's piperia), *Layia carnosa* (beach layia), *Erysimum menziesii* (Menzies' wallflower), *Gilia tenuiflora* ssp. *arenaria* (sand gilia), *Lupinus tidestromii* (Tidestrom's lupine) and *Potentilla hickmanii* (Hickman's potentilla) prior to onset of any construction activities; 2) utilizing our Guidelines for Botanical Inventories¹ in the absence of specific protocols; 3) providing a suitable buffer area between development and sensitive species (*i.e.*, *Astragalus tener* var. *titi* and *Trifolium polypodon* [Pacific Grove clover]); 3) conducting golf-course greens maintenance activities (*i.e.*,

¹ - Botanical survey guidelines are available on our website at the following internet address: http://ventura.fws.gov/SurveyProt/Botanical_surv.htm

mowing, fertilizer use, herbicide use with a glyphosate-based herbicide) after *Astragalus tener* var. *titi* has died back and before its germination period begins; 4) describing and outlining the type of disturbance to be allowed within *A. tener* var. *titi* areas in a management plan prior to construction activities; 5) developing a plan for the habitat restoration efforts that were proposed; 6) initiating restoration efforts prior to construction/shore course improvement activities and around known populations of *A. tener* var. *titi* and *Trifolium polypodon* to benefit plants that currently occur on the project site by allowing for population expansion; and, 7) developing success criteria for the restoration program prior to the onset of any construction or restoration activities, including a schedule of restoration activities, monthly and/or annual plans for restoration activities, and methods for monitoring and reporting the success of the restoration program.

Comment 19: One commenter states that Pebble Beach Company submitted a Memorandum of Understanding to the California Department of Fish and Game several years ago regarding conservation of *Astragalus tener* var. *titi*. However, the California Department of Fish and Game has not responded. The commenter requests that the Conservation Measures section of the recovery plan be restated to reflect the fact that California Department of Fish and Game has not responded.

Our Response: We removed the reference to a Memorandum of Understanding in the *A. tener* var. *titi* conservation measures section of this recovery plan.

Comment 20: One commenter strongly encourages a survey of the private lands in the general locality of the current *Astragalus tener* var. *titi* population.

Our Response: We agree and have therefore recommended additional surveys in the narrative outline of this recovery plan (Action 4.2.1).

Comment 21: One commenter states that the long-term survival of *Astragalus tener* var. *titi* cannot be considered “recovered” in the absence of natural habitat. The commenter believes that a garden of this species planted each year somewhere on the landscape is not a “successful” scenario and that fencing the population and “leaving it alone” is not an effective conservation alternative. They believe that restoration of the physical conditions and plant community

associated with the edges of vernal wet areas adjacent to coastal terrace prairie would be the most likely long-term habitat to sustain populations of *A. tener* var. *titi*. Additionally, the commenter believes that because Pebble Beach Company and the Monterey Peninsula Country Club have the resources available to manage the landscape based on commercial uses, these landowners should become involved in an effort to restore an ecologically viable plant community with this species.

Our Response: We agree with the commenter that *A. tener* var. *titi* habitat will require restoration and protection. Therefore, we have provided recommendations in this recovery plan that include reducing current threats, restoring habitat adjacent to the existing population to allow for expansion, surveying additional suitable habitat for additional populations, and reestablishing populations in historical locations.

Comment 22: One commenter believes a long-term commitment must be made by cooperating parties to establish a garden/greenhouse population of plants to provide as diverse a seed source as possible. They state that specific monitoring tasks must be clearly defined and documented each year for both the garden/greenhouse seed production and a grassland restoration effort. Additionally, the commenter states that although the Pebble Beach Company started a greenhouse propagation program in the 1990's, turnover in staff without any transitional training has resulted in the loss of an effective greenhouse program. Therefore, the commenter recommends an annual training program for workers to identify the plants and become familiar with the entire recovery effort.

Our Response: We have recommended and included the following actions in this recovery plan: 1) establishment of an *ex situ* seed bank (*i.e.*, Action 5.3); 2) establishment of a working group (*i.e.*, Action 3.1) to develop and implement recovery guidelines, which could also include plan development for a greenhouse population of this taxon; and 3) establishment of informational outreach programs for workers (*i.e.*, Action 2.1.1) and the general public (*i.e.*, Action 7.0).

Comment 23: One commenter believes that small areas near Bird Rock should be set aside for manipulation, experimental plantings, and monitoring. The

commenter suggests restoration of vernal wet areas and coastal grasslands through community outreach for residents of all ages. They believe that volunteer opportunities to restore the natural landscape would probably have positive reception.

Our Response: We agree that there is potential *Astragalus tener* var. *titi* habitat in the Bird Rock area. However, much of this habitat is in need of restoration efforts, most specifically nonnative vegetation control of *Carpobrotus edulis* (iceplant), *Plantago coronopus* (cut-leaf plantain), and *Carex pansa* (Pansa sedge). These threats should be removed prior to establishing any new or experimental populations of *A. tener* var. *titi*.

Specific Comments for *Piperia yadonii*

Comment 24: One of the peer reviewers concludes that *Piperia* species cannot be distinguished with any certainty if plants are only in a vegetative form (*i.e.*, leaves only). The peer reviewer believes that any individual who reports apparent leaf differences should document in writing what they see and how they prove the differences to be real. Additionally, another commenter states that extraordinarily large numbers of *Piperia yadonii* recorded during the 1995 surveys were during a very wet year, and the total count of 82,700 individuals was based on counting leaves before the plant was in bloom. Therefore, the surveys did not meet the survey protocol for this species. The commenter believes the number of individuals seen during 1995 to have been artificially high, as numbers seen since then have been lower.

Our Response: We have included the peer reviewer's comments into the recovery plan regarding the difficulty in distinguishing between *Piperia* species that have not flowered. We strongly recommend that all biologists conducting surveys for *Piperia yadonii* carry out a two-part survey. The first part should occur in early spring, when the plant is in leaf and the maximum distribution of non-dormant vegetative plants can be mapped. The second part should involve a return visit to the survey area to identify flowering individuals. Due to the low flowering rate and potential for herbivores to eat all the flowering spikes, a portion of the population in leaf may need to be caged during the first survey

period to ensure at least some flowering spikes survive for identification. Based on the 2004 census results for the Del Monte Forest (see distribution section of the *P. yadonii* species account) we do not believe the 1995/1996 surveys overestimated the total population size in the Del Monte Forest. On the contrary, for the two largest occurrences, the 1995/96 survey was likely an underestimate, due to the survey method and the dormancy this species exhibits

Comment 25: One commenter states that deer have overpopulated the Monterey Peninsula. As a result, approximately 5 percent of the *Piperia yadonii* plants likely bloom and set seed. The commenter believes that a humane form of limiting the deer population is essential if this plant species is expected to survive. The commenter believes the only other alternative is to cover plants with wire baskets in order to give them a chance to set seed. However, this option is labor-intensive and unattractive although the method has worked at Asilomar State Beach for *Erysimum menziesii* ssp. *menziesii* (Menzies wallflower).

Our Response: Only a small part of the *P. yadonii* population that emerges in leaf also sends up a flowering spike. This low flowering rate is often further reduced by herbivory. We have included deer control as a potential measure to address in the narrative outline for *Piperia yadonii* (Action 2.1.2). We also recommend examining browsing on *Astragalus tener* var. *titi* (Action 5.1.3) and developing an outreach program in an attempt to draw the public into assisting with potential deer control (Action 7.2).

Comment 26: Two commenters state they have complained repeatedly about roadside mowing of *Piperia yadonii* plants by Pebble Beach Company or the Pebble Beach Community Services District. The commenters believe that maps should be provided to drivers so inadvertent mowing of *P. yadonii* plants can be avoided.

Our Response: We believe it is important to provide informational materials to any worker who will be conducting maintenance activities within occupied habitat for each of the five listed plants addressed in this recovery plan. Based on previous complaints made, it may be necessary to reevaluate the approach we take during working group discussions to ensure that roadside mowing of listed

species does not occur.

Comment 27: One commenter believes it does not make any sense to protect habitat areas in which disturbance would be minimal and animal life would be most abundant because: 1) *Piperia yadonii* grows in numerous locations where disturbance has occurred; and 2) it appears that *P. yadonii* is thriving in the disturbed areas.

Our Response: We disagree with the commenter and believe that in any case where the federally endangered *Piperia yadonii* occurs, some level of protection is warranted until the species is no longer listed as an endangered species. Therefore, we have outlined a variety of recovery measures that we believe are necessary to downlist *Piperia yadonii* to a threatened species. Additionally, although *P. yadonii* may grow in areas where past disturbance has occurred, the population might only be stable or may be declining due to the disturbance. We should provide protection to all remaining patches of plants that are deemed endangered by the Federal government.

Comment 28: One commenter believes the draft recovery plan refers to a highly improbable and unrealistic goal of developing a deer and rabbit abatement program in an urban forest area.

Our Response: We do not believe it is impossible to develop a deer or rabbit control program. Therefore, we recommend developing control measures in working group discussions which would provide interested parties and landowners the opportunity to strategize and develop the best possible solution to this growing problem for listed plant species on the Monterey Peninsula.

Comment 29: One commenter believes that dumping of nonsite-specific chipped vegetation in *Piperia yadonii* habitat is introducing a host of unwanted species. The commenter recommends that chips to be spread for erosion control in areas known to support populations of *P. yadonii* should be obtained only from very local sources.

Our Response: We agree with the commenter and have recommended in this

recovery plan that chips be those only from local sources if they are to be spread on the Monterey Peninsula (Action 2.1.2).

Comment 30: One peer reviewer requests to know our definition of a metapopulation. Additionally, the peer reviewer cannot discern six possible metapopulations for *Piperia yadonii* unless artificial boundaries are placed between them. The peer reviewer recommends establishing preserves that protect a total of “x” individuals over “x” number of sites in each habitat type spread over the entire geographic range of the species and that priority should be given to large populations in large parcels (due to edge effects and effects of selfing). The peer reviewer believes plants on each site should also have direct or indirect (stepping stone) gene flow with plants on at least five other sites.

Our Response: We agree that more specific recovery criteria should be developed that are objective and measurable. We have, therefore, revised the recovery criteria and the discussion of metapopulations in this plan. We are also recommending research to address this issue.

Specific Comments for *Potentilla hickmanii*

Comment 31: One peer reviewer and two commenters state that immediate corrective action is needed for *Potentilla hickmanii* population at the Indian Village picnic area. They believe the recent change in hydrology has resulted in extra drainage water directed into this area, thus causing a drastic change in water availability and increased invasive grasses competing with *P. hickmanii*. Additionally, control of extra water and careful mowing may be critical to the existence of this plant.

Our Response: We agree with the peer review and commenters. We believe the *Potentilla hickmanii* population is in serious threat of being extirpated as a result of increased water flow into the area. We recommend that the Del Monte Forest Foundation and the Pebble Beach Company immediately address this threat (Action 2.1.3).

Comment 32: One commenter states that Pebble Beach Company's biologists do not agree with us that mowing of the Indian Village site is detrimental to expansion of habitat. The commenter says the Pebble Beach biologists believe mowing (which is voluntarily conducted by the Pebble Beach Company) helps by lessening competition for *Potentilla hickmanii* because it is a low growing species unaffected by mowing.

Our Response: Under some circumstances, mowing could have beneficial effects to *Potentilla hickmanii*. However, if mowing is conducted at the wrong time of year, flower stalks or seed structures could be damaged, thus decreasing the chances that seedlings would emerge the following season. If mowing is to continue in the Indian Village picnic area, the Del Monte Forest Foundation should develop a mowing schedule and provide mapping materials to workers (Action 2.1.3).

Comment 33: One commenter questions who will determine where suitable habitat is located for the recovery of *Potentilla hickmanii*.

Our Response: At least one other potential location (*i.e.*, Carmello Meadows, Point Lobos State Reserve) has been identified for establishment of additional populations of *Potentilla hickmanii*. Additional research and surveys should be conducted by qualified biologists/botanists to determine other suitable habitat areas within the range of the species.

Comment 34: One commenter believes that we are recommending unrealistic goals of relocating and/or removing the Del Monte Forest Foundation's recreational activities from the Indian Village area where *Potentilla hickmanii* occurs.

Our Response: We have discussed this possibility with the Del Monte Forest Foundation and Pebble Beach Company personnel in the past and they felt that relocation of their recreational activities was not possible. However, this population of plants is in worse condition today and immediate action is necessary to prevent extinction of this population. All threats to this species should be removed, to include those recreational activities that are threatening the

continued existence of this species.

Comment 35: One commenter believes that a garden or greenhouse population of *Piperia yadonii* plants should be made to provide as diverse a seed source as possible. They also state that although the Pebble Beach Company started a greenhouse propagation program in the 1990's, turnover in staff without transitional training has seen the loss of an effective greenhouse program.

Our Response: As stated in comment #22 above, a seed bank should be established, and a working group could be developed to address establishment of a greenhouse population of this species.

Specific Comments for *Trifolium trichocalyx*

Comment 36: Two commenters believe some form of fire is needed to prevent extirpation of *Trifolium trichocalyx*. One of the commenters suggests an experiment to remove most trees from approximately a half-acre parcel in known *T. trichocalyx* habitat using a dry-slash technique to create a ground fire. The second commenter suggests maintaining a mosaic of small burns to allow the plant to flower on a 5- to 10-year cycle.

Our Response: We have recommended to the Pebble Beach Company in the past that a prescribed burn is needed for *Trifolium trichocalyx*. However, there is much concern over private property (e.g., residences) in close proximity to the Huckleberry Hill area where *T. trichocalyx* was last found. We believe it is important for the recovery of this species to develop some form of prescribed burn and have therefore recommended this measure in Action 2.1.4.

Comment 37: One commenter is concerned that very few environmental staff (if any) remain working at Pebble Beach Company due to recent dismissals to cut expenditures. As a result, the commenter believes there is no one left on staff able to recognize *Trifolium trichocalyx* or who may be familiar with this species' habitat requirements. Additionally, the commenter believes it will be extremely important to have clear-cut standards, specific success criteria, and monitoring over a minimum of the next 12 years for this species, and likely longer for

Cupressus goveniana ssp. *goveniana*.

Our Response: We believe it is important to develop an outreach program for Pebble Beach Company's employees, construction workers, and recreational users to ensure the level of protection necessary to protect threatened and endangered species. Additionally, an outreach program could reach other small private landowners in the area. Their support may assist us in a long-term outreach program. Recovery success criteria have been outlined in this recovery plan, although a working group made up of scientists, agencies, and other interested parties could further refine the recovery criteria if additional information becomes available.

Comment 38: One commenter believes that if one of the reasons for listing is "loss of potential habitat from residential and recreational development" and (as stated in the draft recovery plan) if "the location where *Trifolium trichocalyx* was last found has been excluded from the most recent development plans (*i.e.*, Del Monte Forest Preservation and Development Plan, 2001), then the most significant threat has been eliminated and the current threat to this species is solely fire suppression efforts.

Our Response: We are not certain of the precise boundaries of the *Trifolium trichocalyx* seed bank. Although the Pebble Beach Company's most recent development plans excluded a portion of habitat that may support a seedbank for this species, additional areas with suitable habitat remain unprotected from residential and recreational development threats. Further research and prescribed burning experiments are needed to clarify the extent of a seedbank for this species.

Comment 39: One commenter believes that the Huckleberry Hill area where *Trifolium trichocalyx* occurs is a low/no use area and therefore protection measures, fences, or enclosures are inappropriate.

Our Response: We agree that the Huckleberry Hill area is a low use area. However, threats to *Trifolium trichocalyx* are still apparent (*i.e.*, potential development threats, lack of natural fire activity). Therefore, we have

recommended that the area where *T. trichocalyx* may occur (in addition to that area that may harbor a seed bank) be permanently protected in perpetuity, in addition to the landowner providing active management that includes development of a burn plan (Action 1.4.4).

Specific Comments for *Cupressus goveniana* ssp. *goveniana*

Comment 40: One peer reviewer believes the *Cupressus goveniana* ssp. *goveniana* habitat needs controlled burns at 50- to 70-year intervals to reduce overstory competition. Additionally, it needs protection from invasive weed trees (e.g., *Eucalyptus* sp., *Acacia* sp., *Pittosporum undulatum* [Victorian Box]) and many other weeds that are slowly moving into the area.

Our Response: We agree that a burn plan should be developed to aid in recovery of this species. Additionally, more research could be conducted to determine if alternative practices may aid in *Cupressus goveniana* ssp. *goveniana* regeneration. We have also recommended nonnative weed removal to aid in seedling establishment (Action 2.1.5).

Comment 41: One commenter states that chips spread along fire roads have introduced seeds of *Cupressus macrocarpa* that have survived as seedlings in the *C. goveniana* ssp. *goveniana* populations. The commenter recommends removing these seedlings and preventing any chips spread in the habitat that are not site-specific.

Our Response: This same problem has been occurring with *Piperia yadonii* (see comment #29). Therefore, we are recommending that landowners only use clippings from local sources if they are to be spread on the Monterey Peninsula (Action 2.1.5).

Comment 42: One commenter believes the role of fire in the long-term viability of *Cupressus goveniana* ssp. *goveniana* has not been researched and care should be taken not to over-interpret the finding of short-term “reproductive success” in the absence of fire.

Our Response: We agree with the commenter and have provided their reasoning

in the narrative outline for researchers and managers to consider when they are developing management guidelines for this taxon (Action 3.2.5).

Comment 43: One commenter states that short-term seed germination and recruitment is not the same as adequate long-term regeneration success. The commenter also states that 10 years is not a sufficient time-frame to measure regeneration success. Additionally, having some level of seedlings present is not a sufficient measure of regeneration quality. Therefore, the commenter suggests that regeneration success be measured in terms of abundant natural regeneration, with parental contributions from many trees, and measured directly with genetic analysis.

Our Response: We agree that likely more than 10 years are needed to measure regeneration success of *Cupressus goveniana* ssp. *goveniana*, as well as the other species addressed in this recovery plan. We have also modified the time-frame in the recovery plan to 12 consecutive years to be consistent with general weather patterns. However, it will likely be necessary to have many more years of data, including a minimum of 12 consecutive years where the populations are stable or increasing.

APPENDIX C. Threats Identified for *Astragalus tener* var. *titi*, *Piperia yadonii*, *Potentilla hickmanii*, *Trifolium trichocalyx*, and *Cupressus goveniana* ssp. *goveniana*, 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> ¹	<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	Advise landowners (Action 1.1). Secure and protect existing sites (Actions 1.3.1, 1.3.2, 1.4.1). Minimize threats (Action 2.1.1). Establish a working group to develop and implement recovery guidelines (Actions 3.1.1, 3.1.2). Use research results and monitoring data to determine effectiveness of management (Actions 5.1.1, 5.1.2, 5.1.3). Develop a public outreach program (Actions 7.1, 7.2, 7.3).	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 (Actions 1.3.1, 1.3.2). Determine other suitable sites and implement reintroduction or establishment of more populations (Actions 4.1, 4.2.1, 4.3.1). Establish a seed bank (Action 5.3). Develop a public outreach program (Actions 7.1, 7.2, 7.3).	A, D	1(a), 1(b), 1(c), 1(f)
Competition from alien plants (<i>Carpobrotus</i> and <i>Plantago</i> , <i>Carex</i> ²)	Minimize threats (Action 2.1.1). Obtain life history data to properly manage the threatened species (Action 3.2.1). Use research results and monitoring data to determine effectiveness of management (Actions 5.2.1, 5.2.2).	E	1(a), 1(b), 1(d), 1(e)
Urban development ² and coastal military activities for historical occurrences	Establish a working group to develop and implement recovery guidelines (Actions 3.1.1, 3.1.2). Determine other suitable areas for additional populations and implement reintroduction/establishment (Actions 4.1, 4.2.1, 4.3.1). Develop a public outreach program (Actions 7.1, 7.2, 7.3).	A, D	1(a), 1(c)

¹ 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.

² Threat 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.

<i>Astragalus tener</i> var. <i>titi</i> (coastal dunes milk vetch), continued			
<i>Threat</i>	<i>Recovery Action</i>	<i>Listing Factor</i>	<i>Recovery Criteria</i>
Modifications in hydrology from improvements and maintenance activities (e.g., mowing to accommodate single-purpose fire regulations) along 17-Mile Drive ²	Inform landowners and consult with planning departments for proper management (Actions 1.1, 1.2). Use research results and monitoring data to determine effectiveness of management (Actions 5.2.1, 5.2.2).	A, D	1(a), 1(d), 1(e)
Herbivory by animal and insect species ²	Minimize threats (Action 2.1.1). Obtain life history data to properly manage the threatened species (Action 3.2.1). Use research results and monitoring data to determine effectiveness of management (Actions 5.2.1, 5.2.2).	A, E	1(a), 1(b), 1(d), 1(e)

<i>Piperia yadonii</i> (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 (e.g., golf course) development	Inform landowners (Action 1.1). Secure and protect existing sites (Actions 1.3.1, 1.3.2, 1.4.1, 1.4.2). Minimize threats (Action 2.1.2). Establish a working group to develop and implement recovery guidelines (Actions 3.1.1, 3.2.2). Use research results and monitoring data to determine effectiveness of management (Actions 5.2.1, 5.2.2). Develop a public outreach program (Actions 7.1, 7.2, 7.3).	A, D	2(a), 2(b), 2(c)
Competition from nonnative species	Minimize threats (Action 2.1.2). Use research results and monitoring data to determine effectiveness of management (Actions 5.2.1, 5.2.2). Establish a working group to develop and implement recovery guidelines (Actions 3.1.1, 3.1.2). Develop a public outreach program (Actions 7.1, 7.2, 7.3).	E	2(b), 2(c)
Roadside maintenance (mowing); a fire directive requesting removal of roadside vegetation for prevention of wildfires ²	Advise landowners and planning departments for proper management (Actions 1.1, 1.2). Minimize threats (Action 2.1.2). Use research results and monitoring data to determine effectiveness of management (Actions 5.2.1, 5.2.2). Develop a public outreach program (Actions 7.1, 7.2, 7.3).	A, D	2(b), 2(c)
Potential increase in deer grazing of flowering stems	Advise landowners (Actions 1.1, 1.2). Minimize threats (Action 2.1.2). Obtain specific data to manage the listed species (Action 3.2.2).	C	2(b), 2(c)
Roadway circulation improvement at Monterey Peninsula Airport ²	Consult with agencies (Action 1.2). Protect habitat (Action 1.4.2). Manage land to control threats (Action 2.1.2). Coordinate with lead agency (Action 7.1).	A, D	2(a), 2(b)
Proposed realignment of U.S. Route 101 near Prunedale ²	Consult with agencies (Action 1.2). Protect habitat (Action 1.4.2). Manage land to control threats (Action 2.1.2). Coordinate with lead agency (Action 7.1).	A, D	2(a), 2(b)
Collection of plants by horticulturists/researchers	Advise landowners (Action 1.1). Secure and protect existing sites (Actions 1.3.1, 1.3.2, 1.4.2). Minimize threats (Action 2.1.2). Develop a public outreach program (Actions 7.1, 7.2, 7.3).	A	2(a), 2(b)
Possibly, loss of viable habitat due to changes in vegetation structure within areas following fire suppression ²	Inform landowners and planning departments for proper management (Actions 1.1, 1.2). Manage land to control threats (Action 2.1.2). Use research results and monitoring data to determine effectiveness of management (Actions 5.2.1, 5.2.2).		2(b), 2(c)

<i>Potentilla hickmanii</i> (Hickman's potentilla)			
<i>Threat</i>	<i>Recovery Action</i>	<i>Listing Factor</i>	<i>Recovery Criteria</i>
Recreational activities and maintenance (e.g., mowing) of recreational area	Advise landowners (Action 1.1). Secure and protect existing sites (Actions 1.3.1, 1.3.2, 1.4.3). Minimize threats (Action 2.1.3). Establish a working group to develop and implement recovery guidelines (Actions 3.1.1, 3.1.2). Use research results and monitoring data to determine effectiveness of management (Actions 3.2.3, 5.1.3, 5.2.1, 5.2.2). Develop a public outreach program (Actions 7.1, 7.2, 7.3).	A, D, E	3(a), 3(b), 3(d)
Residential development (potential alteration of hydrology)	Secure, protect and properly manage existing sites (Actions 1.3.1, 1.3.2, 1.4.3, 2.1.3). Minimize threat (Action 2.1.3). Establish a working group to develop and implement recovery guidelines (Actions 3.1.1, 3.1.2).	A, D	3(a), 3(b), 3(d)
Competition from invasive alien plants	Minimize threats (Action 2.1.3). Use research results and monitoring data to determine effectiveness of management (Actions 3.2.3, 5.1.3, 5.2.1, 5.2.2).	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 (Actions 1.3.1, 1.3.2, 1.4.3). Determine other suitable sites to reintroduce or establish more populations (Actions 4.2.3, 4.3.1, 4.3.2). Develop management strategies through research to obtain species specific data to better manage the populations (Actions 3.2, 3.2.3). Monitor the populations for survival, seed production and recruitment (Action 5.1.3). Establish a seed bank (Action 5.3). Develop a public outreach program (Actions 7.1, 7.2, 7.3).	E	3(a), 3(b), 3(d), 3(e)
Browsing by deer; snail and slug damage; vole herbivory and soil inundation ²	Advise landowners (Actions 1.1, 1.2). Minimize threats (Action 2.1.3). Obtain specific data to manage the listed species (Action 3.2.3).	A, C	3(a), 3(c), 3(d)
Changes in hydrology resulting in extra water drainage into meadow at Indian Village picnic area ²	Advise landowners (Actions 1.1, 1.2). Minimize threats (Action 2.1.3).	A, C	3(a), 3(c), 3(d)
Potential development at Montara population ²	Advise landowners and consult with agencies (Actions 1.1, 1.2, 7.1). Protect habitat (Action 1.4.3). Manage land to control threats (Action 2.1.3).	A, D	3(a), 3(b), 3(d)
Alteration of fire frequency and intensity ²	Minimize threats (Action 2.1.3). Obtain specific data to manage the listed species (Action 3.2.3).	A, C	3(a), 3(c), 3(d)

<i>Trifolium trichocalyx</i> (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 (Action 2.1.4). Obtain specific data to manage the listed species (Action 3.2.4). Monitor populations for survival, seed production and recruitment (Action 5.1.3). Determine other suitable sites where fire can occur and implement reintroduction or establishment of more populations (Actions 4.2.4, 4.3.3).	A, E	4(a), 4(b), 4(c)
Residential and recreational development and use	Advise landowners (Action 1.1). Secure, protect and properly manage existing sites (Actions 1.3.1, 1.3.2, 1.4.4, 2.1.4). Minimize threats (2.1.4). Establish a working group to develop and implement recovery guidelines (Actions 3.1.1, 3.1.2). Use research results and monitoring data to determine effectiveness of management (Actions 5.2.1, 5.2.2). Develop a public outreach program (Actions 7.1, 7.2, 7.3).	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 (Actions 1.3.1, 1.3.2, 1.4.4). Determine other suitable sites and implement reintroduction or establishment of more populations (Actions 4.2.4, 4.3.3). Develop management strategies through research to obtain species specific data to better manage the populations (Action 3.2.4). Monitor occurrences to evaluate trends in population dynamics (Action 5.1). Establish a seed bank (Action 5.3). Develop a public outreach program (Actions 7.1, 7.2, 7.3).	E	4(a), 4(b), 4(c), 4(d)

<i>Cupressus goveniana</i> var. <i>goveniana</i> (Gowen cypress)			
Threat	Recovery Action	Listing Factor	Recovery Criteria
Habitat alteration due to residential and recreational (e.g., golf course) development, edge effects	Advise landowners (Action 1.1). Secure and protect existing sites (Actions 1.3.1, 1.3.2, 1.4.5). Minimize threats (Actions 2.1.5). Establish a working group to develop and implement recovery guidelines (Actions 3.1.1, 3.1.2). Use research results and monitoring data to determine effectiveness of management (Actions 5.2.1, 5.2.2). Develop a public outreach program (Actions 7.1, 7.2, 7.3).	A, D	5(a), 5(b)
Disruption of natural fire cycles	Minimize threats (Recent research has suggested fire is not necessary for regeneration; Action 2.1.5). Develop management strategies through research and implement alternative management practices critical for continued existence of forests (Action 3.2.5). Use research results and monitoring data to determine effectiveness of management (Actions 5.2.1, 5.2.2). Develop a public outreach program (Actions 7.1, 7.2, 7.3).	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 (Actions 3.1.1, 3.1.2). Minimize threats (Action 2.1.5). Use research results and monitoring data to determine effectiveness of management (Actions 5.2.1, 5.2.2).	E	5(a), 5(b)
Small population size/stochasticity ²	Establish an <i>ex situ</i> seed bank (Action 5.3).	A, E	5(d)
Risk from introduced insects or disease ²	Minimize threats (Action 2.1.5). Establish an <i>ex situ</i> seed bank (Action 5.3).	A, C, D, E	5(a), 5(d)
Ongoing impacts from air pollution and climate change ²	Use research results and monitoring data to determine effectiveness of management (Actions 5.2.1, 5.2.2). Develop a public outreach program (Actions 7.1, 7.2, 7.3).	A, B, E	5(a), 5(b)
Possible genetic contamination from planted trees ²	Advise landowners (Action 1.1). Develop management strategies through research and implement alternative management practices critical for continued existence of forests (Actions 3.2.5). Develop a public outreach program (Actions 7.1, 7.2, 7.3).	A, D	5(a), 5(b)

APPENDIX D. Glossary of Technical Terms³

abiotic	not biological; not involving or produced by organisms
alkaline	having a pH value greater than 7; opposite of acidic
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
caudex	the woody base of an otherwise herbaceous perennial species
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

³ 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/>

brown; somewhat excessively drained with low to medium 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 genetic composition (<i>i.e.</i> , allele frequency) in population over time; also called random genetic drift. Genetic drift occurs more quickly and dramatically in small populations and can lead to fixation or loss of alleles.
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 closely related 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
podzolic	highly leached whitish-grey soils on the upper soil surface found under forest conditions in cool temperate to humid climates
polymorphic	having a number of variations. For example, different forms of an enzyme or a number of different alleles at a locus
population	the individuals of a species that occur in a locality. Populations discussed in this recovery plan are not necessarily synonymous with “populations” defined biologically as a group of freely interbreeding individuals.
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
scarification	human-induced rupture of a seed coat to facilitate germination

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
spikes	the peduncle (stalk of entire inflorescence) that holds flowers that are arranged (usually flush) along its axis
spur	hollow, often conic projection made from sepals or petals that usually holds nectar
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 E. Marine Terrace Plant Communities and Successional Patterns on the Monterey Peninsula

1. 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. Therefore, 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.

Vegetation on this terrace includes northern coastal scrub and coastal terrace prairie. Coastal scrub habitat includes, but is not limited to, *Baccharis pilularis* (coyote brush), *Ceanothus thyrsiflorus* (blue blossom), *Rubus ursinus* (California blackberry), *Toxicodendron diversiloba* (poison-oak), and *Mimulus aurantiacus* (bush monkeyflower). Coastal terrace prairie habitat supports perennial bunchgrasses, nonnative annual grasses, and native and

nonnative herbs (e.g., *Camissonia ovata* [suncups], *Calochortus uniflorus* [star-tulip], and prostrate *Baccharis pilularis* and *Mimulus aurantiacus* on tops of mounds. Although some areas form distinct habitat types, other areas have an integration of these two habitat types due to successional patterns.

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.

This terrace supports Monterey pine forest habitat except at the ocean edge where Sheridian soils on ocean bluffs support forests of *Cupressus macrocarpa* (Monterey cypress). This Monterey pine forest habitat supports both pure stands of *Pinus radiata* in addition to mixed *Pinus* sp. and *Quercus agrifolia* (coast live oak) forest. Understory species in the Monterey pine forest habitat may include *Toxicodendron diversiloba*, *Mimulus aurantiacus*, *Rubus ursinus*, *Rhamnus californica* (California coffeeberry), *Ceanothus thyrsiflorus*, *Baccharis pilularis*, *Iris douglasiana* (Douglas' iris), *Ribes speciosum* (fuchsia-flowered gooseberry), and *Polypodium californicum* (California polypody). Understory species in the Monterey cypress forest habitat may include *Mimulus aurantiacus*, *Stachys bullata* (hedge-nettle), *Rubus ursinus*, *Iris douglasiana*, *Symphoricarpos mollis* (snowberry), *Toxicodendron diversiloba*, and *Polystichum munitum* (swordfern). In openings where recent burns or blowdowns have occurred, *Pinus radiata* and shrub species regeneration is dense.

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.

This terrace supports forests of *Pinus radiata* and *Quercus agrifolia*. On this terrace, Monterey pine forest is relatively open, with some stands considered

“woodland” with a grass understory rather than a closed forest. In woodlands, understory species are mostly bunchgrasses, which appear similar to coastal prairie habitat. However, some areas support a dominate amount of European annual grasses (e.g., *Bromus diandrus* [ripgut brome]). Common understory species may include *Pteridium aquilinum* (bracken fern), *Achillea millefolium* (yarrow), *Iris douglasiana*, *Juncus patens* (spreading common rush), *Leymus glaucus* (blue wildrye), *Leymus condensatus* (giant wildrye), *Galium californicum* (California bedstraw), *Zigadenus fremontii* (star lily), *Sanicula laciniata* (coast sanicle), *Fragaria vesca* ssp. *californica* (California strawberry), and *Oxalis pes-caprae* (Bermuda buttercup). Upper edges of this terrace near the Terrace 4 boundary at one location support an understory of *Arctostaphylos tomentosa* var. *tomentosa* (shaggy-barked manzanita) and *Vaccinium ovatum* (huckleberry).

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 this terrace with natural vegetation remain on the Monterey Peninsula. Of those areas that remain, Monterey pine forest habitat can have either an open or closed canopy, with occasional to moderate presence of *Quercus agrifolia*, and a mixture of *Pinus muricata* with *Pinus radiata* in open canopy stands. *Pinus radiata* stands appear to be stunted in height to approximately 50 to 70 feet tall. Understory species may include grassland species with scattered *Arctostaphylos tomentosa* var. *tomentosa* and *Vaccinium ovatum*, or a uniform shrub cover that also includes *Rhamnus californica*, *Mimulus aurantiacus*, and *Ceanothus thyrsiflorus*. One site along State Route 68 appears to be near the inland limit for lowland Monterey pine forest habitat, although trees do occur inland on shale bedrock formations at a higher elevation.

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.

Habitat types on this terrace are divided into three phases: Monterey pine forest, Monterey-Bishop pine forest, and pygmy forest. The Monterey pine forest habitat supports an open canopy of *Pinus radiata* with *Quercus agrifolia*. The pines are stunted, becoming flat-topped between 50 and 60 feet tall. The understory is a mix of open grass and duff with patches of dense shrubs, including species such as *Arctostaphylos tomentosa* var. *hookeri* (Hooker's manzanita), *Arctostaphylos pumila* (sandmat manzanita), *Rhamnus californica*, *Mimulus aurantiacus*, *Toxicodendron diversiloba*, and *Baccharis pilularis*. The Monterey-Bishop pine forest supports an open stand mixed with *Pinus radiata* and *Pinus muricata*. The *Pinus radiata* are stunted in height, although they form a canopy above a subcanopy of *Pinus muricata* and smaller *Pinus radiata*. The understory is an even mix of shrubs, including *Arctostaphylos tomentosa* var. *tomentosa*, *Arctostaphylos tomentosa* var. *hookeri*, *Baccharis pilularis*, and *Mimulus aurantiacus*. The pygmy forest habitat is dominated by *Pinus muricata* and *Cupressus goveniana* ssp. *goveniana* (Gowen cypress) that grow between 10 and 25 feet tall, with occasional scattered *Pinus radiata* that grow between 20 and 30 feet tall. The understory is dominated by *Arctostaphylos tomentosa* var. *tomentosa*, and occasional *Rhamnus californica*. Open canopy pygmy forest habitat supports a more diverse shrub understory, occurring at sites of recent fires on very shallow soils.

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.

Mature stands of vegetation on this terrace include Monterey pine forest in an open overstory. *Pinus radiata* are stunted at approximately 40 feet, and scattered *Pinus muricata* are present. The understory supports a dominate

Vaccinium ovatum with *Arctostaphylos tomentosa* var. *tomentosa*.
Arctostaphylos tomentosa var. *hookeri* is more dominant in areas that have a more open canopy. Total shrub cover ranges between 50 and 80 percent with a mixed grassy understory, including bunchgrasses. Additionally, scattered individuals of *Arbutus menziesii* (madrone) and *Salix scouleriana* (Scouler's willow) can also be found here.

2. Plant Succession

Plant communities on the Monterey Peninsula and surrounding area have developed simple and complex interrelationships based on climate, moisture, and soil type. Community structures can sometimes be layered or stratified. Natural succession of a plant communities have developed through time, with the larger vegetation (*e.g.*, *Pinus radiata*, *Pinus muricata*, *Cupressus goveniana* ssp. *goveniana*) superseding the previous pioneer plants. Pioneer weeds and grasses (*e.g.*, *Vulpia* sp., *Elymus glaucus*, *Danthonia californica*, etc.) begin the succession, then are eventually shaded out by larger shrubs (*e.g.*, *Baccharis pilularis*, *Toxicodendron diversilobum*, *Mimulus aurantiacus*, etc.). These shrubs are displaced or dominated by the larger trees. This system of layering provides environmental levels for wildlife and plants alike

The main plant layers include the understory, intermediate, and overstory layers. The understory includes the smallest vegetation (*i.e.*, mosses, ferns, grasses, small wildflowers, and low ground covering varieties of herbaceous or woody plants). The intermediate layer includes small to large shrubs as well as small species of trees or young saplings of larger overstory tree species. These plants are usually adapted to softer light and cooler temperatures that are created by shade from the overstory canopy. Woody perennial plants dominate the intermediate story. The overstory includes the largest species of trees. This layer typically creates a canopy that influences the overall light availability and average temperatures at the lower levels. Overstory trees can be sparsely distributed or grow close together. Destruction of canopy trees in many cases adversely affects the understory environment.

APPENDIX F. Exotic plant species occurring in native Monterey pine forests or in the vicinity of Monterey, California (D. Rogers *in litt.* 2002).

Scientific Name	Common Name	Present (P) or Invasive (I)¹
<i>Acacia baileyana</i>	Bailey acacia	P
<i>A. melanoxydon</i>	blackwood acacia	I
<i>A. longifolia</i>	Sydney golden wattle	P
<i>Arctotheca calendula</i>	capeweed	I
<i>Avena fatua</i>	wild oat	I
<i>Briza maxima</i>	rattlesnake grass	I
<i>B. minor</i>	small quaking grass	P
<i>Bromus diandrus</i>	ripgut brome	I
<i>Carduus pycnocephalus</i>	Italian thistle	I
<i>Carpobrotus edulis</i>	iceplant	I
<i>Cirsium vulgare</i>	bull thistle	P
<i>Conicosia pugioniformis</i>	false iceplant	P
<i>Conium maculatum</i>	poison hemlock	I
<i>Cortaderia selloana</i>	pampas grass	I
<i>C. jubata</i>	jubata	I
<i>Cynodon dactylon</i>	bermuda grass	I
<i>Delairia odorata</i> (= <i>Senecio mikanooides</i>)	cape ivy, German ivy	I
<i>Erechtites glomerata</i>	Australian fireweed	I
<i>E. mimima</i>	Australian fireweed	P
<i>Ehrharta erecta</i>	veldt grass	I
<i>Festuca arundinacea</i>	tall fescue	P

1 - Present (P) means that the species has been positively identified within at least one Monterey pine population. Invasive (I) means that the species is not only present but has been identified as spreading some distance from its original site of introduction.

Appendix F., continued

Scientific Name	Common Name	Present (P) or Invasive (I)¹
<i>Genista monspessulana</i>	French broom	I
<i>Hedera helix</i>	English ivy	I
<i>Holcus lanatus</i>	velvet grass	P
<i>Lolium perenne</i>	perennial ryegrass	I
<i>Oxalis pes-caprae</i>	Bermuda buttercup	P
<i>Pennisetum clandestinum</i>	kikuyu grass	I
<i>Tetragonia tetragonioides</i>	New Zealand spinach	P
<i>Ulex europaeus</i>	gorse	I
<i>Vinca major</i>	periwinkle	I

APPENDIX G. Special status species known to occur on the Monterey Peninsula or within the vicinity of Monterey, California.¹

Species	Listing Status¹ Fed/State/CNPS	Habitat	Distribution	Threats
<i>PLANTS</i>				
<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

¹ **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 Is., SDG - San Diego, SFO - San Francisco, SLO - San Luis Obispo, SMT - San Mateo, SON - Sonoma, SRA-Santa Rosa Is.

Species	Listing Status ¹ Fed/State/CNPS	Habitat	Distribution	Threats
<i>PLANTS, continued</i>				
<i>Arctostaphylos hookeri</i> ssp. <i>hookeri</i> Hooker's manzanita	-/-/1B	Closed-cone conifer forest, chaparral, coastal scrub	MNT, SCR: many at Fort Ord, Prunedale Hills, Larkin Valley; scattered on Mnt. Pen.	agriculture, development, fire suppression, competition w/ introduced <i>Eucalyptus</i>
<i>Arctostaphylos hookeri</i> ssp. <i>hookeri</i> Hooker's manzanita	-/-/1B	Closed-cone conifer forest, chaparral, coastal scrub	MNT, SCR: many at Fort Ord, Prunedale Hills, Larkin Valley; scattered on Mnt. Pen.	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
<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

Species	Listing Status ¹ Fed/State/CNPS	Habitat	Distribution	Threats
<i>PLANTS, continued</i>				
<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 ¹ 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 ¹ 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

Species	Listing Status ¹ Fed/State/CNPS	Habitat	Distribution	Threats
<i>PLANTS,</i> <i>continued</i>				
<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
<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
<i>INVERTEBRATES</i>				
<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

Species	Listing Status ¹ Fed/State/CNPS	Habitat	Distribution	Threats
AMPHIBIANS				
<i>Ambystoma macrodactylum 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; documented in 2002 to occur throughout Monterey Peninsula	elimination or degradation of habitat from land development and land use activities; habitat invasion by nonnative species
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, organochlorines, shooting, transmission lines, electrocutions, contaminated prey species