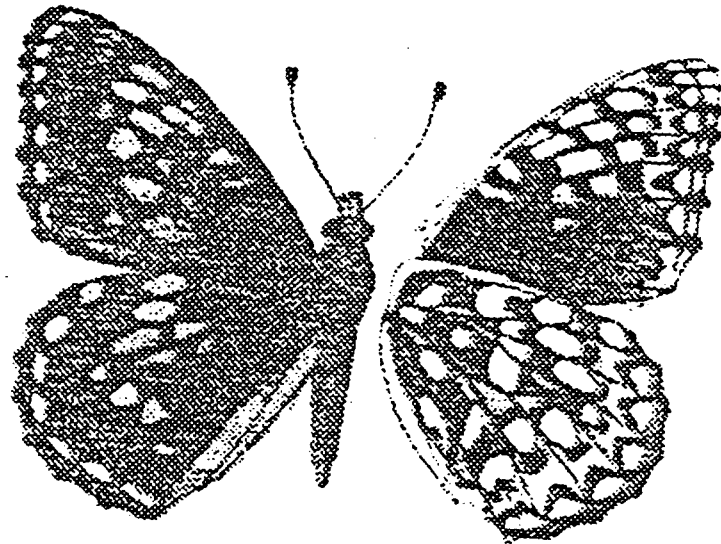


Recovery Plan

for Seven Coastal Plants and the Myrtle's Silverspot Butterfly



SEVEN COASTAL PLANTS AND
THE MYRTLE'S SILVERSPOT BUTTERFLY
RECOVERY PLAN

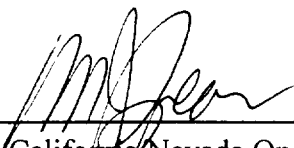
Prepared by

U.S. Fish and Wildlife Service
Region 1
Ventura and Sacramento, California

for

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

Approved: _____


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

Date: _____

9/29/98

As the Nation's principal conservation agency, the Department of the Interior has responsibility for most of our nationally owned public lands and natural resources. This includes fostering the wisest use of our land and water resources, protecting our fish and wildlife, preserving the environmental and cultural values of our national parks and historical places, and providing for the enjoyment of life through outdoor recreation. The Department assesses our energy and mineral resources and works to assure that their development is in the best interests of all our people. The Department also has a major responsibility for American Indian reservation communities and for people who live in island Territories under U.S. administration.

DISCLAIMER

Recovery plans delineate reasonable actions which are believed to be required to recover and/or protect listed species. Plans are published by the U.S. Fish and Wildlife Service, sometimes prepared with the assistance of recovery teams, contractors, State agencies, and others. Objectives will be attained and any 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 necessarily represent the views nor the official positions or approval of any individuals or agencies involved in the plan formulation other than the U.S. Fish and Wildlife Service. They represent the official position of the U.S. Fish and Wildlife Service **only** after they have been signed by the Regional Director, 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 tasks.

LITERATURE CITATION

U.S. Fish and Wildlife Service. 1998. *Seven Coastal Plants and the Myrtle's Silverspot Butterfly Recovery Plan*. Portland, Oregon. 141 pp.

Additional copies may be purchased from:

Fish and Wildlife Reference Service:

5430 Grosvenor Lane, Suite 110

Bethesda, Maryland 20814

telephone: 301/492-6403 or 1-800-582-3421

fax: 301/564-4059

e-mail fwrs@fws.gov

Fees for plans vary depending on the number of pages.

ACKNOWLEDGMENTS

A rough draft for this recovery plan was prepared by the Habitat Restoration Group, Felton, California, under contract to the Service. Service biologist Heather McSharry reviewed early drafts of this document. Comments and additional information were provided by Cynthia Roye (California Department of Parks and Recreation), Gary Fellers (Biological Resources Division, United States Geological Survey), James Willison (Department of the Army), Joey Dorrell-Canepa (Pebble Beach Company), Andrea Pickart (The Nature Conservancy; now with the U.S. Fish and Wildlife Service), Virginia Norris (California Native Plant Society), Scott Sinclair (Six Rivers National Forest), Teresa Sholars (College of the Redwoods), Edward Horton (Pebble Beach Company), and the following participants in the Seven Coastal Plants Recovery Workshop sponsored by the California Department of Fish and Game: Dave Allen, Anthony Lobay (City of Pacific Grove), Bruce Cowan, Diane Elam (US Fish and Wildlife Service), Grey (University of California Natural Reserve), Ken Gray (California Department of Parks and Recreation), Deb Hillyard (California Department of Fish and Game), Jane Holte, Sarah Koenig (Point Reyes National Seashore), Patti Kreiberg (Sunset Coast Nursery), Corky Matthews (California Native Plant Society), Tom Moss (California Department of Parks and Recreation), Lee Otter (California Coastal Commission), Terry Palmisano (California Department of Fish and Game), Renee Pasquinelli (California Department of Parks and Recreation), Bob Soost and Dean Taylor (California Native Plant Society), and Vern Yadon.

Drawings of *Chorizanthe* by Jeanne R. Janish are reproduced, by permission of Stanford University Press, from the Illustrated Flora of the Pacific States by L. Abrams, volume II. The drawing of *Layia carnososa* also by Jeanne R. Janish, is reproduced, also by permission of Stanford University Press, from L. Abrams and R. Ferris, Illustrated Flora of the Pacific States, Volume IV. Illustrations of *Erysimum* reproduced by permission of Robert A. Price, of the University of Georgia, from his doctoral dissertation (Price 1987).

EXECUTIVE SUMMARY OF THE RECOVERY PLAN FOR
SEVEN COASTAL PLANTS AND THE MYRTLE'S SILVERSPOT BUTTERFLY

CURRENT SPECIES STATUS: These species are listed as endangered except for the threatened *Chorizanthe pungens* var. *pungens*. The following numbers of populations and individuals are based on the maximum totals during the last 10 years:

species	# of populations	# of individuals
<i>Chorizanthe howellii</i>	3	23,700
<i>Chorizanthe pungens</i> var. <i>pungens</i>	7	2,000,000
<i>Chorizanthe valida</i>	1	10,000
<i>Erysimum menziesii</i> (three subspecies)	16	33,300
<i>Gilia tenuiflora</i> ssp. <i>arenaria</i>	15	100,400
<i>Layia carnosa</i>	19	at least 300,000
<i>Lupinus tidestromii</i>	7	433
Myrtle's silverspot butterfly	3	10,000

HABITAT REQUIREMENTS AND LIMITING FACTORS: The plant species are restricted to foredunes and dune scrub vegetation, and to adjacent sandy habitats occupied by coastal scrub or coastal prairie of northern and central coastal California. The butterfly species occurs in the coastal grasslands and scrub, with the larval host plant (western dog violet) in the immediate vicinity of Point Reyes, Marin County. These species are threatened by competition from non-native plants, loss of habitat from commercial and residential development, and habitat disturbance from recreation and grazing.

RECOVERY OBJECTIVE: To delist these species.

RECOVERY CRITERIA:

- Protection of habitat presently occupied by the species, with long-term commitments to conserving the species and the native vegetation.
- In protected habitat, successful control of invasive non-native plants (and snails) and successful management of lesser problems, including grazing, pedestrians, and off-road vehicles. Management success must be demonstrated through ten years of biological monitoring. The time is needed to observe the effectiveness of management in dry and wet years.

- The threatened *Chorizanthe pungens* var. *pungens* may be considered for delisting when permanent protection has been implemented, as currently planned, in the Fort Ord disposal and reuse process and the coastal populations receive protected status.

ACTIONS NEEDED:

1. Protect existing populations and habitats.
2. Minimize the threats to the plants and butterfly.
3. Develop management strategies incorporating ecological and land use strategies.
4. Manage populations and habitats to achieve delisting.
5. Monitor population trends to evaluate recovery success.
6. Coordinate recovery actions to protect other listed and sensitive species.
7. Develop and implement an outreach program.

COSTS (thousands of dollars):

Year	Need 1	Need 2	Need 3	Need 4	Need 5	Need 6	Need 7	Total
1998	26	27	30	80	18	2	6	189
1999	25	27	30	80	18	2	6	188
2000	25	27	30	120	18	2	6	228
2001	25	27	30	40	18	2	6	148
2002	25	27	30	40	18	2	6	148
Total	126	135	150	360	90	10	30	901

Date of Recovery: Within 10 years of establishing population stability for each species

TABLE OF CONTENTS

	PAGE
I. INTRODUCTION	1
A. <i>CHORIZANTHE HOWELLII</i>	15
1. Description	15
2. Distribution	16
3. Habitat/Ecosystem	16
4. Life History/Ecology	17
5. Reason for Listing	17
6. Conservation Measures	18
B. <i>CHORIZANTHE PUNGENS</i> VAR. <i>PUNGENS</i>	18
1. Description	18
2. Distribution	19
3. Habitat/Ecosystem	20
4. Life History/Ecology	21
5. Reasons for Listing	21
6. Conservation Measures	22
C. <i>CHORIZANTHE VALIDA</i>	25
1. Description	25
2. Distribution	25
3. Habitat/Ecosystem	27
4. Life History/Ecology	27
5. Reason for Listing	28
6. Conservation Measures	28
D. <i>ERYSIMUM MENZIESII</i>	29
1. Description	29
2. Distribution	30
3. Habitat/Ecosystem	31
4. Life History/Ecology	32
5. Reasons for Listing	33
6. Conservation Measures	34
E. <i>GILIA TENUIFLORA</i> SSP. <i>ARENARIA</i>	37
1. Description	37
2. Distribution	38
3. Habitat/Ecosystem	38
4. Life History/Ecology	39
5. Reason for Listing	40
6. Conservation Measures	40
F. <i>LAYIA CARNOSA</i>	43
1. Description	43
2. Distribution	43
3. Habitat/Ecosystem	44
4. Life History/Ecology	45

	5. Reasons for Listing	45
	6. Conservation Measures	46
G.	<i>LUPINUS TIDESTROMII</i>	48
	1. Description	48
	2. Distribution	49
	3. Habitat/Ecosystem	49
	4. Life History/Ecology	49
	5. Reasons for Listing	50
	6. Conservation Measures	50
H.	MYRTLE'S SILVERSPOT BUTTERFLY	52
	1. Description	52
	2. Distribution	53
	3. Habitat/Ecosystem	55
	4. Life History/Ecology	56
	5. Reasons for Listing	59
	6. Conservation Measures	60
	7. Recovery Strategy	60
I.	STRATEGY OF RECOVERY FOR THE PLANTS	63
II.	RECOVERY	89
A.	OBJECTIVE AND CRITERIA	89
B.	NARRATIVE OUTLINE FOR RECOVERY ACTIONS ADDRESSING THREATS	95
	1. Protect habitat of the listed species and their occurrences on private lands.	95
	2. Minimize threats to the plants and butterfly.	99
	3. Develop management strategies through a research program to document the listed species' life histories and their responses to vegetation management.	101
	4. Manage occurrences and habitats	104
	5. Monitor occurrences and threats to determine effectiveness of management and to establish delisting criteria.	113
	6. Coordinate recovery actions to protect other listed species and species of special concern.	115
	7. Develop and implement an outreach program.	122
C.	LITERATURE CITED	123
III.	IMPLEMENTATION SCHEDULE	131
APPENDIX I.	Summary of the Agency and Public Comments on the Draft Recovery Plan.	135
APPENDIX II.	Mailing List	137

LIST OF TABLES

NUMBER		PAGE
1	Conservation Status of Major Dune Systems of Northern and Central California	2
2	Summary of Occurrence Data for <i>Chorizanthe howellii</i>	65
3	Summary of Occurrence Data for <i>Chorizanthe pungens</i> var. <i>pungens</i>	66
4	Summary of Occurrence Data for <i>Chorizanthe valida</i>	68
5	Summary of Occurrence Data for <i>Erysimum menziesii</i> ssp. <i>menziesii</i>	69
6	Summary of Occurrence Data for <i>Erysimum menziesii</i> ssp. <i>eurekaense</i>	70
7	Summary of Occurrence Data for <i>Erysimum menziesii</i> ssp. <i>yadonii</i>	71
8	Summary of Occurrence Data for <i>Gilia tenuiflora</i> ssp. <i>arenaria</i>	72
9	Summary of Occurrence Data for <i>Layia carnosa</i>	75
10	Summary of Occurrence Data for <i>Lupinus tidestromii</i>	77

LIST OF MAPS

NUMBER		PAGE
1	Major Coastal Dune Systems of Northern and Central California	4
2	Major Coastal Dune Systems of Central California	5
3	Approximate Historic Distribution of Myrtle's Silverspot Butterfly	54

LIST OF FIGURES

NUMBER		PAGE
1	Plant Identification - <i>Chorizanthe howellii</i>	79
2	Plant Identification - <i>Chorizanthe pungens</i> var. <i>pungens</i>	80
3	Plant Identification - <i>Chorizanthe valida</i>	81
4	Plant Identification - <i>Erysimum menziesii</i> ssp. <i>eurekaense</i>	82
5	Plant Identification - <i>Erysimum menziesii</i> ssp. <i>menziesii</i>	83
6	Plant Identification - <i>Erysimum menziesii</i> ssp. <i>yadonii</i>	84
7	Plant Identification - <i>Gilia tenuiflora</i>	85
8	Plant Identification - <i>Layia carnosa</i>	86
9	Plant Identification - <i>Lupinus tidestromii</i>	87
10	Identification - Myrtle's silverspot butterfly	88

I. INTRODUCTION

Listed Species and their habitats. Seven plants and one invertebrate animal from the coastal dunes of northern and central California are considered in this recovery plan. Myrtle's silverspot butterfly (*Speyeria zerene myrtleae*) and six of the plants — *Chorizanthe howellii* (Howell's spineflower), *Chorizanthe valida* (Sonoma spineflower), *Erysimum menziesii* (Menzies' wallflower)¹, *Gilia tenuiflora* ssp. *arenaria* (Monterey gilia), *Layia carnososa* (beach layia), and *Lupinus tidestromii* (Tidestrom's lupine) — were listed as endangered on June 22, 1992 (U.S. Fish and Wildlife Service 1992). *Chorizanthe pungens* var. *pungens* (Monterey spineflower) was listed as threatened on February 4, 1994 (U.S. Fish and Wildlife Service 1994).

The plants are restricted to foredune and dune scrub communities and adjacent sandy habitats occupied by coastal scrub or coastal prairie. The butterfly occurs in coastal grasslands and scrub, both in marine terraces and in stabilized coastal sand dunes. The primary threats to the seven plant species, the silverspot butterfly, and its larval food plant, are competition from invasive non-native plant species, commercial and residential development, off-road vehicle (ORV) use, other recreational uses, and cattle grazing. In addition, Myrtle's silverspot butterfly is threatened by overcollecting.

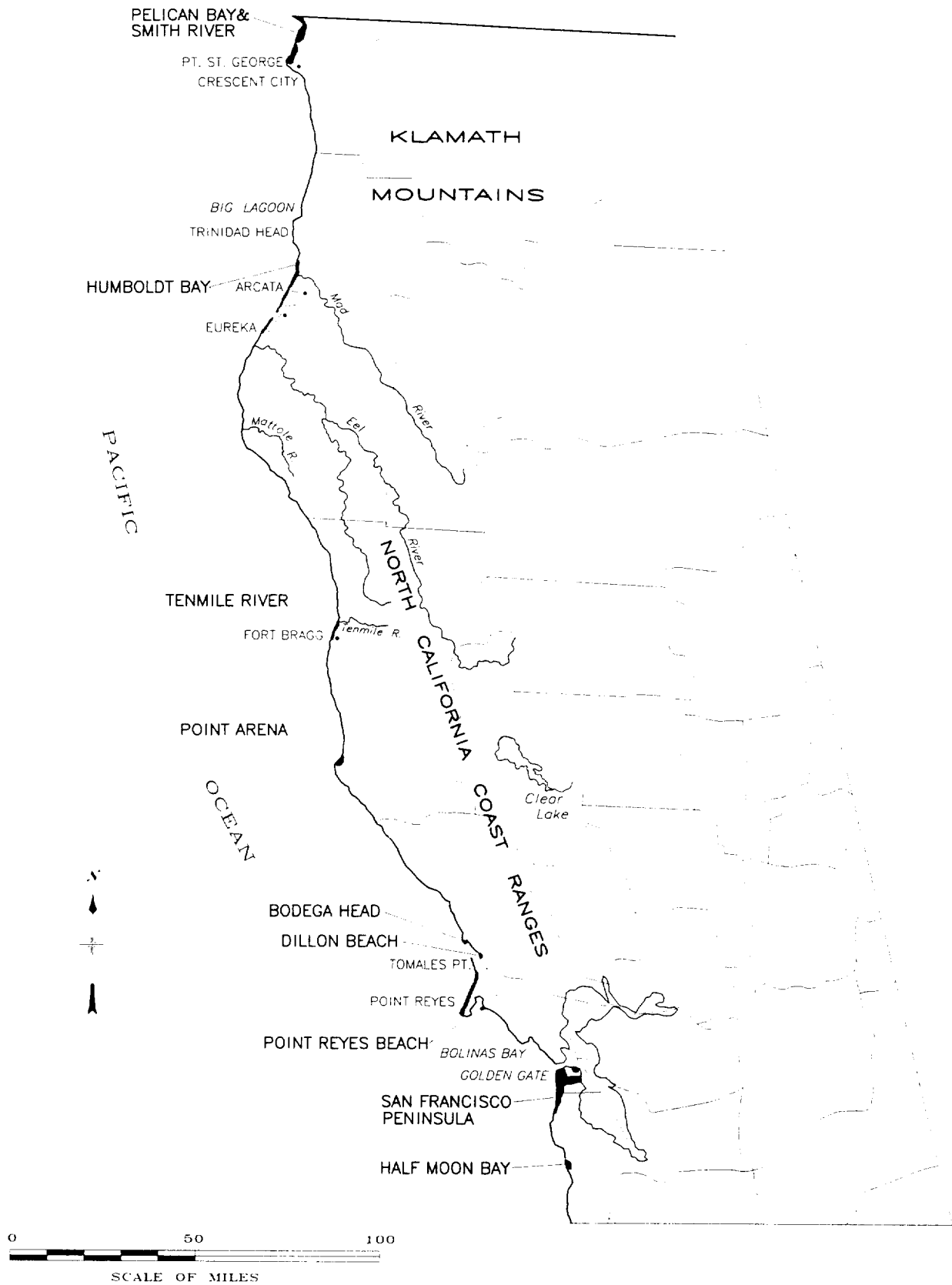
The coastal dune ecosystem of the central and northern California coast consists of a series of discrete dune systems or complexes from Point Conception to Crescent City. South of Point Conception, the biologic communities of sand dunes shift to a southern species composition characteristic of the warmer, drier coastal climate of Baja California (Barbour and Johnson 1977, Cooper 1936). North of Crescent City, coastal dune communities shift to northern species composition which reflects the higher rainfall and forested late succession conditions of the large Oregon and Washington dune systems. Each dune system along the central to northern California coast is associated with a local sediment supply, derived either from "fossil" sources (e.g., erosion of sandy marine bluffs made of ancient beach and dune deposits), modern supplies (e.g., sediment loads of stream mouths), or combinations of both. Large dune systems develop where sand transported by nearshore waves and currents accumulates along segments of the shoreline which are also exposed to the influence of dominant winds. This occurs primarily in

¹ Changes to the taxonomy of *Erysimum menziesii* after it was listed are explained on page 29.

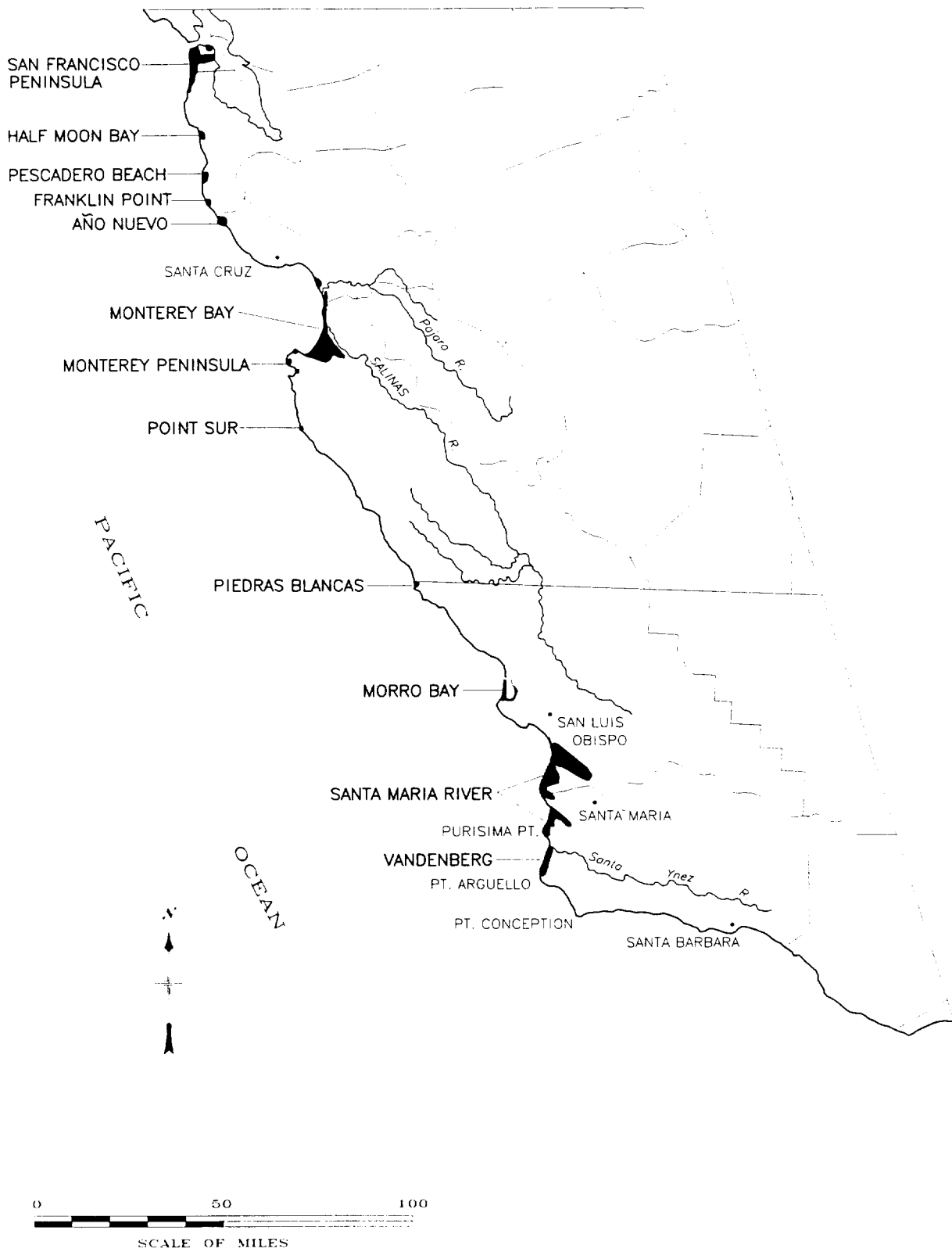
Table 1. Conservation Status of Major Coastal Dune Systems of Central and Northern California

Dune System	Ownership	Conservation Status
Pelican Bay/Smith River dune system (Point St. George and Lake Talawa, to the mouth of the Smith River, Del Norte County)	State Parks and private	Large areas proposed for residential development. Extensive dominance by European beachgrass. Outside range of listed species.
Humboldt Bay dune systems (Eel River barrier beaches to Mad River and Clam Beach; Humboldt County)	Federal, County, municipal and private	Wide range of protection levels. Extensive dominance by European beachgrass; infested with introduced yellow lupine. Locally high recreational impacts. Significant endangered species habitat, populations.
Ten Mile River dunes (Ten Mile River to Fort Bragg; MacKerricher State Park; Mendocino County)	State Parks and some private	Threatened by recreational trail project. Limited invasion by European beachgrass, no yellow lupine. Significant endangered species habitat, populations.
Point Arena dunes (Manchester Beach; Garcia River mouth; Mendocino County)	State Parks	Extensive invasion by European beachgrass, yellow lupine. Major restoration potential. Low recreational impacts.
Bodega Head dune system (Salmon Creek mouth to Bodega Head; also Doran Beach spit; Sonoma County)	State Parks and University of California Reserve	Extensive invasion by European beachgrass, yellow lupine. Major restoration and reintroduction potential.
Dillon Beach dune complex (Marin County)	Private	Only large mobile dune field in north-central coast. Threatened by development, sand mining, beachgrass, yellow lupine invasion. Major restoration and reintroduction potential; Significant historic and modern listed species habitat.
Point Reyes Beach dune system (Marin County)	Federal	Well-protected, but extensive invasion by European beachgrass. Major restoration potential. Significant listed species habitat.
San Francisco Peninsula dune complex (San Francisco County)	Remnant dune area ownership mostly Federal, with some city and private	Almost completely urbanized, but significant remnants persist. One privately owned remnant area at risk of development. Extensive invasion by iceplant. Significant listed species habitat (<i>Lessingia germanorum</i> , outside this plan); major restoration potential.

Dune System	Ownership	Conservation Status
Half Moon Bay dunes (San Mateo County)	State Parks	Extensive invasion by iceplant.
Pescadero Beach dunes (San Mateo County)	State Parks	Substantially restored and protected, but threatened by erosion. Supports species of concern.
Franklin Point dunes (to Gazos Creek; San Mateo County)	State Parks	Substantially protected. Extensive invasion by European Beachgrass. Supports species of concern.
Año Nuevo dunes (San Mateo County)	State Parks	Substantially protected. Extensive invasion by European Beachgrass. Supports species of concern.
Monterey Bay dune complex (Monterey County)	State Parks, Federal, private	Some areas protected but subject to weak management; some areas in restoration. Old stable dunes threatened by development. Extensive invasion by iceplant. Center of listed species habitat, populations.
Monterey Peninsula dune systems (Monterey County)	State Parks, private	Subject to development impacts; degraded by past development. Some areas protected. Extensive invasion by iceplant. Significant habitat and populations of listed species.
Point Sur dunes (Monterey County)	State Parks	
Piedras Blancas dunes (Monterey County)	State Parks, private	
Morro Bay dune complex (San Luis Obispo County)	State and City (spit), State and private (old climbing dunes)	Mostly well-preserved, but large areas of old dunes subject to development. Supports species of concern. Iceplant invasion is problematic. Limited European beachgrass invasion.
Santa Maria River dune complex (Pismo, Oceano, Guadalupe, Nipomo, and Mussel Rock dunes; San Luis Obispo and Santa Barbara County)	State and private	Some areas subject to adverse recreational impacts, oil field development. Substantial protection exists for extensive areas. Supports many species of concern. Dune ponds support several listed species.
Vandenberg dune complex (Purisima Point, San Antonio Terrace, and Lompoc dunes; Santa Barbara County)	Federal	Major invasion by veldtgrass, iceplant. Supports several species of concern.



Map 1. Major coastal sand dune systems of northern and central California. See Table 1 for a description of each sand dune system.



Map 2. Major coastal sand dune systems of Central California. See Table 1 for a description of each sand dune system.

shallow embayments, or where shoreline orientation interrupts longshore transport of sand. Development of dune systems also requires relatively low topography back of the shoreline, such as floodplains and terraces of river systems, ancient stabilized dune fields, or shallow lagoons or estuaries enclosed by barrier beaches. Because most of the California coast consists of mountains or steep bluffs, modern dune ecosystems and dune species distributions occur at disjunct localities, rather than in continuous, diffuse patterns (Cooper 1967, 1936).

California dune systems are composed of dunes of different ages, deposited with long-term changes in sea level and sand supply. Most active dune systems are “recent” (Holocene) in geologic terms, originating when deglaciation (ice sheet melt) and sea level rise began about 13,000 years before present. Cooper (1967) identified two “advances,” or major waves of dune migration: one early in the Holocene (“Episode I”), presumably under conditions of lower sea level and greater sand supply, and one late (“Episode II”) associated with more recent deposits and shoreline positions. Holocene sea level, though continuing to rise, has been near its current stand for approximately the last 3000 years. Dune age may be complex because actively migrating younger dunes may override and partially bury older ones, and older dunes may become “rejuvenated” (develop blowouts, reactivated dune mobility). Old soil horizons, differentiated to varying degrees, may be found in blowouts or foredune scarps in many dune systems. These indicate long episodes of dune mobility (barren, migrating dunes) followed by periods of stability (extensive vegetation cover), later followed by remobilization.

Dune age is an important ecological factor because it corresponds with soil development and physical stability of the dune, and also with plant associations. Soil development proceeds on dunes that have become stabilized by vegetation, which accumulates organic matter (decomposing roots and above-ground plant tissues) and weathered fine minerals near the surface of the dune. Accumulation of weathered minerals and organic matter increases the nutrient-holding capacity of older dune sands (Ranwell 1972). Soil development in dunes, and the degree and duration of stability, strongly affects the species composition of the vegetation. Older dune soils may appear darker gray-brown because of organic (carbon) compounds and staining by oxidized iron minerals, in contrast with the whitish tan color of young dune soils. Stable dune surfaces also can accumulate seed banks of at least some species that form long-lived dormant seeds.

The current configuration of dune systems along the California coast is very recent in a geological time scale. Sea level rose to roughly its current elevation from nearly 300 feet below the modern level in the early Holocene (Schlocker 1974). At this low stand of sea level, the marine shoreline extended up to miles seaward of its current position, exposing extensive marine terraces and probably wide, extensive dune fields. As the shoreline retreated with rising sea level, old dune fields that had developed during the Pleistocene (the “ice ages” with low sea levels during glaciations) or even earlier, were eroded and truncated. The erosion of exposed Pleistocene or earlier beach and dune deposits with rising sea level also reworked and “recycled” sand stored in them for development of new coastal dunes (Schlocker 1974, Cooper 1967). Although most Pleistocene dunes have been eroded or drowned by rising sea level, some large remnants persist. The landward, downwind “heads” of dune complexes such as Monterey Bay and the Santa Maria complex include large remnants of Pleistocene dunes, with more recent Holocene dunes overriding them at the seaward edge. These ancient Pleistocene dunes are distinguished from modern (Holocene) dunes by very weathered brownish sands (stained by iron oxides and organic substances from decomposition of plant roots and leaves) which have become somewhat cemented to varying degrees, forming formed brownish sandy soils. Stable Pleistocene dunes have undergone significant soil development and plant community succession beyond the active dune phase (e.g., chaparral, forest), and are often not popularly recognized as dunes. Many dune plant species (including listed species and species of concern), however, occur in portions of Pleistocene dunes. Some recent dunes are derived partly or mostly from erosion of ancient beach and dune deposits which form weakly cemented sandstone bluffs (e.g., Fort Funston, San Francisco, portions of Monterey Bay dunes, Point Reyes).

Dune landforms are important factors affecting the distribution and abundance of plant species. Variation in dune landforms results from basic physical controls of the dune system such as the supply of sand available for new dune formation, rainfall variation, shoreline changes, and orientation to dominant winds. These physical controls, and the sand transport processes that shape the dunes, profoundly influence the types of dune vegetation that establish in dune systems. Vegetation in turn provides important feedback to physical processes of sand transport, and actively affects the evolution of dune landscapes. The original dune types which prevailed in California coastal dunes included sand shadows (local sand accumulations in the lee of objects or clumps of vegetation), embryo foredunes (low domes or hummocks of sand around young colonies of creeping

vegetation landward of the beach), foredunes (large vegetated mounds or coalesced series of mounds forming irregular ridges of sand at the seaward edge of dune systems, formed by well-established creeping pioneer vegetation), barchanoid dunes (unvegetated crescent-shaped deposits similar to desert dunes), parabolic or U-dunes (elongated hairpin-shaped dunes with partially vegetated flanking ridges and a central blowout or deflating depression, often with a migrating lobe of sand at its head), lobate or tongue dunes (attenuated, convex, bare, mobile sand lobes like U-dunes but without a central blowout) and transverse dunes (large unvegetated waves of sand with their long axes at right angles to the dominant wind, gently sloping upwind and usually with steep, bare slipping faces downwind). Within these dune landforms are erosional features such as blowouts (bowl-shaped or irregular depressions with sparse vegetation cover or none, actively eroding by wind; may be incipient U-dunes) and dune slacks (depressions where dune erosion has lowered elevations near the water table, often waterlogged near the surface or ponded in winter).

Coastal dune-forming processes and resultant landscapes in north-central and northern California (north of Monterey Bay) have been profoundly altered by the introduction of European beachgrass or marram (*Ammophila arenaria*), which has altered both foredunes and U-dunes. *Ammophila* is capable of spreading, rapid growth at relatively high levels of sand accretion, and develops continuous, dense vegetation which causes sand to deposit in a relatively narrow, steep, tall, continuous foredune ridge which is a very efficient trap for wind-blown sand (Seabloom and Wiedemann 1994). Tall foredune ridges are typical of European and northeast American dune systems (Ranwell 1972, Godfrey et al. 1979), but not the Pacific coast, which was originally typified by broad discontinuous low mounded foredunes (Cooper 1958, 1967). *Ammophila* is also highly efficient at stabilizing mobile dunes, which was the reason it was introduced to the Pacific coast at San Francisco's Golden Gate Park (McLaren 1927). Another exotic dominant plant of coastal California dunes, ice-plants or sea-figs (*Carpobrotus chilensis*, *C. edulis*, and hybrids between them.) has a low, creeping growth habit and burial tolerance somewhat similar to native pioneer dune plants, and consequently has less impact on dune landforms than *Ammophila*.

There are only about a dozen major dune systems or complexes along the central and northern California coast — the number depends on classification (Table 1, Maps 1 and 2). These dune systems are separated by long distances of intervening marine bluffs or

rocky cliffs and mountains, ecological and geographic barriers which isolate them into relatively discrete biogeographic units. Modern dispersal of beach and foredune plants with seeds adapted for floating or vegetative fragment dispersal may occur over long distances, but most of the plant species of stable dune scrub are now probably quite well isolated among populations. The plants' modern geographic ranges are probably relictual from early Holocene periods of lower sea level and more continuous former distribution of beach and dune environments along the low marine terrace which is now submerged (e.g., *Lupinus tidestromii*, *Erysimum menziesii*). These dune systems provide the biogeographic context for recovery of the ecosystem and listed species at a sub-regional level.

The main northern California coastal dune systems are located at indentations of the coastline where either low marine terraces, floodplains, or embayments interrupt the mountainous coastline. They occur along the large barrier spits of Humboldt Bay and adjacent rivers in Humboldt County, the wide dune terrace adjacent to mouth of Ten Mile River (MacKerricher State Park) in Mendocino County, and the dune field at the floodplain and marine terrace at the Garcia River mouth, Point Arena (Manchester State Park) in Mendocino County. Other northern dune systems include those from Lake Talawa to the Smith River, Del Norte Co., Big Lagoon, Humboldt county, and the mouths of many rivers with small spits and dunes (Gualala River, Sonoma county, Mattole River, Little River, Humboldt Co. With the exception of Ten Mile dunes, northern California dune vegetation, topography, and geomorphic processes have been strongly altered since the 1930s by proliferation of introduced dune-stabilizing plants *Ammophila arenaria* and *Lupinus arboreus*. The north coastal dune systems were mostly composed of foredunes and U-dunes in Humboldt Bay, and open transverse dunes at Ten Mile River and Point Arena. North coastal dune systems lack relict Pleistocene dunes (Cooper 1967). Recent investigations in Humboldt Bay dune systems indicate that episodes of dune mobility and buried soil horizons in the Holocene were associated with great earthquakes that caused rapid uplift of the land and a sudden drop in sea level (Carver et al. 199). North coastal dune systems support large populations of Menzies' wallflower (*Erysimum menziesii*) and Beach layia (*Layia carnososa*), the only population of Howell's spineflower (*Chorizanthe howellii*), and the rare annual *Collinsia corymbiflora*. They also provide significant habitat for the threatened Western snowy plover (*Charadrius alexandrinus nivosus*).

In the north-central (Marin-Sonoma) California coast, the major dune systems occur at Bodega Head, Sonoma county; Dillon Beach to Tom's Point, Marin county; and the outer beach and dunes of Point Reyes, Marin county. Other dune systems of the north-central coast are associated with small south-facing spits along Bodega, Drakes, and Bolinas bays, respectively: Doran Spit, Limantour Spit, and Stinson Beach. Dunes also occur at the mouths of the small lagoons at Muir Beach and Rodeo Lagoon. The dune systems of the north-central coast have also been mostly stabilized by *Ammophila* during the 20th century, with the exception of Dillon Beach dune system (*Ammophila* mainly in foredunes). The dune systems of spits were composed of hummocky foredunes and stabilized dune hummocks. The larger systems were likely dominated by U-dune and transverse ridge topography. Dillon Beach dunes also include extensive areas of old early Holocene stable dunes, covered in coastal scrub and grassland. With the exception of the Dillon Beach dunes, the north-central coast dune systems are publicly owned or managed as reserves. North-central coast dunes support populations of Tidestrom's Lupine (*Lupinus tidestromii*), *Layia carnososa*, and food plants of the Myrtle's silverspot butterfly. The only habitat of *Chorizanthe valida* occurs on sandy soils derived from ancient dune deposits of Point Reyes. Threatened Western snowy plovers feed and nest in north-central coast beach-dune systems.

Major Central California coast dune systems occur at the San Francisco Peninsula, Monterey Bay, and Monterey Peninsula. The vast, diverse San Francisco dune system is almost completely urbanized. It formerly included multiple transverse dunes and dune slacks, perched bluff-top dunes (Fort Funston; still extant), climbing dunes (Bakers Beach) U-dunes, and bayshore foredunes (Presidio Marsh spit). *Layia carnososa* and the endangered San Francisco *Lessingia* (*Lessingia germanorum*) occurred in the San Francisco dune system (Thomas 1961); *Layia* is now extirpated there. The Monterey Bay dune complex (consisting of Pleistocene and Holocene units) is predominantly well-vegetated U-dune topography, with a mixture of mobile and stabilized dunes. Smaller dune systems occur at Año Nuevo, Franklin Point, Gazos Creek, Pescadero Creek, and Half Moon Bay. These dune systems are only locally affected by *Ammophila* invasion, but are have extensive invasion by iceplant. The extensive Pleistocene dune sheet at Monterey Bay are subject to development pressure. Most Holocene dunes are publicly owned and managed as reserves or parks, with some important exceptions (Table 1). The Monterey Bay and Peninsula dunes of the central coast support populations of *Gilia tenuiflora* ssp. *arenaria*, *Lupinus tidestromii*, *Layia carnososa*, and *Chorizanthe pungens*.

Threatened Western snowy plovers feed and nest in the beach-dune systems of the central coast.

In the south-central California coast, the largest dune systems occur at Morro Bay and the extensive dune sheets of the Santa Maria River complex (including Pismo, Oceano, Guadalupe, Nipomo, Mussel Rock dunes), and the related dunes at Vandenberg Air Force base (Purisima Point/San Antonio Terrace and Lompoc dune sheets). These consist of a large spit with foredunes and U-dunes (Morro Bay) and extensive sheets of transverse and U-dunes (Santa Maria and Vandenberg complexes). These dune complexes also include extensive Pleistocene dunes. Smaller south-central coast dunes systems occur at Piedras Blancas Point and Point Sur. Most of these dune systems are publicly owned and managed as parks, although recreational use precludes management for natural resources in some cases (Table 1). *Layia carnosa* occurs at Vandenberg dunes, and the federally endangered marsh sandwort (*Arenaria paludicola*) and Gambel's Watercress (*Rorippa gambelii*) occur in dune slacks (dune-impounded lakes and marshes) within south-central coast dune systems. Federally threatened Western snowy plovers feed and nest in the open dunes and beaches. Numerous rare plant species of concern, such as *Dithyrea maritima*, also occur in south-central dune systems.

Vegetation of California coastal dunes. The variation in dune vegetation of coastal California is summarized by Johnson (1978), and the historic distributions of plant species with high fidelity to coastal dunes was described by Cooper (1936). Numerous coastal dune vegetation types have recently been classified based on species composition alone (Sawyer and Keeler-Wolf 1997). Major native vegetation types (based on composite of species and physical factors) include *coastal foredune* (variable associations of low-growing colonial herbaceous species and grasses in mobile and recently stabilized dunes near the shoreline), *coastal dune scrub* (low or erect woody shrub communities on stable dunes with herbaceous species in gaps, usually in backdunes, landward of foredunes), *coastal dune forest* (pine, Douglas-fir, or spruce groves of older stable dunes of northern California coast northwards). Also intrinsic to many dune systems are wetlands which form in deflation basins (wind-eroded hollows or plains) called *dune slacks*, which support a wide range of wetland types including brackish marsh, willow-wax myrtle thickets, winter pools, and rarely permanent ponds and perennial freshwater marshes.

Major changes have occurred to California dune vegetation because of introduced plant species, several of which alter sediment transport patterns, soil nutrient dynamics, and competitive relations within vegetation. European beachgrass or marram (*Ammophila arenaria*), introduced from France to stabilize the dunes of Golden Gate Park in the 1870s, was later transplanted along the coast and spread rapidly to dominate all but a few coastal foredunes north of Monterey Bay by the late 20th century (Cooper 1936, 1958, 1967). *Ammophila* spreads by both short and long creeping rhizomes, and forms dense swards. It is narrowly limited to coastal dune environments, but dominates foredune communities north of Monterey Bay. It has been considerably less invasive and widespread south of Monterey Bay, but can be locally dominant even in the south-central coast. *Ammophila*-dominated vegetation produces thick accumulation of leaf litter, interrupts onshore sand transport that nourishes landward mobile dunes, and displaces native foredune vegetation (Cooper 1958, Barbour and Johnson 1977). Dense stands of *Ammophila* lack the open sand gaps and sparsely vegetated areas typical of semi-mobile dunes that are favored by dune annual species and seedlings of perennial and woody species. *Ammophila* spreads primarily by vegetative fragments (rhizome fragments deposited in winter high tide drift-lines), but also establishes by seed to a small but significant extent in wet years or around the edges of dune slacks. Eradication of *Ammophila* is the cornerstone of successful coastal dune restoration in north-central and northern California (Pickart and Sawyer 1998).

Iceplant, particularly *Carpobrotus edulis* and its hybrids with *C. chilense*, also form dense, perennial, invasive, creeping mats which reduce sparse or bare sand gaps in stable dunes, and displace many native species. It spreads rapidly by seed and by eroded stem fragments that wash on the beach in winter. *C. edulis* has been widely planted to provide ground cover in many coastal areas and soil types, and continues to re-invade coastal dunes by seed dispersal even after dieback due to winter freezes, herbicide application, or manual removal. Iceplant mats commonly compose the subdominant or dominant vegetation of stable dune communities in central coast dune systems, particularly Monterey Bay. Another iceplant species, *Conicosia pugioniformis*, is becoming widespread in central coast stable dunes. It is a short-lived and smaller perennial, but is highly invasive. It forms numerous small mats rather than indefinitely spreading ones, but can become highly abundant and competitive with native plants.

Yellow lupine (*Lupinus arboreus*, including less frequent blue-flowered forms formerly classified as *L. eximius*) is a species which Cooper (1936) described as “hardly a typical member of the [stable] dune shrub community . . . not confined to dune sand,” occurring “in all sorts of sandy places . . .” The early recorded geographic distribution for this species (Bolander 1862, Brewer *et al.* 1880) place its northern range limit around San Francisco Bay, although it was not described as a sand dune plant until after its economic importance as an artificial sand binder was established, even before the introduction of *Ammophila* (Jepson 1901, McLaren 1927). It has been introduced as a sand-stabilizing species well north of its native range in Mendocino and Humboldt county, where it has become aggressively invasive and abundant on coastal dunes (Miller 1987, 1988). Because of its adverse effects on native dune plant communities and protected species, it has become the subject of intensive eradication efforts (Pickart and Sawyer 1998, Pickart and Miller 1990, Pickart *et al.* 1998).

Other non-native plants that invade coastal California dunes and threaten to outcompete native plants include the perennial veldtgrass *Ehrharta calycina*, and annual Mediterranean grasses, particularly *Bromus diandrus* and *Vulpia bromoides*. Veldtgrass, a relatively recent invader, establishes primarily in older stable dunes with immature soil development. It is extremely prolific, and readily forms nearly solid stands in dune scrub. Its invasion of the coastal dune ecosystem appears to be at a relatively early stage, and it threatens to become a far more serious and widespread threat if not controlled. Annual Mediterranean grasses (particularly *Bromus diandrus*, ripgut brome) also invade coastal dune scrub (occasionally foredunes, especially in the wake of iceplant infestations), and become most dense in older dune soils. Locally, these grasses can be the most significant threat to native dune plant communities and dune restoration efforts. Sand couch-grass, *Elytrigia juncea* (synonyms include *Elytrigia junceiforme*) is a low-growing, rhizomatous foredune species introduced from Europe. It is locally dominant where it was planted near Pismo Beach, and has persisted for decades at San Francisco. It has not yet invaded beyond these points of introduction. Similarly, the sea-rocket (*Cakile maritima*), a European annual (short-lived perennial in California), has naturalized on beaches and foredunes and is widespread, but does not typically form dense invasive stands. It appears to coexist with the native beach saltbush (*Atriplex leucophylla*) and other foredune herbs.

Public and private lands. Public lands provide habitat for populations of the species in this plan, including lands under the jurisdiction of the California Department of Parks and Recreation (DPR), National Park Service (NPS), Department of Defense (DOD), and Bureau of Land Management (BLM). Several populations are currently managed for species preservation. Some land agencies have developed management plans but have not yet implemented the recommended actions. Several of the endangered plant populations and one butterfly population occur on private lands. Some are in protected status through dedicated conservation easements, but some are in areas previously or currently proposed for land use changes which could threaten listed species.

This recovery plan summarizes current knowledge of the taxonomy, current distribution, habitat and biology of the seven plant taxa and the butterfly. Measures are recommended for a program that will meet the plan objectives to de-list the species. It is important to note that the information on distribution of the species, populations and numbers of individuals are largely derived from data provided by the Natural Diversity Data Base (NDDDB) of the California Department of Fish and Game. The NDDDB tracks the information on listed and sensitive species in California using a Geographic Information System to record specific locations and maintains a data base that represents information presented from numerous field sources. The maps in this plan are not the definitive record of species distribution. If a reader needs to know the exact location of a species, it is recommended that the NDDDB be their source for mapped information. Ideally, field observations recording the status of existing occurrences will be turned in annually to the NDDDB. The NDDDB's recorded locations for data on species are termed "occurrences." Although this plan refers to occurrences regularly, the reader must bear in mind that they are data-management units and do not necessarily coincide with biological populations, nor with landform units (e.g., dune fields) or units of natural vegetation. This plan is concerned with conserving populations in their context of natural vegetation, not with conserving specific "occurrences."

The reader should bear in mind the limits to NDDDB and other data. Data on the numbers of individuals vary in quality, consistency and accuracy depending on the observability of cryptic taxa, completeness of the survey, expertise of the observer, quality of the growing season, and consistency of the timing of the survey. Surveyors in potential but undocumented habitats might have difficulty determining if the habitat is occupied in low population years. The data in the "totals" section of this plan's

population tables are based on the most abundant years of record per site and are intended to present the optimum conditions recorded to date. It is not yet possible to state how many individuals are needed for a population to be secure. When accurate life history and consistent monitoring data become available for these species, it will become possible to assess their security. Other equally important elements to measure recovery will be the quality and integrity of the supporting habitat for these species, the number of populations, their distribution within historic ranges, and trend information on population stability.

A. *CHORIZANTHE HOWELLII* (Howell's spineflower)
(Recovery Priority Number – 8)²

1. Description

Chorizanthe is a genus of herbs in the buckwheat family (Polygonaceae) with many species in California. *Chorizanthe howellii* (Howell's spineflower) was described in 1934 by George Goodman. Its name commemorates John Thomas Howell, who had collected specimens in 1929. Chromosome counts of this species ($n = 40$) indicate that it this species originated as a stabilized polyploid hybrid (Reveal and Hardham 1989), most likely between *C. cuspidata* var. *villosa* ($n = 20$) and *C. valida*. This is a typical means by which new plant species arise. *Chorizanthe howellii* is an herbaceous annual. The plants are 0.3–1 decimeter (1.2–3.9 inches) tall and 1–5 decimeters (3.9–20 inches) across. The basal leaves are 1–3 centimeters (0.39–1.2 inches) long and 5–15 millimeters (0.2–0.6 inch) wide. What appears to be a spiny flower is in fact mostly the involucre that surrounds the flower, tipped with 6 brown, straight spines (awns). The distinguishing morphological feature of *C. howellii* is its straight (not hooked) awns. The only other coastal spineflowers with this trait are *C. valida* (distinguished by an erect growth habit and whitish to straw-colored awns), and some northern populations of *C. cuspidata* (formerly distinguished as *C. villosa*), which has a very prominent central tooth (not

² The Fish and Wildlife Service prioritizes recovery actions by directing resources first to species facing a high (versus moderate or low) degree of threat, with high (versus low) potential for recovery, and to species with a high level of taxonomic distinctiveness. A species that is the only existing member of its genus comes before a species in a genus consisting of more than one species, which comes before a subspecies or variety. The highest priority is 1, the lowest is 18. The priority system was presented in the Federal Register, vol. 48 (221), page 51985, November 15, 1983.

minute as in *C. howellii*) on each perianth lobe (petal or sepal). The involucre, including its spines, is 3–4 millimeters (0.1–0.2 inch) long. Flowers are 3.5–4.5 millimeters (0.1–0.2 inch) long. Figure 1 (page 79) shows the appearance of *C. howellii*.

2. Distribution

Chorizanthe howellii is known, both historically and currently, from coastal dunes north of Fort Bragg in Mendocino County, California. Three populations are known in the dune system south of Ten Mile River. One extended population is in MacKerricher State Park (NDDDB occurrence No. 1, 3, 4, 6, 7, 10), with part of one occurrence extending beyond the State park into adjacent private property (NDDDB No. 7). Three additional populations are on private lands. Summary data on these occurrences are presented in Table 2 (please refer to the introduction of the plan to interpret the numbers).

Chorizanthe howellii occurs sporadically within an area of more than 51 hectares (125 acres) on portions of the United States Geological Survey (USGS) Fort Bragg and Inglenook quadrangles. The largest occurrence (NDDDB No. 1) contained more than 20,000 individual plants of *C. howellii*, as reported in 1989 (NDDDB 1994); however, in 1994 the entire State Park population was estimated to be much smaller (C. Roye, California Department of Parks and Recreation, *in litt.*, 1996). *C. howellii* is known from 3 populations totaling 23,700 individuals.

3. Habitat/Ecosystem

Chorizanthe howellii occurs in recent coastal dunes and adjacent sandy soils of coastal prairies (ancient dune soils) at elevations ranging from sea level to 37 meters (120 feet). In coastal dunes, it is associated with sand verbena (*Abronia latifolia*) and Menzies' wallflower (*Erysimum menziesii*). In coastal prairie habitat, associated plants include two non-native grasses, sweet vernalgrass (*Anthoxanthum odoratum*), and velvetgrass (*Holcus lanatus*), and two species of special concern, Mendocino coast paintbrush (*Castilleja mendocinensis*) and northcoast phacelia (*Phacelia insularis* var. *continentis*) (Calif. Dept. of Fish and Game 1985a).

4. Life History/Ecology

C. howellii is an annual species, completing its life-cycle within one year. Dispersal of seeds is facilitated by the spines (on the involucre) which attach the seed to passing animals. The preference of this species for vegetation gaps or sparsely-vegetated areas on sandy substrate allows seedlings to establish in areas that are relatively free from other competing native species. It seldom occurs or persists in dune areas of dense European beachgrass cover, dense native vegetation cover, or bare, highly mobile sand. It is unknown whether this species forms a dormant soil seed bank.

The species occurs in areas of relatively mild maritime climate, characterized by fog and winter rains. The fog helps keep summer temperatures cool and winter temperatures relatively warm, and provides moisture in addition to the winter rains. *Chorizanthe howellii* blooms from May through July.

5. Reason for Listing

Chorizanthe howellii has probably always been a narrow endemic, and has become endangered by artificial stresses placed on what were probably naturally small populations. Little is known about the historic number or size of populations before human impacts, because the taxon was not distinguished until after substantial alteration to its ecosystem had occurred. It is mostly restricted to MacKerricher State Park, where recreational and maintenance activities are the main threats to its continued existence.

Recreational activities historically included ORV use and hiker and equestrian traffic that caused habitat degradation. Several colonies will be destroyed by a trail along the entire foredune planned at MacKerricher State Park. The indirect effects of a maintained, stabilized road on sand transport and plant community succession are uncertain. Stabilization of foredunes in other dune systems (Godfrey et al. 1979) often results in reduced sand transport landward, and accelerated succession to closed, disturbance-intolerant vegetation. This could also adversely affect *C. howellii*. Trail improvements would probably increase pedestrian access to dunes, and increase the risk of trampling to more remote populations of *C. howellii*. In addition, invasion of the dune habitat by the non-native plant variously called sea-fig, fig-marigold, or iceplant (*Carpobrotus edulis*), European beachgrass (*Ammophila arenaria*), and burclover (*Medicago polymorpha*),

which can outcompete and supplant native species, is a serious threat to *C. howellii*. Trail disturbance is likely to facilitate the establishment of these invasive plants.

6. Conservation Measures

The MacKerricher State Park Ten Mile Dunes Restoration Plan describes measures to protect and enhance the habitat for *Chorizanthe howellii* within the park (Table 2, occurrences No. 1, 3, 4, 6, 7). Conservation measures undertaken for *C. howellii* have included the elimination of ORV use, limited management of invasive, non-native plants including iceplant, European beachgrass, and burclover, and the augmentation of populations of *Chorizanthe howellii* and *Erysimum menziesii*. MacKerricher State Park has redirected an equestrian trail away from occupied habitat.

An archaeological dig conducted by the University of California, Davis in 1989-90 disturbed occupied habitat. Seed was collected in the summer of 1989 before the dig began. Plants were grown at the California Conservation Corps (CCC) Napa nursery and outplanted by the CCC in February 1990. The project had very limited success (Teresa Sholars, California Native Plant Society, *in litt.* 1997).

B. *CHORIZANTHE PUNGENS* VAR. *PUNGENS* (Monterey spineflower) (Recovery Priority Number – 15)

1. Description

Chorizanthe pungens var. *pungens* or Monterey spineflower is another prostrate annual species in the buckwheat family (Polygonaceae). It was first described by George Bentham in 1836 based on a specimen collected from Monterey, by David Douglas in 1833. Later, Charles Parry (1889) assigned specimens he had collected in 1888 from the Salinas Valley to *C. douglasii* var. *albens*. Parry's collections and existing populations in the Salinas Valley are now assigned to *C. pungens* var. *pungens*. *Chorizanthe pungens* var. *pungens* is classified as a separate variety from var. *hartwegiana* (Ben Lomond spineflower) of the Santa Cruz Mountains. *Chorizanthe pungens* var. *pungens* has involucre lobe margins (edges of the spines) that are white (rarely pinkish) rather than dark pinkish to purple and the plants tend to be prostrate rather than erect (Reveal and Hardham 1989). The involucre's awns are hooked at the tip (uncinate), while the spines

of another spineflower in Mendocino County, *C. howellii* are straight. Another spineflower species, *C. diffusa*, has a range that overlaps with *C. pungens* var. *pungens* in the Marina Dunes. It has a hairless lemon-yellow perianth tube which differs from the hairy white to rose floral tubes of *C. pungens*, and tends to favor both gravelly and sandy substrates. Chromosome counts of *C. pungens* are $n = 20$ (Reveal and Hardham 1989). Figure 2 shows the morphology of *C. pungens* var. *pungens*. *C. pungens* blooms from April to June most years.

2. Distribution

Chorizanthe pungens var. *pungens* occurs from the Monterey Peninsula (Monterey County) northward along the coast to southern Santa Cruz County, and inland to the Salinas Valley (Reveal and Hardham 1989, Ertter 1990). Early collections by Gambel in 1842 indicated that this species historically occurred as far south as San Simeon near the northern boundary of San Luis Obispo County (in the Piedras Blancas dune system or nearby), but in recent times this species has not been found south of the Monterey Peninsula (Reveal and Hardham 1989). In the Salinas Valley, *C. pungens* var. *pungens* is now limited to a few occurrences near Prunedale (Reveal and Hardham 1989). The northernmost occurrence occurs in Day Valley near Soquel in Santa Cruz County. Available data on these occurrences are summarized in Table 3 (page 21).

Surveys have been conducted at Fort Ord in recent years in preparation for closing the base. In 1992, Jones & Stokes Associates found *Chorizanthe pungens* var. *pungens* in almost all the undeveloped areas on the western half of Fort Ord (U.S. Army Corps of Engineers [COE] 1992). More recently BLM conducted comprehensive surveys and determined that the previous study's interpretation of data had grossly overestimated occupied habitat at 70 percent. The new study estimated occupied habitat at 1 to 10 percent (BLM, *in litt.*, 1998). The original survey used large blocks of habitat and the calculations included closed canopy blocks of woody vegetation. The reduction in estimated occupied habitat yields a population between 200,000 and 2,000,000 individuals. These numbers will require further refinement to understand status and trends for occurrences on Fort Ord. Plans call for approximately 60 percent of the habitat to remain in open space, protecting as many as 1.2 million to as few as 120,000 plants. The 3,232 hectare (8,000 acre) impact area (unexploded ordinance) has not been surveyed (BLM *in litt.* 1998). Additionally, BLM is concerned that the beach habitats have not

been thoroughly inventoried and suggest that there is as much as 1,010 hectares (2,500 acres) of potential habitat on the stretch of beach from Manresa State Beach to Pacific Grove, which includes private lands. The draft version of this recovery plan had estimated that there were only 44 hectares (108 acres) of potential habitat. The farthest inland population currently known is at Manzanita Park near Prunedale (Monterey County), where *C. pungens* was mapped by Vern Yadon (1989). This is the farthest inland occurrence currently known to exist. Populations are found on State Park System lands at Manresa, Marina, Sunset, Salinas River, and Asilomar State Beaches and Fort Ord Dunes State Park (C. Roye, *in litt.*, 1996).

In 1987, a survey of six properties in the Marina Dunes found a total of 43 individuals of *Chorizanthe pungens* var. *pungens* on five of the properties: Marina State Beach, Granite Rock Company, Gullwing, RMC Lonestar Cement Company, and Martin (Zoger and Pavlik 1987). The occurrence at this site might be more extensive than indicated as the survey was conducted in a poor rainfall year (Dorrell-Canepa, *in litt.*, 1995). Other occurrences are known from Pebble Beach. In summary, *C. pungens* var. *pungens* is known from seven occurrences with as many as 1.2 million individuals, the apparent majority of them at Fort Ord.

3. Habitat/Ecosystem

Chorizanthe pungens var. *pungens* occurs in recent coastal dunes, coastal scrub, and farther inland in maritime chaparral on sandy soils derived from ancient stabilized dunes dating to the ice age (Pleistocene) (Zoger and Pavlik 1987). This species tends to occur on bare sandy patches with little vegetative cover (Zoger and Pavlik 1987). At Fort Ord, this species was found in firebreaks, along roadsides, in sandy openings between shrubs, the central portion of the firing range, and areas where military activities resulted in frequent habitat disturbances. The distribution of suitable habitat within dune systems is subject to inherent dynamic shifts caused by patterns of dune mobilization, stabilization, and successional trends in coastal dune scrub that reduce vegetation gaps. Accordingly, individual colonies of *C. pungens* in unstable habitat are naturally subject to substantial long-term turnover and shifts in distribution and size.

Other plants associated with this species include beach-bur (*Ambrosia chamissonis*), coastal sagewort (*Artemisia pycnocephala*), and mock heather (*Ericameria ericoides*).

4. Life History/Ecology

Seed dispersal is facilitated by the involucrel spines, which attach the seed to passing animals. The preference of these species for gaps in the vegetation or sparsely vegetated areas on sandy substrate allows seedlings to establish in areas that are relatively free from other competing native species; this is particularly true for *C. pungens* var. *pungens* which prefers bare soils. State Park personnel hypothesize that trampling along trails may actually aid germination (C. Roye, *in litt.*, 1996) or seedling establishment, by suppressing competition, which could be offset by trampling mortality to the plants.

This plant occurs in areas of relatively mild maritime climate, characterized by fog and winter rains. The fog helps keep summer temperatures cool and winter temperatures relatively warm, and provides moisture in addition to the normal winter rains.

Chorizanthe pungens var. *pungens* flowers are produced from April through June and the seed is collectable through August (Dorrell-Canepa, *in litt.*, 1995).

5. Reasons for Listing

Habitat loss and conversion for agricultural and residential development, activities at military institutions, and invasion by non-native plants were identified as the primary threats to *Chorizanthe pungens* var. *pungens* (59 FR 5505). Hikers and equestrians may trample this plant at locations throughout its range. Residential and golf course development in maritime chaparral habitat is a potential threat to several occurrences in Monterey and Santa Cruz counties. The proposed route realignment of Highway 101 in northern Monterey County also has the potential to affect several small, scattered occurrences.

Most of the historical locations of *Chorizanthe pungens* var. *pungens* in the Salinas Valley have probably been extirpated by conversion of grassland and valley oak woodland habitats to agricultural fields. The one remaining occurrence near Prunedale is in Manzanita County Park, but the park has no management plan for this species and this species is threatened in the park by plans to replace the natural vegetation with turf for playing fields (Vernal Yadon, botanist, *pers. comm.* 1994).

Construction of roads and buildings on Fort Ord possibly destroyed some occurrences of this species in the past. Conversion of this military base to other uses, including educational and scientific research facilities, may threaten this species if new buildings are constructed; however, large portions of this plant's habitat on Fort Ord are to be reserved for open space (see conservation measures below).

When *Chorizanthe pungens* var. *pungens* was listed, its occurrences at Sunset State Beach were threatened by recreational activities, with plants subject to trampling and invasive non-native species introduced as part of dune stabilization programs.

Iceplant (*Carpobrotus edulis* and hybrids), an invasive non-native species, is now a dominant species of stable and moderately active dunes in Monterey Bay. Iceplant forms dense, continuous mats of succulent vegetation with few or no gaps, in contrast with the sparse cover of native vegetation. Cover by iceplant of dunes near Fort Ord can exceed 80 percent, even in areas that were subject to mass dieback during the freezes of the early 1990s (land managers' observations, *pers. comm.* by P. Baye, U.S. Fish and Wildlife Service 1998). Because of the persistent re-invasion of stable dunes by iceplant, and the progressive increase of iceplant colonies over time, invasion by this species appears to be the greatest long-term threat to the survival of *C. pungens* var. *pungens*. Limited corrective measures have been taken (see conservation measures below) against iceplant invasion, but recurrent invasion by iceplant will continue to be problematic unless iceplant eradication is undertaken on a massive scale, so as to destroy the seed sources.

6. Conservation Measures

Restoration of dunes at the Naval Postgraduate School in Monterey where *Chorizanthe pungens* var. *pungens* occurs may benefit this species. This restoration work has included removing non-native invasive species such as iceplant, converting previous landfills and other semi-dune areas to natural coastal dunes and coastal prairies, and planting native species (Cowan 1994). When work is completed, the total area restored will be about 12 hectares (30 acres). The *C. pungens* var. *pungens* occurrence at Sunset State Beach may be enhanced by a restoration program established for the removal of non-native species (Ferreira 1989). At sites like these, budgeting for long-term maintenance is essential to the success of iceplant removal because it rapidly re-invades cleared plots, often

reestablishing dominance within several years. Monitoring of these sites is necessary to determine if the conservation efforts are successful.

For known occurrences of *Chorizanthe pungens* var. *pungens* (Table 3) on lands within the jurisdiction of the County of Monterey, Policy 2.3 of the North County Land Use Plan (LUP), relating to environmentally sensitive habitats, is applicable. The County of Monterey LUP policies allow only resource-dependent uses in habitats known to support rare and endangered species. The LUP also recognizes dune habitat, with or without rare and endangered species, as an environmentally sensitive habitat. Within environmentally sensitive habitat, the LUP allows resource-dependent uses that do not significantly disrupt habitat values. Land uses adjacent to environmentally sensitive habitats should be compatible with the long-term maintenance of the resource. The County requires the protection of environmentally sensitive habitats in new land divisions or developments through deed restrictions or dedications of permanent conservation easements.

General Code 16.32 of the County of Santa Cruz allows only resource-dependent uses within environmentally sensitive habitat areas, including habitat for rare and endangered species. For proposed land divisions or developments, the County requires protection of environmentally sensitive habitats through dedication of an open space or conservation easement to protect the portion of a sensitive habitat that is undisturbed by the proposed development. Alternatively, the developer may protect sensitive habitat on an adjacent parcel.

For occurrences of *Chorizanthe pungens* var. *pungens* (Table 3) on lands in the City of Marina, the City's LUP policies support protection and restoration of native dune habitat and vegetation and the habitat of recognized rare and endangered species. The City's policies specify that primary habitat areas for sensitive species be protected and preserved. Development within secondary or support habitat areas is allowed, if it does not significantly affect primary habitat areas. Where development is proposed on parcels containing rare and endangered species, parcel owners are required to develop and execute a management plan that will protect the identified plant species. The City has completed the Coastal/Vernal Ponds Comprehensive Management Plan which identifies habitat for *C. pungens* var. *pungens* and *Gilia tenuiflora* ssp. *arenaria* on lands administered by California DPR as part of Marina State Beach (Table 8). The plan recommends management actions to protect the rare plant habitat.

Sand City's LUP expresses the intent to protect and preserve endangered species habitat. The City is developing a Habitat Conservation Plan (HCP) for part of its planning area to protect the endangered Smith's Blue Butterfly (*Euphilotes enoptes smithi*). The plan will protect a small area occupied by *C. pungens* var. *pungens* and *Gilia tenuiflora* ssp. *arenaria*.

Several management plans address *Chorizanthe pungens* var. *pungens*. Marina State Beach and Asilomar State Park staff have implemented an aggressive program to eradicate invasive non-native plants, revegetate dunes, and protect dune habitat from recreational uses (i.e., by using raised wooden walkways). The State has installed interpretive signs that educate the park visitor about the sensitivity of the dune habitat and its listed plant species.

The Department of Defense (DOD) developed the Fort Ord Habitat Management Plan (HMP) that documented the occurrences within the military facility as part of the base closure plans. The plan delineates the habitats on the site³ that will be set aside for preservation and which occurrences may be affected by future development. Designating large portions of Fort Ord as open space will provide conservation opportunities for this species providing protection for 55 percent of the known habitat on the former base. When Fort Ord was still operating as a military facility, the DOD established small preserves (from 4 to 42 acres) to protect rare species. Under the HMP, BLM will be responsible for portions of the sensitive habitat areas, as will the University of California, Santa Cruz and California DPR. More than 16,000 acres of Fort Ord are slated for preservation as open space and native plant and wildlife habitat by the HMP. Portions of the *Chorizanthe pungens* var. *pungens* occurrences will be managed by the University as part of its Natural Reserve System. Other portions of the occurrences will become part of

³ Site: this word is used in a nontechnical sense to mean an entire property or, for large properties, a dune system with population(s) of endangered plants. This plan focuses on conserving and managing dune system vegetation that will support populations of the listed plants rather than on conserving the exact spots where populations happen to be growing at the present time. The populations are inherently impermanent — expanding, moving into new areas, and declining with changes in local vegetation. Over the long term, the endangered plants need the opportunity to move about the dune systems, colonizing patches of suitable habitat. As a result, the plan states conservation goals in terms of healthy populations, not in terms of conserving the exact spots where populations have been observed (i.e., “occurrences,” as defined for record-keeping purposes by the California Natural Diversity Database [CNDDB]).

the City of Marina and be subject to City development policies. Guidelines for specific management actions are not outlined.

C. *CHORIZANTHE VALIDA* (Sonoma spineflower)

(Recovery Priority Number – 5)

1. Description

The Sonoma spineflower, *Chorizanthe valida*, was described by Sereno Watson in 1877 from specimens collected in 1840–41 by Ilya G. Vosnesensky, an entomologist and curator of the Zoological Museum in St. Petersburg, Russia, who traveled and collected in northern California. It is very similar in appearance to *C. howellii*, the primary distinguishing characteristic of *C. valida* being its ascending to erect growth habit and the brightly colored red and white involucre. The bright red base of the involucre's straight spines contrasts with their bright ivory tips, and the red spine bases contrast sharply with the dull-colored involucral tube. The basal leaves of *C. valida* are 1–2.5 centimeters (0.4–0.9 inch) long, 4–8 millimeters (0.2–0.3 inch) wide, and often less hairy on the top surface than underneath. The flowers are 5–6 millimeters (0.2–0.3 inch) long. *C. valida* is depicted in Figure 4.

2. Distribution

Only 1 population of *Chorizanthe valida* is currently known from near Abbots Lagoon in Point Reyes National Seashore, between Tomales Point and Point Reyes. Historically the plant was more widespread on the peninsula, occurring near the Point Reyes Post office, then located west of Schooner Bay, as well as north of Creamery Bay in Drakes Estero (Reveal and Hardham 1989). The location of Vosnesensky's original collection was referred to as "Russian Colony" by Sereno Watson in 1877 when he described the plant. More recently, this site was referred to as "near Fort Ross" and designated as the type locality by Reveal and Hardham (1989). However, Davis and Sherman (1990) proposed that the original Vosnesensky collection may have been taken from the Point Reyes Peninsula in Marin County. The Fort Ross site has been surveyed many times, most recently in 1987, and *C. valida* has not been found. Additional historical collections of this spineflower were recorded from "near" Petaluma and Sebastopol in the interior portion of Sonoma County (Reveal and Hardham 1989). The collections from these sites differ from the Point Reyes material in flower color. The plants at Point Reyes are

distinct with bright red at the base of the awns that have bright ivory tips (present in the original Vosnesensky collections). The extinct, interior collections have a hint of red at the base of the awns with straw colored tips (Reveal and Hardham 1989).

A population was reported in 1980 from Rodeo Lagoon in Golden Gate National Recreation Area, Marin County, California. The Natural Diversity Data Base reports that the collection actually came from Abbotts Lagoon (U.S. Fish and Wildlife Service 1992).

The only known extant population of *Chorizanthe valida* (NDDDB No. 2) is in the Lunny Pasture adjacent to Abbotts Lagoon in Point Reyes National Seashore (PRNS) (Davis and Sherman 1990) (Table 4). This site is on the USGS Drake's Bay quadrangle at an elevation of about 12 meters (40 feet). The Lunny Pasture population was discovered June 1980, by Wilma Follette and a group of amateur botanists of the Marin Chapter of the California Native Plant Society (CNPS) (CNPS 1980). Before then, *Chorizanthe valida* had been thought to be extinct from Point Reyes, with the last collection made by A.D.E. Elmer in July 1903 (Calif. Native Plant Society 1980). The 1903 specimen's location was given as the Point Reyes Post Office, at that time located west of Schooner Bay and north of Creamery Bay in Drake's Estero (Davis and Sherman 1990).

The Lunny Pasture population of *Chorizanthe valida* was estimated to cover 100 square meters (1,076 square feet) in 1983. In 1984, more than 2,000 plants covered an area of 1,564 square meters (16,829 square feet) (Fowler and Fellers 1984). The increase in population area from 1983 to 1984 was probably due to natural population fluctuations that occur in annual species in response to weather conditions (Fowler and Fellers 1984). A 1986 survey estimated that the colony of *C. valida* in Lunny pasture consisted of two distinct subpopulations covering approximately 17,000 square meters (182,920 square feet) and well more than 2,000 plants (Clark and Fellers 1986). Subsequent monitoring by CNPS has documented wide fluctuation in numbers, ranging from 2,000 to 30,000 plants (NDDDB 1994; Virginia Norris, CNPS Marin Chapter, *in litt.*, 1995; R. Soost *in litt.*, 1996). Variation between estimates may be due to undercounting, differences in observer accuracy, or the natural fluctuations between years. In summary, *C. valida* is known from one population with a maximum of 30,000 individuals.

3. Habitat/Ecosystem

Chorizanthe valida occurs exclusively in the sandy soil of a coastal prairie (on pre-Holocene dune deposits) near Abbotts Lagoon, at an elevation of approximately 12 meters (40 feet). The prairie is adjacent to a brackish lagoon, coastal swale, and coastal scrub, but *C. valida* does not grow in those habitats (Davis 1988a). This site is adjacent to the Holocene dune system that stretches about 19 kilometers (12 miles) from Tomales Point to Point Reyes (Cooper 1967). Other plants associated with this species include two species of special concern, Point Reyes horkelia (*Horkelia marinensis*) and large-flower linanthus (*Linanthus grandiflorus*). Dominant species include coyote brush (*Baccharis pilularis*) and several annual grasses.

4. Life History/Ecology

Chorizanthe valida is an herbaceous annual in the buckwheat family (Polygonaceae). Dispersal of seeds is facilitated by the spines, which attach the seed to passing animals. As with other *Chorizanthe* species, this species occurs on sandy substrate, where seedlings establish in areas that are relatively free from other competing native species. It is unknown whether the species forms a dormant seed bank.

The species occurs in areas of relatively mild maritime climate, characterized by fog and winter rains. The fog helps keep summer temperatures cool and winter temperatures relatively warm, and provides moisture in addition to the normal winter rains. *Chorizanthe valida* flowers sometime between June and August, depending on the year's weather pattern.

Chorizanthe valida has a peak blooming season of only three weeks, after which it rapidly loses color and goes to seed. After about a month, the dull brown flowerhead begins to disintegrate and the spiny seeds are dispersed on the ground nearby. During the blooming period, *C. valida* emits a strong floral scent which attracts many insect pollinators (Davis and Sherman 1990). Honey bees (*Apis mellifera*), yellow-faced bumblebees (*Bombus vosnesenski*), and solitary ground nesting wasps (*Bembix americana comata*) are known to forage on *C. valida* flowers (Davis 1988b). An insect identified as belonging to the order Hemiptera: Lygaeidae also occurs on this plant. The insect closely resembles the seeds in size and color (Davis 1988b).

5. Reason for Listing

The rarity of *Chorizanthe valida* (1 extant population) makes it exceptionally vulnerable to disturbances. Development may have led to the loss of the historical mainland populations of this species near Sebastopol and Petaluma, California, if indeed populations existed inland from Point Reyes.

The extant population is in the PRNS, inside a pasture that has been grazed for over a century. The PRNS issues special use permits to ranchers for dairy and beef operations because the enabling legislation for the park considers that cattle operations merit preservation as part of the cultural heritage of western Marin County (Davis and Sherman 1990). Changes in grazing or trampling intensity (cattle stocking rates) could alter the vegetation structure that has allowed *C. valida* to persist. Increased grazing or trampling may increase seedling mortality, and reduced grazing/trampling could allow surrounding vegetation to close vegetation gaps and outcompete *C. valida*.

6. Conservation Measures

Point Reyes National Seashore is aiming to perform yearly monitoring of *Chorizanthe valida* and other rare species (Clark and Fellers 1986). Volunteers from CNPS monitor the rare plant populations at PRNS, but not yet on an annual basis.

The possibility that grazing may benefit *Chorizanthe valida* by suppressing competitors has been investigated (Davis and Sherman 1990). Exclosures were built in 1988 and the colony was monitored. A higher density of *C. valida* was found outside the exclosures than inside, and it was suggested that this species may be adapted to a grazing regime. However, the plants inside the exclosures were more than twice as tall as the plants outside, growing as tall as the grasses that were protected from cattle. There were no plants inside the exclosures in 1996 (Hickson *in litt.* 1996). A change in the grazing regime may allow for an increase in both the number and size of the plants.

In 1988 seeds were collected and introduced into three 2 × 2 meter plots within 100–200 meters of the existing occupied site. The sites had successful reproduction and two expanded outside the original seeded area (Davis and Sherman 1990). The successful

introduction of the species into appropriate habitat should be considered for its long term viability.

D. *ERYSIMUM MENZIESII* (Menzies' wallflower)

(Recovery Priority Number – 2)

1. Description

Menzies' wallflower (*Erysimum menziesii*) was first described in 1830 by Sir William Jackson Hooker, Director of Kew Gardens, as a species of the genus *Hesperis*. The type herbarium sheet, containing two intermixed but unrelated plants (the wallflower and *Phoenicaulis cheiranthoides*), was collected by Archibald Menzies in the late 18th century. In 1881, Richard Wettstein, Director of the Vienna Botanical Garden, transferred the name to the genus *Erysimum*. The species consists of four geographically distinct subspecies: *E. menziesii* ssp. *menziesii*, *E. menziesii* ssp. *eurekaense*, *E. menziesii* ssp. *yadonii* (Figures 5,6, and 7, respectively), and *E. menziesii* ssp. *concinnum* (not rare).

There has been an important change in the taxonomy of *Erysimum menziesii* since the Service listed the entire species as endangered in 1992. At that time, Robert Price's 1987 doctoral dissertation had already recognized subspecies *eurekaense* and subspecies *yadonii*, but Price had not yet formally published these new names. Nor had Price made *Erysimum concinnum* a subspecies of *E. menziesii*. Price's treatment of the species in the Jepson manual reflects these recent changes (Price 1993). The Service listed what are now ssp. *menziesii*, ssp. *eurekaense*, and ssp. *yadonii*. The final listing rule made it clear that what is now *E. menziesii* ssp. *concinnum* is not included. The Service will update the List of Endangered and Threatened plants to reflect this change in taxonomy.

A member of the mustard family (Brassicaceae or Cruciferae), this species may be a biennial or a short-lived perennial depending on the particular population. Each plant usually has several flowering stems from 0.5 to 1.5 decimeters (1.2–5.9 inches) tall. The flower petals are usually yellow, 15–20 millimeters (0.6–0.8 inch) long. The flowers are grouped into racemes on terminal branches. The fleshy leaves form a basal rosette and are somewhat spoon-shaped, narrowing abruptly to the leaf stalk. Leaves are 2–11 centimeters (0.8–4.3 inches) long and 4–15 millimeters (0.1–0.6 inch) wide, and the leaf margins are entire, dentate, or lobed. The fruit is a silique, 3–13 centimeters (1.2–5.0 inches) long, and 2–4 millimeters (0.08–0.1 inch) wide, four-sided when green, and flattened when dry.

The three endangered subspecies of *Erysimum menziesii* are distinguished as follows:

- Erysimum menziesii* ssp. *menziesii* has flower stalks 3–9 millimeters (1.2–3.5 inches) tall, and the longest fruits are usually less than 8 centimeters (3.1 inches) long, whereas *E. menziesii* ssp. *eurekaense* has flower stalks 9–15 millimeters (0.4–0.6 inch) tall, and the longest fruits are usually greater than 8 centimeters (3.1 inches) in length. The leaves of *E. menziesii* ssp. *menziesii* are generally lobed or irregularly toothed and the flowers are rich yellow.

- Erysimum menziesii* ssp. *eurekaense* is distinguished from the other subspecies by its more toothed (dentate) leaves, longer stems, and longer narrower fruits. Also, the leaves are less fleshy than those of *E. menziesii* ssp. *menziesii*, and the flowers of ssp. *eurekaense* are light yellow.

- Erysimum menziesii* ssp. *yadonii* differs from the other subspecies because it blooms in summer (June-August), whereas the other subspecies bloom in winter or spring. It tends to be perennial with a branched caudex. The flower petals are rich yellow.

2. Distribution

The species occurs on coastal sand dunes in Monterey County from Cypress Point north to Point Pinos and in the Marina Dunes, in Mendocino County from Fort Bragg north to Ten Mile River, and in Humboldt County on the South Spit of Humboldt Bay and the Bay's North Spit (Samoa Peninsula) from its southern tip to the Lanphere Dunes unit of the Humboldt Bay Refuge managed by the Fish and Wildlife Service (Map 1). Tables 5,6, and 7 provide data for the occurrences of each subspecies (please refer to the introduction of the plan to interpret the numbers). In summary, *Erysimum menziesii* (three subspecies) is known from at least 16 extant occurrences with 33,300 individuals.

Erysimum menziesii ssp. *menziesii* is located in Monterey and Mendocino Counties. In Monterey County, there are seven isolated occurrences along the Monterey Peninsula from Point Pinos to Cypress Point (Table 4) in Pacific Grove, Asilomar State Park, Spyglass Hill, Point Piños Lighthouse, Signal Hill Road, Bird Rock Road (east of 17 Mile Drive) and Spanish Bay Golf Course. The Mendocino County occurrences range from Ten Mile River south to Fort Bragg. Most of the occurrences are at MacKerricher State

Park, where they include hybrids with the common northern subspecies *E. m. ssp. concinnum*. The Pudding Creek (Glass Beach headlands) occurrence near Fort Bragg is thought to be *E. m. ssp. concinnum* and its taxonomic identity should be confirmed. The largest recorded occurrence, covering 577.1 hectares (1,426 acres), is at Ten Mile River in Mendocino County (Map 1).

Erysimum menziesii ssp. eurekaense occurs in Humboldt County from the coastal dunes of South Spit to the Lanphere Dunes (Table 6). The subspecies *eurekaense* has five extant, recorded occurrences (NDDDB 1996) in Humboldt County: Lanphere Dunes, northwest of Mad River Slough, north of Manila (Samoa Peninsula), U.S. Coast Guard Station (Samoa Peninsula), and the South Spit (Humboldt Bay). The subspecies has also been mapped as occurring in 12 stands in 3 subpopulations on the Samoa Peninsula.

Erysimum menziesii ssp. yadonii is restricted to 4 occurrences in the vicinity of the Marina Dunes, 2 at Marina State Beach, and the others at the RMC Lonestar Cement Company property approximately 0.8 kilometer (0.5 mile) south of the Salinas River Lagoon (Table 7 and Map 2). The largest sub-populations (thousands of plants) occur in the stable foredunes around RMC Lonestar and Marina State Beach in the southern portion of the Monterey Bay dune complex. At the latter site, plant numbers have been augmented through propagation and reintroduction.

3. Habitat/Ecosystem

Erysimum menziesii is discontinuously distributed in the coastal foredune community of four disjunct dune systems: Humboldt Bay in Humboldt County, Ten Mile River in Mendocino County, and Monterey Bay and Monterey Peninsula in Monterey County. The species occurs in the sparse, semi-stable foredune community classified as Sand-verbena–beach bursage series by Sawyer and Keeler-Wolf (1995).

The habitats of the Monterey County populations differ from those of the northern California populations. Plants of *Erysimum menziesii* are generally distributed in clusters or patches (Botanica Northwest Associates 1992). In northern California, the species occurs in northern foredune or dune mat community, on the flanks or crests of dunes, open sand areas, sparsely vegetated dunes, and the borders of lupine scrub (Botanica Northwest Associates 1992). These habitats are not spatially fixed, and are subject to cycles of erosion, deposition, and re-establishment of plant communities over decades.

Consequently, a high degree of population turnover is expected at relatively large spatial scales relative to individual patches or colonies. The species can tolerate some sand movement. The associated vegetation (sand-verbena – beach bursage series community) is composed of low-growing suffrutescent (half-shrubby, dying back to a perennial base) and herbaceous native species (Sawyer and Keeler-Wolf 1995). Common species are beach sagewort (*Artemisia pycnocephala*), dune goldenrod (*Solidago spathulata*), coast buckwheat (*Eriogonum latifolium*), sand verbena, beach pea (*Lathyrus littoralis*) and seashore bluegrass (*Poa douglasii*).

In Monterey County, the species occurs on coastal strand, close to the high tide line, but largely protected from wave action. The species has high exposure to strong wind, salt spray, and occasional wave action from storms and high tides. The substrate is loose sand lacking in organic matter and minerals (Thomas Reid Associates 1987). What appears to be suitable habitat also occurs in geologically-recent bluff scrub and open, sparsely vegetated dunes, although a search conducted in this habitat was unsuccessful (Thomas Reid Associates 1987). Associated species along the Monterey Peninsula include beach primrose (*Camissonia cheiranthifolia*), beach-bur, sea rocket (*Cakile maritima*), beach knotweed (*Polygonum paronychia*), sand verbena and iceplant. Monterey County habitats of this species are relatively free of the invasive *Ammophila arenaria*.

4. Life History/Ecology

Erysimum menziesii is a biennial or short-lived perennial. The species reproduces by seed, and the seeds are dispersed by wind. Subspecies *yadonii* can be perennial, but will not fruit more than twice.

Erysimum menziesii germinates after the first rains in fall or early winter. The vegetative rosette stage of the life cycle can continue for up to eight years, and flowering may depend on rosette size (Pickart and Sawyer 1998).

The plant's pollinators are thought to be bees, bumblebees, butterflies, and moths (Price 1986). The species can set fertile seed through self pollination, so it reproduces both by selfing and through outcrossing (Price 1986). Subspecies *yadonii* is pollinated by a solitary bee species (*Emphoropsis miserabilis*) (Pickart 1988). The seeds are dispersed over time because they can remain attached after the seed pod splits open (Pickart 1988).

Current evidence suggests that the seed bank is contained in the old standing plants and that seed in the soil (sand) does not seem to persist. Most seed dispersal is restricted to the immediate vicinity of the parent plants. Long distance dispersal of seed may occur by fragmentation of seed-bearing branches breaking off and tumbling with the prevailing wind. Isolated individuals of *E. menziesii* occur on slipfaces of bare, active dunes downwind of vegetated dunes at Ten Mile dunes. This indicates that long-distance seed dispersal may occur where the surface roughness of the dune is minimized. The location and size of wallflower populations are dynamic because the plant occurs in a dynamic habitat. Monterey Bay occurrences are known to appear and disappear along the coastal strand (Thomas Reid Associates 1987). Population modeling and effects of differing management techniques for *Erysimum menziesii*, *Layia carnosa*, and coastal dune systems are presented by Pickart and Sawyer (1998).

A study by Professor Michael Mesler on Humboldt County occurrences concludes that the subspecies *eurekense* flowers for seven weeks (March to mid-April). Average flower production is 29 flowers per plant, and an approximate average of two flowers are receptive to pollination per day (Pickart 1988).

5. Reasons for Listing

The species is threatened by invasion by non-native species, industrial and residential development, and trampling by recreational users such as pedestrians, equestrians, hang-gliders, and ORV users (U.S. Fish and Wildlife Service 1992). MacKerricher State Park is planning to construct a trail that would destroy some colonies. ORV activities still occur on private lands and present occasional problems on public lands. Crucifer rust (*Albugo candida*), a fungus, has been the focus of a long term study to evaluate its effects on the population ecology of *Erysimum menziesii* that will be used to develop a projection model to predict seed and seedling survival (Pickart and Sawyer 1998). The severity of disease threats is uncertain.

In Humboldt County, subspecies *eurekense* is highly threatened by displacement from invasive non-native species, particularly European beachgrass, iceplant (*Carpobrotus chilensis* × *C. edulis*), yellow bush lupine (*Lupinus arboreus*), and more recently quaking grass (*Briza maxima*). *Briza* will require research to determine the most effective methods to control or manage it. ORV impacts were cited in the final rule for *Erysimum*

menziesii as a cause of habitat degradation. Afterward, successful management efforts reduced the threats from ORVs; however, a recent influx of trespass violations accompanied by failure to enforce existing laws and ordinances is complicating (if not preventing) the ability to achieve recovery for the species (Miller, *in litt.*, 1997; A. Pickart, U.S. Fish and Wildlife Service, *in litt.*, 1997). The displacement of subspecies *menziesii* by the invasive non-native iceplant is a major threat to Monterey County occurrences and the occurrences north of Fort Bragg. This threat is discussed above, with respect to *Chorizanthe pungens*.

In Monterey County, additional threats include browsing by deer (attempts to plant seedlings are successful only with caging), recreational uses (trampling), coastal erosion, sand mining activities, and the deposition of dredge material from adjacent water bodies.

6. Conservation Measures

For known occurrences of *Erysimum menziesii* (Tables 5, 6, and 7) on lands within the County of Monterey jurisdiction, Policy 2.3 of the North County Land Use Plan (LUP), relating to environmentally sensitive habitats, is applicable. The Monterey County LUP has established policies allowing for only resource-dependent uses within habitats known to support rare and endangered species. The LUP also recognizes dune habitat as environmentally sensitive, with or without rare and endangered species. Resource-dependent uses are allowed within environmentally sensitive habitat if they do not significantly disrupt habitat values. For proposed land divisions or developments, the County requires the protection of environmentally sensitive habitat through deed restrictions or dedications of permanent conservation easements. Deed restrictions often do not allow for adequate control of the land use to protect rare plant population.

The *Erysimum menziesii* occurrence at Lanphere Dunes is managed by controlling exotic yellow bush-lupine and European beachgrass. All European beachgrass has been eliminated from the preserve (although not from the dune system), and the next major task is to control ice plant (A. Pickart *in litt.*, 1997). The management of the preserve has been so successful that there has been a significant increase in *E. menziesii* populations. The management techniques and monitoring programs that have led to this success can be reviewed in Pickart and Sawyer (1998). Foredunes at the preserve are not “finished” — the foredunes will continue to recolonize with beachgrass and will require follow-up until

the littoral cell (the entire beach area between headlands) is cleared of beachgrass propagules (P. Baye, U.S. Fish and Wildlife Service and A. Pickart, *pers. comm.*, 1998). A study mandated by the Environmental Protection Agency (the Menzies Wallflower Research Program, funded by Louisiana-Pacific Corporation and Simpson Timber Company, administered by Humboldt State University and implemented cooperatively with The Nature Conservancy [TNC]) has resulted in the development of habitat management measures that include removal of non-native plants, restoration, and habitat protection activities (Pickart, Miller and Duebendorfer 1990; Sawyer 1991). A study of the demographics and genetics of the subspecies was funded by the National Science Foundation and conducted by Michigan State University and TNC (Pickart and Sawyer 1998).

Humboldt County and the City of Eureka have several policies relating to the protection of sensitive resources. The Humboldt County Local Coastal Program prohibits vehicles above the wave slope except in the Samoa Dunes Recreational Area. Due to inadequate funding the Sheriff's Department has reduced the frequency of patrolling, with a resultant increase in trespass. ORVs continue to impact the dune system, and the impacts have recently escalated (A. Pickart *in litt.*, 1995; Hofmann *in litt.* 1997). The County has recently adopted a management plan for the north and south spits of Humboldt Bay. The plan designates certain areas for vehicular access on the beach and dunes as well as vehicle-free zones. This plan addresses access on public lands as well as access to/from adjacent BLM lands (Samoa and Manila dunes), private lands and the Lanphere Dunes. The plan recommends management actions to restore degraded dune habitat areas, including removal of invasive, non-native plant species, fencing of rare plant habitat areas and limiting public access. These recommendations remain unfunded (A. Pickart *in litt.*, 1995). Recovery of these species will require preventing habitat loss and degradation through County enforcement of these codes and ordinances, with funding support from outside sources.

The Eureka Dunes Protected Area, a 32-hectare (80-acre) site on the North Spit of Humboldt Bay (NDDDB No. 4, Table 6), is owned by the City of Eureka and managed by the Center for Natural Lands Management. The Eureka Dunes Habitat Mitigation Bank Phase II Enhancement Plan was funded by the California Coastal Conservancy and developed by TNC. Implementation of the plan is not yet funded. Management has largely been limited to fencing sensitive habitat and protection from ORVs. A grant from

the State Coastal Conservancy provided some funds for removal of *Lupinus arboreus*. A more recent invasive species, *Briza maxima*, will require research as it is extremely difficult to control. The City of Eureka prepared a draft plan for the “Skypark” property that contains one of the largest populations of the spp. *eurekense*. The plan would provide for habitat protection through fencing and site rehabilitation but remains unfunded (Miller *in litt.* 1997).

The BLM has restoration projects to reduce the threat of lupine and beachgrass. The BLM has fenced 15 hectares (roughly 40 acres) of *Erysimum menziesii* habitat to protect it from ORV use on the Samoa Peninsula. The BLM has funded a restoration program and developed a strong volunteer program to provide for weed removal on the Manila and Samoa sites (J. Wheeler, *in litt.* 1997). The BLM secured a grant from the National Fish and Wildlife Foundation and internally funded a national Partners Against Weeds Initiative to remove European beachgrass from the Humboldt Bay Dunes and the Manila Dunes Area of Critical Environmental Concern (ACEC) and Research Natural Area (RNA) (J. Wheeler, *in litt.* 1997). Continued financial support for dune restoration and maintenance will be essential to recover the species.

The Dunes Forum, a local coalition of landowners, community members, private organizations, and public agencies, was formed in 1996. The Forum meets monthly to promote coordinated, regional ecosystem management to conserve and restore dune ecosystems in Humboldt County. Originally formulated by TNC, the group now meets at the local BLM office.

For occurrences of *Erysimum menziesii* (Tables 5 and 7) on lands in the Cities of Marina and Pacific Grove, implementation of the cities’ LUP should protect and restore native dune habitat and vegetation, and the habitat of rare and endangered species. The cities’ policies specify that primary habitat areas for sensitive species be protected and preserved. Development within secondary or support habitat areas is allowed, if it does not significantly impact primary habitat areas. Where development is proposed on parcels containing rare and endangered species, parcel owners are required to develop and execute a management plan that will protect the identified plant species.

The City of Sand City's LUP specifies the intent to protect and preserve endangered species habitat. Development of a habitat management and monitoring plan will be needed to assist in the long term protection and assistance in recovery for the species.

Many comprehensive studies have been completed for The Marina Dunes of Monterey County including *The Marina Dunes Rare Plant Survey* (Zoger and Pavlik 1987). The California DPR conducted a population augmentation project at Marina and Asilomar State Beaches in Monterey County from July 1985 through July 1988. More than 5,000 seedlings were planted at Marina State Beach with an 80 percent success rate, although Peter Baye (U.S. Fish and Wildlife Service, *pers. comm.*) saw very little *E. menziesii* var. *yadonii* at Marina state beach compared with the Lonestar site in 1997 and 1998, raising questions about long-term persistence. The occurrences on California DPR lands continue to be monitored. The Pebble Beach Company has established endangered species management areas where Menzies wallflower establishment experiments are being monitored at Spanish Bay (Dorrell-Canepa, *in litt.*, 1995). California DPR also has a Management and Recovery Plan for Asilomar State Park. Habitat protection measures such as boardwalks, fences, and signs have been implemented at Marina State Beach and Asilomar State Park to reduce recreational use impacts.

The MacKerricher State Park Ten Mile Dunes Restoration Plan has been completed. Conservation measures undertaken have included the elimination of ORV use, limited management of invasive, non-native plants including iceplant, European beachgrass, and burclover, and the augmentation of occurrences. MacKerricher State Park has redirected an equestrian trail away from occupied habitat. Also at MacKerricher State Park, *Erysimum menziesii* ssp. *menziesii* habitat was revegetated after an archaeological dig.

E. *GILIA TENUIFLORA* SSP. *ARENARIA* (Monterey gilia)

(Recovery Priority Number – 9)

1. Description

The species was first described and named *Gilia arenaria* in 1833 by George Bentham based on specimens collected by David Douglas in the early 1800s. In 1943, Willis Linn Jepson reduced the plant to a variety of *G. tenuiflora*. After further taxonomic studies of the genus *Gilia* by Verne Grant and Alva Day Grant (1956), this plant was changed in rank to subspecies.

Gilia tenuiflora ssp. *arenaria* is an annual species belonging to the phlox family (Polemoniaceae). Plants are less than 1.7 decimeters (less than 6.7 inches) tall with a basal rosette of leaves (Figure 7). The central stem is erect with several other stems spreading out from the base which are covered with dense glandular hairs, sometimes giving a cobwebby appearance near the base (Grant and Grant 1956). This subspecies has funnel-shaped flowers with narrow petal lobes 2–4 millimeters (0.08–0.1 inch) wide and a narrow, purple throat 2–3 millimeters (0.08–0.1 inch) wide. Other characteristics that distinguish *G. tenuiflora* ssp. *arenaria* from the other three subspecies of *G. tenuiflora* include relatively large fruit capsules 5–6 millimeters (0.2–0.23 inch) long and stamens that are only slightly exerted.

Gilia tenuiflora ssp. *arenaria* locally intergrades with *G. tenuiflora* ssp. *tenuiflora* at the more inland areas of its distribution at Fort Ord (Dorrell-Canepa 1994).

2. Distribution

Gilia tenuiflora ssp. *arenaria* is endemic to the Monterey Bay and Peninsula dune complexes. It is distributed in discontinuous populations from Spanish Bay on the Monterey Peninsula north to Moss Landing. There are 15 known natural occurrences of this subspecies, which are outlined in Table 8 and depicted on Figure 7 (please refer to the introduction of the plan to interpret the Table's numbers). NDDDB occurrence #11 is an experimental reintroduction, done as part of a dune mitigation project for a golf course development. Monterey Peninsula occurrences in the vicinity of Spanish Bay and Asilomar State Beach. Monterey Bay Dune occurrences from Moss Landing to Monterey, along coastal and inland dunes.

One of the largest known occurrences of *Gilia tenuiflora* ssp. *arenaria* was recently discovered at Fort Ord in 1993. Preliminary estimates indicate that as much as 60% of the total known individuals of this species may occur at Fort Ord. In summary, this subspecies is known from 15 extant occurrences with 110,400 individuals.

3. Habitat/Ecosystem

Gilia tenuiflora ssp. *arenaria* grows in sandy soils of dune scrub, coastal sage scrub, and maritime chaparral in the coastal dunes of Monterey County. This species is associated

with dune scrub vegetation on sedimentary rocks (laid down during an ancient rise in sea level) and aeolian (wind-blown) deposits formed as sea level rose since the end of the last ice age (Barbour and Johnson 1988). The species occurs on recently stabilized U-dunes, semi-open older dune scrub of Holocene age, and on Pleistocene dunes with coastal grassland and scrub vegetation. It occurs in many topographic positions and aspects. Suitable habitat usually has a north, east, or west aspect or, in wet years, even a south aspect. The species occurs at elevations no higher than 30 meters (100 feet). The substrate is sand with some soil development and litter accumulation (T. Reid and Associates 1987). The species favors sites with limited exposure to strong winds, salt spray and waves. It grows in open areas and wind-sheltered openings in the low-growing dune scrub vegetation and in areas where the sand has experienced some disturbance, such as along trails and roads. The species is usually tolerant of small amounts of drifting sand, but tends to occur in stable sites with minimal sand accretion or deflation. Dynamic dune succession involving vegetative stabilization of mobile dunes, and remobilization (secondary blowouts) of dunes with dense dune scrub, are likely to cause long-term shifts in the distribution and abundance of *Chorizanthe* populations within dune systems in the long term.

Low-growing dune scrub species associated with *Gilia tenuiflora* ssp. *arenaria* are silver beach lupine (*Lupinus chamissonis*), *Phacelia distans*, *Amsinckia spectabilis*, beach sagewort, mock heather, and coast buckwheat, and low-growing herbs such as *Camissonia contorta*, *C. micrantha*, *C. cheiranthifolia*, *Linaria canadensis*, *Crassula connata* and several species of *Chorizanthe*. Within the open, sparsely vegetated dunes, associated species include Monterey spineflower, dune knotweed, slender fescue (*Vulpia octoflora*), blue toadflax (*Linaria canadensis*), and popcorn-flower (*Cryptantha leiocarpa*).

4. Life History/Ecology

The species is thought to be primarily self-pollinating based on its stamens not protruding from the flower, no observations of pollinators, and very viable seed (Dorrell-Canepa, *in litt.*, 1995). Dorrell-Canepa (1994) has studied the ecology and growth of this species. She found that seeds, in the field, germinate from December to February, and fruit is set from the end of April to the end of May. The species appears to produce viable seed even

at very small statures. Seeds are dispersed by wind throughout the dune openings; dispersal, however, is inhibited by dense stands of low-growing dune scrub.

Rabbit herbivory significantly affected the survival of young seedlings and adult plants. Mice or voles may also graze the species, but if the basal rosette is not entirely taken, the plant often recovers and sets seeds. In 1995 after heavy rains, herbivory was severe enough that many plants did not grow back (Dorrell-Canepa, *in litt.*, 1995).

5. Reason for Listing

Gilia tenuiflora ssp. *arenaria* is a Monterey County endemic species, restricted to the coastal dune scrub community of the Monterey Bay dunes and the Asilomar dunes of the Monterey Peninsula. Overall, the species is threatened by the degradation of suitable habitat from encroachment of invasive, non-native plant species, trampling by equestrians and pedestrians, as well as habitat removal for commercial and/or residential development. ORV activities have historically degraded habitat for the species.

The occurrences along the Monterey Bay dunes are on both private and public land. The Naval Postgraduate School dunes occurrence is threatened by trampling, and by the invasion of non-native species such as iceplant and ripgut brome (*Bromus diandrus*). The occurrence on Tioga Avenue in Sand City is threatened by iceplant invasion, commercial activity, and proposals for residential development in the dunes (C. Roye, *in litt.*, 1996). The Salinas River State Beach occurrence is threatened by invasion of iceplant and sand burial. The proximity of the Marina State Beach occurrence to the parking and horse staging area makes it susceptible to trampling from pedestrians and equestrians. The occurrence on RMC Lonestar Cement Co. property is threatened by sand mining. The inland dune occurrences are threatened by development and invasive, non-native species. Monterey Peninsula occurrences have been adversely affected by golf course development, non-native species, and trampling by pedestrians.

6. Conservation Measures

For known occurrences of *Gilia tenuiflora* ssp. *arenaria* (Table 8) on lands within the jurisdiction of the County of Monterey, Policy 2.3 of the North County Land Use Plan (LUP), relating to environmentally sensitive habitats, is applicable. The Monterey

County LUP policies allow only resource-dependent uses in habitats known to support rare and endangered species. The LUP also recognizes dune habitat as environmentally sensitive, with or without listed species. Resource-dependent uses are allowed with environmentally sensitive habitat if they do not significantly disrupt habitat values. Land uses adjacent to locations of environmentally sensitive habitats should be compatible within the long-term maintenance of the resource. For proposed land divisions or developments, the County requires the protection of environmentally sensitive habitat through deed restrictions or dedications of permanent conservation easements. Where development has already occurred in areas supporting rare and endangered species, property owners should be contacted and encouraged to voluntarily establish conservation easements, deed restrictions, or utilize other measures to protect these species and their habitats.

For occurrences of *Gilia tenuiflora* ssp. *arenaria* (Table 8) on lands in the City of Marina, implementation of the City's LUP will protect and restore native dune habitat and vegetation, and the habitat of recognized rare and endangered species. The City's policies specify that primary habitat areas for sensitive species be protected and preserved. Development within secondary or support habitat areas is allowed, so long as it does not significantly impact primary habitat areas. Where development is proposed on parcels containing rare and endangered species, parcel owners are required to develop and execute a management plan to protect the identified plant species. The City has recently completed the Coastal/Vernal Ponds Comprehensive Management Plan that identifies habitat for *Gilia tenuiflora* ssp. *arenaria* on lands owned by California DPR as part of Marina State Beach (Table 8). The plan recommends management actions to protect the rare plant habitat.

Sand City's LUP specifies the intent to protect and preserve endangered species habitat. The City will be developing several small Habitat Conservation Plans (HCPs) for federally-listed animals in part of its planning area. The HCPs will protect small areas of occupied habitat for *Chorizanthe pungens* var. *pungens* and *Gilia tenuiflora* ssp. *arenaria*.

The California DPR Resource Management Plans for the Monterey Bay area include measures to protect *Gilia tenuiflora* ssp. *arenaria* on State Beaches. Management actions prescribed by the plans are control of invasive, non-native species (non-native grasses and

iceplant), mitigation and monitoring of human use impacts, alteration of visitor use patterns, and restoration of the dunes' native vegetation (Dept. of Parks and Rec. 1991). California DPR's restoration activities at Marina, Asilomar, and Salinas River State Beaches have included fencing and boardwalks to impede trampling by equestrians and hikers, control of invasive non-native plants, and vegetation restoration. Control of iceplant and stabilization of bare dunes with native vegetation has been undertaken by DPR since 1986 (C. Roye, *in litt.*, 1996).

The Navy is undertaking a dune restoration project that will restore native dunes and create native habitats in degraded areas at the Naval Postgraduate School. One of the main objectives of the restoration effort is to eradicate non-native plant species (e.g., iceplant and ripgut brome).

Base closure of Fort Ord has resulted in the transfer of management of some habitat for this species to the BLM, University of California, and the California DPR to be managed as open space. Approximately 73 percent of the known habitat for *Gilia* on the former base will be protected. A *Gilia* restoration plan has been prepared by DPR to increase the Fort Ord coastal occurrence by 14,000 to 18,000 individuals as part of an effort to restore 700 acres of coastal dune habitat (C. Roye, *in litt.*, 1996).

Numerous research studies are ongoing or have been completed for *Gilia tenuiflora* ssp. *arenaria*. Dorrell-Canepa (1994) has studied the survival of seeds directly planted in dunes versus outplanting of greenhouse-raised seedlings. She found that greenhouse germination was almost 100 percent, compared with 6 –15 percent of seed sown in dunes. She attributed the low field germination rates to variability in rain. Seeds have been collected for seed banking by the Rancho Santa Ana Botanic Garden and individuals conducting research or restoration. An experimental revegetation site at Spanish Bay golf course had an introduced occurrence of this species (occurrence number 11), which has since been extirpated. The experiment was not successful and no plants are present at that site.

F. *LAYIA CARNOSA* (Beach layia)

(Recovery Priority Number – 8)

1. Description

In 1841, Thomas Nuttall described this species as *Madaroglossa carnososa* based on specimens he collected in 1835. In 1843, John Torrey and Asa Gray transferred this species to the genus *Layia*. In 1892, Edward Greene transferred it to the genus *Blepharipappus*. However, subsequent taxonomic considerations of this species agreed with Torrey and Gray (Munz and Keck 1959; Ferris 1960).

Layia carnososa is a succulent annual herb, less than 15 centimeters (less than 6 inches) tall, belonging to the sunflower family (Asteraceae)(Figure 8). This plant can be unbranched to highly branched, spreading to more than 4 decimeters (16 inches) across. Several characteristics distinguish *L. carnososa* from other similar species: fleshy leaves, inconspicuous flower heads with short 2–4 millimeter (0.08–0.1 inch) white ray flowers and yellow disk flowers, and bristles around the top of the one-seeded dry fruit (achene).

2. Distribution

Until recent surveys, 17 occurrences of *Layia carnososa* had been found in 7 dune systems from Santa Barbara County to Humboldt County. It is rather certain that some occurrences were extirpated or reduced in size before they could be surveyed. Today, this species is known from 19 extant occurrences with 300,000 individuals. Extant occurrences are summarized in Table 9 (please refer to the introduction of the plan to interpret the numbers). Five of the historical occurrences in San Francisco, Monterey and Humboldt counties are thought to be extirpated.

The largest occurrences are in Humboldt County. Three of the historic Humboldt County occurrences were on the Samoa Peninsula in the Humboldt Bay dune system; two of them have been extirpated. The extirpated occurrences were in the Little River area of Humboldt County; the northernmost occurrence was probably removed when the river mouth naturally meandered north, eliminating the dune flora that was collected by Joseph Tracy in the early 20th century (occurrence number 14). The second extirpated occurrence (occurrence number 15) was lost to construction of Highway 101 and invasion of non-native plant species in the 1960's. Other Humboldt occurrences include one

associated with dunes at the mouth of McNutt Gulch, and one in dunes south of the Mattole River.

The Marin County occurrences occur in the dunes between Kehoe Beach Dunes and Point Reyes lighthouse at Point Reyes National Seashore. Surveys by CNPS volunteers have recorded thirteen colonies along the dune complex at PRNS (Norris, *in litt.*, 1994).

The San Francisco Peninsula occurrence occurred on the dune habitat in Golden Gate Park. Last collected from that area in 1904, the species has been extirpated from this intensely surveyed area, probably because dunes (except for small remnants) were developed for Golden Gate Park and urbanization of San Francisco. At the time of the last collection, San Francisco dune reclamation projects had been in progress over square miles of dunes for more than 30 years, so it is possible that other localities were eliminated without detection.

The Monterey Peninsula dune system had four occurrences, although the Point Pinos site, the type locality, is thought to have been extirpated. After it had been reported to be extirpated, an occurrence at Asilomar State Beach was rediscovered following the removal of iceplant. Additional occurrences have been discovered on neighboring private property (C. Roye, *in litt.*, 1996). Two beach layia occurrences exist on north Spyglass Hill and on the nearby Spyglass Hill dunes.

In April 1995, David Keil rediscovered a small occurrence (80 plants) of *L. carnosa* on Vandenberg Air Force Base (VAFB), Santa Barbara County (David Keil, Curator, Robert Hoover Herbarium, *pers. comm.*, 1995). During a subsequent visit to the site an additional 200 individuals were discovered closer to the ocean bluffs.

3. Habitat/Ecosystem

The species is restricted openings in coastal sand dunes ranging in elevation from 0–30 meters (0–100 feet), where it colonizes sparsely vegetated, partially stabilized dunes or relatively bare blowouts in secondary succession. In northern California, it occurs in the northern foredune community; in Monterey County, the species occurs in the central foredune community described as the sand-verbena – beach bursage series by Sawyer and Keeler-Wolf. It generally occupies sparsely vegetated open areas on semi-stabilized

dunes. The foredune community experiences some drifting sand and has low-growing herbaceous and perennial native species. The species also occurs in open areas, such as along trails and roads.

The cover of associated vegetation protects the species from sand dune movement and erosion. Associated species include coast buckwheat, beach pea (*Lathyrus littoralis*), beach sagewort, dune bluegrass, dune goldenrod, sand verbena, and beach-bur.

4. Life History/Ecology

This winter annual germinates during the rainy season from fall to mid-winter, blooms in spring (April to June), and completes its life cycle before the dry season. It tends to grow in patches, and occurrence numbers vary annually, both spatially and temporally (Botanica Northwest Associates 1992). Colonies often occur where sparse, open vegetation traps wind-dispersed seeds, but causes minimal shading.

The number of seed-heads on individual plants varies with plant size, ranging from unbranched, short, erect plants on dry, exposed sites with a single head to highly-branched plants in moist hollows in dunes with over 100 heads. Seeds are dispersed by wind mostly during late spring and summer months. Nothing is known about the pollination ecology of *Layia carnosa* (Bruce Baldwin, Curator of the Jepson Herbarium, *pers. comm.*, 1995). Populations of *Layia carnosa* are subject to large fluctuations in size and dynamic changes in local distribution, consistent with the shifts in dune blowouts, remobilization, and natural dune stabilization that occur in the coastal dune ecosystem.

5. Reasons for Listing

The threats to *Layia carnosa* are displacement by invasive, non-native vegetation, recreational uses such as ORV activities and pedestrians, and urban development.

In Humboldt County, *Layia carnosa* is threatened by invasive non-native species that were used to stabilize dunes, including yellow bush lupine, European beachgrass, and iceplant. Occurrences on the Samoa Peninsula are also threatened by industrial development and ORV activity. The recent resurgence of ORV trespass resulting from inadequate enforcement of existing ordinances is a serious problem. Recovery may not

be feasible without adequate funding to enforce laws designed to protect sensitive resource areas in the dune systems. The problem is magnified by the fact that a private ORV club is located between BLM and Fish and Wildlife Service properties in the most ecologically valuable habitat on the north spit. Dispersal of invasive plants mentioned earlier as well as pampas grass (*Cortaderia jubata*) is occurring onto adjacent managed lands (A. Pickart *in litt.* 1997).

The occurrence in the Kings Range National Conservation Area is managed by the BLM. This occurrence was threatened by ORV use and cattle grazing, but is now protected by newly reconstructed fencing and strict conditions on grazing.

The Mattole River occurrence is on private land north of the river, and is threatened by cattle grazing and displacement by European beachgrass.

Marin County occurrences are primarily threatened by invasion of European beachgrass, and to a lesser extent, iceplant. They are affected to a small extent by grazing from deer, hares, and rabbits. Cattle grazing is not an impact in the Abbotts-Kehoe area.

Monterey County occurrences have low numbers of individuals and are threatened primarily by invasive non-native plants and encroaching development. The threats are similar to those facing *Chorizanthe pungens* (p. 21).

The Santa Barbara County occurrence is adjacent to a road on Vandenberg AFB. The primary threats to this species are construction and road maintenance including installation of a pipeline, road paving, and controlling vegetation by mowing and spraying with herbicides. During road maintenance operations in 1997 half of the rediscovered site was destroyed.

6. Conservation Measures

Layia carnosa, or beach layia, was State listed as endangered in 1991. For known occurrences of *Layia carnosa* (Table 9) on lands within Monterey County jurisdiction, Policy 2.3 of the North County Land Use Plan (LUP), relating to environmentally sensitive habitats, is applicable. The Monterey County LUP has established policies allowing only resource-dependent uses in habitats known to support rare and endangered

species. The LUP also recognizes dune habitat, as environmentally sensitive, with or without rare and endangered species. Resource-dependent uses are allowed in environmentally sensitive habitat if they do not significantly disrupt habitat values. Land uses adjacent to locations of environmentally sensitive habitats should be compatible with the long-term maintenance of the resource. For proposed land divisions or developments, the County requires the protection of environmentally sensitive habitat through deed restrictions or dedications of permanent conservation easements.

As part of the Marin County-wide Plan, conservation zones and subzones have been established for coastal areas that include occurrences of *Layia carnosa* (Table 9). Conservation zones are subject to a development review checklist that requires conservation measures, such as clustered development, dedicated open space easements and undeveloped greenbelt areas. The National Park Service has an ongoing effort to control exotic species. Continued efforts to manage non-native weeds will be essential for the protection of this species.

For occurrences of *Layia carnosa* on lands in Humboldt County (Table 9), the County and City of Eureka have several policies relating to the protection of sensitive resources. The Humboldt County Local Coastal Program prohibits vehicles above the wave slope except in the Samoa Dunes Recreational Area. The County has recently adopted a management plan for the north and south spits of Humboldt Bay. The north spit area supports *Erysimum menziesii* ssp. *eurekense* and *Layia carnosa*. The plan designates certain areas for vehicular access on the beach and dunes as well as vehicle-free zones. This plan addresses access on public lands as well as access to/from adjacent BLM lands, private lands and the Lanphere Dunes. The plan recommends management to restore degraded dunes, including removal of invasive, non-native plant species, fencing of rare plant habitat and limiting public access.

In Humboldt County, the Lanphere Dunes is fenced and patrolled to control trespass by ORV users. TNC has conducted native plant restoration activities on the North Spit of Humboldt Bay. Exotic plant removal in the dunes has resulted in colonization of the openings by *Layia carnosa*.

One occurrence on the Samoa Peninsula occurs on land managed by the BLM and the City of Eureka. BLM manages the property and has fenced an area for the protection of

Layia carnosa. Degradation of habitat continues on the adjacent City of Eureka land. Although the City has zoned the site as a mitigation bank, protective measures have not been implemented. The BLM has an extensive occurrence on its Manila Dunes ACEC and RNA and has funded weed control through its Partners Against Weeds Initiative (J. Wheeler, *in litt.* 1997). Continued financial support for dune restoration will be needed to recover the species.

Various individuals have collected seed under the authority of a Memorandum of Agreement with the California Department of Fish and Game (CDFG). The Pebble Beach Company collected achenes from the *Layia carnosa* occurrence on its land. The achenes were sent to the State Endangered Plant Program for banking some years ago but the collecting and outplanting has ceased (B. Lopez, Pebble Beach Co., *pers. comm.* 1995). The seeds sent to the Endangered Plant Program (now the Plant Conservation Program) were transmitted to the Rancho Santa Ana Botanic Garden for long-term storage in 1990. Leslie Gottlieb, Professor of Genetics at the University of California, Davis, has collected achenes for research that to date focuses on the study of gene duplications.

G. *LUPINUS TIDESTROMII* (Tidestrom's lupine)

(Recovery Priority Number – 5)

1. Description

Lupinus tidestromii (Tidestrom's lupine) was described by Edward Greene in 1895 from an 1893 collection made by Ivar Tidestrom on the Monterey Peninsula. In 1938, Alice Eastwood described a similar lupine from Point Reyes (*L. layneae*). Philip Munz (1958) later recognized the Point Reyes plants as a variety of *L. tidestromii*, and called them *L. tidestromii* var. *layneae* to separate them from the Monterey Peninsula plants. The recent treatment by Rhonda Riggins and Teresa Sholars suggested that *L. tidestromii* exists as a single, variable species (Riggins and Sholars 1993).

Lupinus tidestromii, a member of the pea family (Fabaceae), is a creeping perennial herb, 1–3 decimeters (4–12 inches) tall (Figure 10). The above-ground parts are herbaceous. The technical description of the roots indicate that they are bright yellow but observers have not noted this characteristic from the northern plants. The narrow leaves have 3–5

leaflets, each 5–20 millimeter (0.2–0.8 inch) long, and arranged in a fan shape. The stems and leaves have short hairs. The inflorescence stems are 4–8 centimeters (1.6–3.1 inches) long, and the whorls of flowers are blue to lavender. The fruits are pods containing 5–8 seeds with blackish spots. The prostrate habit, number of leaflets (mostly 3), and small leaflet size, 1.3–2 centimeters (0.5–0.8 inch) long, and dense hairs on the foliage distinguish *L. tidestromii* from other lupines occurring in the area.

2. Distribution

Lupinus tidestromii occurs in two disjunct areas: the Monterey Peninsula in Monterey County, and northwest Marin county to the Russian River, Sonoma County (Map 1) (please refer to the introduction of the plan to interpret the numbers). Clark and Fellers (1986) identified 3 occurrences of this species in PRNS, extending from Abbotts Lagoon to Point Reyes Test Station. Field studies by CNPS have expanded the known limits of the 3 occurrences to include seven colonies in the dunes of Point Reyes (Soost, *in litt.*, 1996). The southernmost occurrence is located at Pebble Beach in Monterey County. The NDDDB occurrence number 11 is a transplanted occurrence which was part of a dune created as mitigation for golf course construction. This species is known from 19 extant occurrences with 433 individuals.

3. Habitat/Ecosystem

Lupinus tidestromii occurs on partially stabilized coastal dunes up to about 8 meters (25 feet) high. Several occurrences on the Monterey Peninsula are on remnant dunes in the yards of private residences. It occurs in the mild maritime climate of the central California coast and grows in coastal dune communities in association with Menzies' wallflower, sand gilia, beach evening-primrose, beach-bur, beach sagewort, sand verbena, and mock heather.

4. Life History/Ecology

L. tidestromii is a perennial, polycarpic (flowering more than once) herb. The life history of *Lupinus tidestromii* is largely unknown or the information is unpublished. Flowering occurs from May through June. *L. tidestromii* is probably pollinated by bees (Moldenke 1976). Within populations, plants exhibit highly congested distributions. Most lupine

seeds for all 5 coastal species can be found littered at the plant base. This and large seed size is consistent with localized limited dispersal, and limited long-distance dispersal by abiotic factors. Seeds of *Lupinus* are generally long lived and probably forms a persistent dormant seed bank. For seeds to germinate under natural conditions, the seed coat probably must be degraded (although not necessarily scarified, as by “sandblasting” by windblown sand). *Lupinus tidestromii* grows in stable to slightly mobile dunes, far from “sandblasting” habitats, so very slow microbial decomposition of seed coats of long-lived seeds is the more likely route to germination. This is not a species of accreting foredunes, and it has very low burial tolerance compared with larger dune plants of the pea family (e.g., *Lupinus chamissonis* and *Lathyrus littoralis*, which grow in highly mobile dunes). As a result, *Lupinus tidestromii* is confined to the vast stable deflation plains next to southern Abbotts Lagoon.

Reasons for Listing

The major threats to *Lupinus tidestromii* included invasion by non-native plants, such as iceplant and European beachgrass and loss of habitat due to development and trampling by hikers and equestrians. Livestock grazing may have been a threat in the past, but the only population grazed by livestock in recent years was a small one at Dillon Beach, which is probably extirpated. Two occurrences on the Monterey Peninsula were eliminated by construction of a golf course. Other occurrences on privately owned sites in Monterey are potentially threatened by residential and recreational development. At the time of listing the occurrences in Asilomar State Park and PRNS were subject to trampling by hikers, a problem now corrected by controlled pedestrian routes. Additionally, cattle grazing on the dune system near Dillon Beach presents a potential threat of trampling to this species.

6. Conservation Measures

For known occurrences of *Lupinus tidestromii* (Table 10) on lands within Monterey County jurisdiction, Policy 2.3 of the North County Land Use Plan (LUP), relating to environmentally sensitive habitats, is applicable. The Monterey County LUP has established policies allowing for only resource-dependent uses in habitats known to support rare and endangered species. The LUP also recognizes dune habitat, with or

without rare and endangered species, as environmentally sensitive. Resource-dependent uses are allowed within environmentally sensitive habitat if they do not significantly disrupt habitat values. Land uses next to locations of environmentally sensitive habitats should be compatible with the long-term maintenance of the resource. For proposed land divisions or developments, the County requires the protection of environmentally sensitive habitat through deed restrictions or dedications of permanent conservation easements.

As part of the Marin County Wide Plan, conservation zones and subzones have been established for coastal areas that include habitat for *Lupinus tidestromii* (Table 10). Currently, only one occurrence is known to occur within the jurisdiction of the County and it is reported to have been affected by camping and cattle grazing (Soost, *in litt.*, 1996). The most viable occurrences occur in Point Reyes National Seashore.

Asilomar State Beach has developed a management plan for dune enhancement. This plan proposes restoration of native dune vegetation, control of invasive, non-native species, monitoring and mitigation of human-use impacts, and changing visitor use patterns. Boardwalks have been constructed to direct visitors away from sensitive dune areas and allow beach access while minimizing trampling of dune vegetation (C. Roye, *in litt.*, 1996).

The Pebble Beach Company set aside an 8.1-hectare (20-acre) preserve as mitigation for loss of sensitive species during the construction of the Spanish Bay Golf Course. *Lupinus tidestromii* was one of the species transplanted to the site in 1987, and monitoring is continuing.

At the time of writing (summer 1998), legislation was moving through Congress to acquire agricultural easements and development rights for three parcels totaling 550 acres of the Dillon Beach dune systems. This would benefit *Lupinus tidestromii* and other species of concern.

H. MYRTLE'S SILVERSPOT BUTTERFLY (*Speyeria zerene myrtleae*)

(Recovery Priority Number – 9)

1. Description

The Myrtle's silverspot butterfly (*Speyeria zerene myrtleae*) is a member of the brush-footed family (Nymphalidae). Cyril dos Passos and L. Paul Grey (1945) described the taxon based on specimens collected by W. F. Breeze on July 27, 1917, in San Mateo, California (many modern authorities believe that the original locality label referred to San Mateo County, probably the western coast, rather than the City of San Mateo on the Bay). Butterflies in the genus *Speyeria* are commonly known as silverspots or fritillaries. Myrtle's silverspot is one of three related coastal subspecies of *Speyeria zerene* that occur from Washington to California — the Oregon silverspot (*Speyeria zerene hippolyta*), Behrens' silverspot (*Speyeria zerene behrensi*), and Myrtle's silverspot. All three occupy restricted habitat types close to the coast, have been seriously impacted by human activities (Hammond and McCorkle 1983, Schaeffer and Kiser 1994), and are federally listed as threatened or endangered species.

Myrtle's silverspot is a medium-sized butterfly with a wingspan averaging 55–60 millimeters (2.1–2.3 inches) (Figure 11). The upper sides of the fore and hind wing surfaces are golden brown to fulvous with many conspicuous black spots, lines, and other markings, sometimes with a greenish tinge basally. The undersides are light tan, reddish brown, and brown with black lines and distinctive silver spots and black spots. The base of the wings and the body are densely covered with hairs (Howe 1975, Scott 1986).

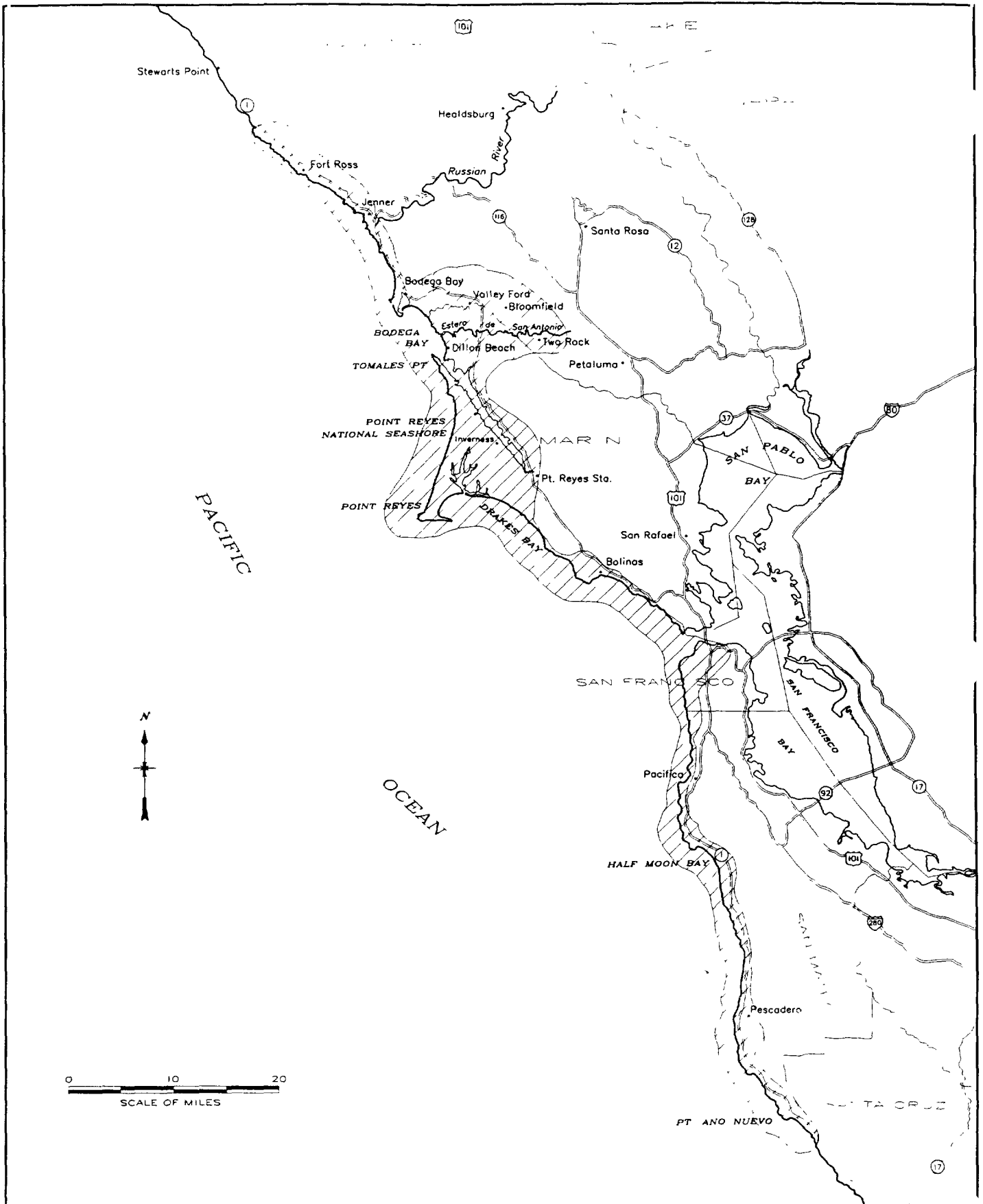
Overall, Myrtle's silverspot is similar in size and appearance to Behrens' silverspot, but can be distinguished by its discal area (center of the underside of the hind wing) that is reddish-brown with yellowish-green overscaling, and its submarginal band that is bright yellow (Howe 1975). Behrens' silverspot is endemic to the Point Arena area over 80 kilometers (50 miles) to the north. Figure 11 shows a black-and-white rendering of color illustrations published in Howe (1975) of male and female Myrtle's silverspot, with the underside of the wing on the right. Scott (1986) also published color illustrations of this species. Butterflies at Point Reyes National Seashore may vary from the original description of Myrtle's silverspot (Fellers, *in litt.* 1996), which was based entirely on seven specimens from south of the Golden Gate Bridge.

The life history of the threatened Oregon silverspot butterfly, a closely related subspecies, was described by McCorkle and Hammond (1988). Mattoon *et al.* (1971) provided additional information on the life history of silverspot butterflies. A general description of the larvae and pupae of the Oregon silverspot butterfly is given by McCorkle and Hammond (1988). The morphology and biology of the early stages of Myrtle's silverspot butterfly are probably similar to this taxon.

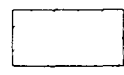
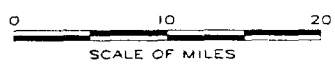
2. Distribution

Myrtle's silverspot occupies the southernmost range of all the coastal *Zerene* silverspot butterflies. The approximate historic range of Myrtle's silverspot is shown in Map 3. The butterfly was recorded from coastal San Mateo County as far south as Pescadero (in 1950), north to the vicinity of Black Point in northern Sonoma County. There were only ten specimens collected south of the Golden Gate (G. Pratt, *pers. comm.* 1998). Other historical records of Myrtle's silverspot are known from Inverness and Point Reyes Station in Marin County; and in Sonoma County from near Bodega Bay, Coleman Valley Road (two sites), Jenner, Fort Ross, Bloomfield (the most inland site), and Valley Ford (information from the "BUGGY" database, maintained by Richard A. Arnold, Ph.D., Entomological Consulting Services, Ltd.). Butterflies that are intermediate in appearance between "typical" Myrtle's and Behrens' silverspots have been observed north of Jenner and south of Stewart's Point, including the Fort Ross area, and the Jenner area population is sometimes considered to have had some characteristics similar to Behrens' silverspots (Launer *et al.* 1992). The current status of populations north of the Jenner area is unknown. A *Speyeria zerene* population of uncertain taxonomic status, but with affinities to Myrtle's silverspot, occurs in the vicinity of Sears Point, Sonoma County.

By the late 1970s, populations of Myrtle's silverspot south of the Golden Gate Bridge were believed to be extinct and extant populations were known only from Marin County at the PRNS. In 1990, an additional population was discovered at a site in coastal Marin County (Arnold 1990), near Estero de San Antonio, on property proposed for golf resort and residential development (Murphy and Launer 1991). This discovery led to more surveys of the current and historical range of Myrtle's silverspot butterfly. The proposal for the golf course was withdrawn and later replaced with a proposal for low density residential development and open space at the same site.



PACIFIC OCEAN



Approximate Historic Distribution of
Myrtle's Silverspot Butterfly

MAP 3

The Center for Conservation Biology (CCB) at Stanford University undertook field studies from 1991 through 1993. Results of these studies were published in 1994 in a back-dated journal volume (Launer *et al.* 1992). Myrtle's silverspots were observed at several sites from 1991-93, including PRNS and both north and south of the Estero de San Antonio in Marin County, and east of the town of Bodega Bay in Sonoma County. Other lands in the region that may have suitable habitat have not been censused (Launer *et al.* 1992).

The CCB studies cited above included a mark/recapture program to estimate the number of butterflies, although because of low recapture rates the resulting figures must be considered rough. At the private site in coastal Marin, the number of Myrtle's silverspots was estimated to be between 2,500 and 5,000 adults in 1991. Two apparently separate populations in PRNS were estimated at less than 5,000 individuals and several hundred individuals, respectively, in 1993 (Launer *et al.* 1992). In summary, this butterfly is currently known from 3 occurrences, with a probable total of fewer than 10,000 individuals. Population sizes can be expected to fluctuate drastically (see the section below).

3. Habitat/Ecosystem

Myrtle's silverspot inhabits coastal dunes, coastal prairie, and coastal scrub at elevations ranging from sea level to 300 meters (1,000 feet), and as far as 5 kilometers (3 miles) inland (Launer *et al.* 1992). The adult butterflies prefer areas protected from onshore winds, but can be observed in exposed areas when winds are calm. Temperatures in this region are moderated by fog, which keeps summers relatively cool and winters relatively warm compared to inland habitats. The fog also provides moisture to vegetation, in addition to the ample winter rains.

Critical factors in the distribution of the Myrtle's silverspot include presence of the presumed larval host plant, *Viola adunca* (western dog violet), and availability of nectar sources for adults. Although alternate larval host plants have neither been confirmed nor ruled out for the Myrtle's silverspot, other subspecies of *Speyeria zerene* and other species of *Speyeria* can feed on more than one species in the genus *Viola* (Scott 1986). Seeds of *Viola* are often dispersed by ants (McCorkle 1980, Little 1993). Violets sometimes bear self-pollinating flowers, and are also cross-pollinated by insects.

Selection of habitat for oviposition (egg-laying) has been observed in the Oregon silverspot (McIver et al. 1990). Gravid (fertilized egg-bearing) females were attracted to areas of low vegetation height (38 centimeters [15 inches] or less), where they would sometimes perform a searching flight characterized by low hovering or dipping. Females flew past areas with deep thatch (covered by plant litter). They were more likely to land and perform a walking search and more likely to lay eggs in areas with higher violet density and cover. However, other, unknown factors must also affect the selection of oviposition sites, since some portions of the study sites with low vegetation height and high violet cover were used less frequently than expected. McIver et al. (1990) therefore suggested that managing for violet density alone would not necessarily enhance silverspot oviposition.

Much of the coastal prairie in this species' range has been grazed for over a century, and is now characterized by a mixture of non-native annuals and forbs and native prairie plants. In the upland grasslands, this butterfly has been observed obtaining nectar from non-native species such as bull thistle (*Cirsium vulgare*) and rarely Italian thistle (*Carduus pycnocephalus*) (Arnold 1990, Murphy and Launer 1991, A. Launer *pers. comm.* 1998). In dune scrub habitat, these butterflies seek nectar from several native species such as gum plant (*Grindelia* sp.), western pennyroyal (*Monardella undulata*), yellow sand verbena (*Abronia latifolia*), seaside daisy (*Erigeron glaucus*), and mule ears (*Wyethia* sp.). Other flowers might serve as good nectar sources for the opportunistic adults, such as brownie thistle (*Cirsium quercetorum*) and groundsel (*Senecio* sp.). The related Oregon silverspot has been observed to visit yarrow (*Achillea millefolium*), goldenrod (*Solidago* sp.), beach aster (*Aster chilensis*), rough cat's-ear (*Hypochaeris radicata* — a non-native), and pearly everlasting (*Anaphalis margaritacea*) (McIver et al. 1990). Myrtle's silverspot does not use the flowers of the invasive non-native iceplant (*Mesembryanthemum* sp.) or sea fig (*Carpobrotus* sp.) for nectar (Launer et al. 1992).

4. Life History/Ecology

During the summer flight season, females of Myrtle's silverspot lay their eggs singly on or near dried leaves and stems of violets. Eggs of the closely related Oregon silverspot butterfly are milky white at first, then gradually change to pale yellow, then to brownish-grey or pinkish bronze with pearly longitudinal lines. About five days before hatching,

the head capsule can be seen as a dark purple tip, with the remainder of the egg lightening to white or gray (McIver *et al.* 1990).

Within a few weeks after the eggs are laid (23-29 days for Oregon silverspots: McIver *et al.* 1990), the larvae or caterpillars emerge. These caterpillars, which are less than 5 millimeters (0.2 inches) long, crawl a short distance into the surrounding foliage or litter, and spin a silk pad on which they spend the fall and winter. The fall and winter period of inactivity is a physiological resting state called diapause, during which no feeding occurs. The larvae may be able to extend their diapause for more than one year. Upon termination of diapause in the spring, the caterpillar finds a nearby violet and begins feeding. Feeding is difficult to observe, and apparently occurs at dusk and possibly at night (Launer and Murphy 1993). The larval feeding stage lasts about 7–10 weeks, after which the larvae form their pupal chamber out of leaves spun together with silk.

The adult butterfly emerges from the pupa after about two weeks. Emergence typically occurs from mid-June to mid-July. The timing of adult emergence is probably related to photoperiod and to weather, especially temperature and sunlight, which may result in annual differences in the timing of peak emergence of as much as a few weeks. Although Myrtle's silverspot adults only live for about two to five weeks, because of individual variation in emergence time, the species has a 2- to 3-month flight period, ranging from mid-June to early October (Launer *et al.* 1992). Adult activity is closely tied to weather conditions: they are active during calm weather and inactive during windy periods.

Both sexes are good flyers and can travel kilometers in search of nectar, mates, or violets, although if all these resources are all available in topographically restricted valleys or basins that are sheltered from strong winds, most movements are short (Launer *et al.* 1992). Males emerge earlier than females and patrol widely for females, a behavior that may tend to bias survey counts in their favor. In related species, both sexes produce pheromones that apparently function in mate-finding and courtship (Scott 1986). Males of most *Speyeria* transfer a mating plug at the end of copulation, and most females therefore mate only once (Arnold 1988).

Oregon silverspot females captured and observed in the laboratory have laid up to 200 or more eggs, although the viability of these eggs varies greatly (McCorkle 1980, Arnold 1988). Under laboratory conditions, mated females of *Speyeria mormonia* laid an

average of about 250 eggs over their lifetime (Boggs and Ross 1993), but actual numbers laid in the field may be less (Arnold 1988). Dempster (1983) found that variation in the number of eggs laid was the most important factor influencing butterfly and moth population fluctuations.

Little is known about impacts of disease, parasitism, or predation on Myrtle's silverspots. About 40 percent of 11 Oregon silverspot eggs observed in the field died before hatching, due to predation or disease (McIver et al. 1990). The larvae have spines and an eversible (can be protruded) ventral scent gland (Scott 1986), similar to structures that in other species are used to ward off predators. McCorkle (1980, *in litt.* 1989), McCorkle and Hammond (1988) and Launer and Murphy (1993) consider that silverspot larvae may be vulnerable to predation by ants, ground beetles, spiders, and shrews.

Adult feeding on nectar is very important to the reproduction of the Myrtle's silverspot. In a related species, *Speyeria mormonia*, a strong correlation exists between the amount of nectar consumed by female butterflies and the number of eggs they produce (Boggs and Ross 1993). Males of Myrtle's silverspot also nectar, possibly to fuel their patrolling and mating activities. Ideally, a spectrum of plants that flowers across the flight season of the butterfly is used. Launer *et al.* (1992) suggested that lack of nectar resources, in some cases due to grazing pressures, could be a factor in the regional decline of the Myrtle's silverspot. The reduction in native plant abundance due to invasion by non-native plant species probably also has reduced nectar availability.

Populations of *Speyeria* butterflies are known to exhibit large fluctuations in numbers of individuals, appearing at times to be virtually on the brink of extinction, and then rebounding to substantially higher numbers the following year. Such wide population fluctuations — changing by a factor of 10 or more in a single year — are typical of insects with little overlap among generations, and of annual plants, and stand in contrast to most vertebrate populations. High and variable mortality during the immature life stages, and corresponding high fecundity to counterbalance the high mortality, are characteristic of these organisms (for example, the threatened bay checkerspot butterfly [USFWS 1998]). The annual variability of California climate, even at the relatively moderate, maritime-influenced locations inhabited by the Myrtle's silverspot, contribute to extreme population fluctuations through effects on development, mortality, and fecundity, either directly or mediated through effects on host plant growth and survival.

Myrtle's silverspot butterfly occurs in separate populations whose long-term persistence may depend upon intercolony movement. Habitat degradation resulting in the loss of intervening populations, larval food plants, and adult nectar sources may make movements between populations more difficult.

5. Reasons for Listing

The listing of the Myrtle's silverspot was based on its extirpation from the southern third of its historical range (south of the Golden Gate Bridge) and adverse effects of urban development, invasive non-native vegetation, livestock grazing, and other human influences throughout its range. The coastal San Mateo occurrence was last documented at Pescadero in 1950, and was probably extirpated by loss of habitat to urbanization, agriculture, and invasion of non-native plants. Historical occurrences at Valley Ford and Bloomfield may have been extirpated by farming and grazing pressures and by invasion of non-native plants, although the current status of the butterfly in these areas has not been exhaustively investigated.

Overcollection is a threat to Myrtle's silverspot. Specimens of Myrtle's silverspot butterfly are known to have been illegally collected in Point Reyes National Seashore (C. Nagano and J. Mendoza, both of U.S. Fish and Wildlife Service, pers. obs. 1992–1994; Department of Justice 1993). Although collectors generally do not adversely affect the healthy, well-dispersed populations of many butterfly species, a number of rare species, highly valued by collectors, are vulnerable to extirpation from collecting (C. Nagano and J. Mendoza, pers. obs. 1992–1994). Collection of butterfly species that exist in small colonies or repeated handling and marking (particularly of females and in years of low abundance) can seriously damage populations through loss of individuals and genetic variability (Singer and Wedlake 1981, Gall 1984, Murphy 1988). Collection of females dispersing from a colony also can reduce the probability that new colonies will be founded. Butterfly collectors pose a threat because they may be unable to recognize when they are depleting colonies below the thresholds of survival and recovery, especially when they lack appropriate biological training or the area is visited for a short period of time (Collins and Morris 1985). Furthermore, collectors who take every specimen they can find on successive days could easily eliminate populations of some species in just a few years, as they reportedly have with Mitchell's satyr butterfly (*Neonympha mitchelli mitchelli*) (USFWS 1991).

Inadequate nectar resources appear to be an ongoing problem for several Myrtle's silverspot populations. Butterflies without adequate nearby nectar plants may be forced to expend time and energy reserves searching for nectaring areas, reducing the number of fertilized eggs laid, and at the same time exposing them to predation, winds, and road mortality. Overgrazing of properties within the range of Myrtle's silverspot may have reduced the abundance of native nectar sources, and could be contributing to the regional decline of this species (Launer *et al.* 1992). The reduction in native nectar sources may have been offset, at least partially, by the silverspot's use of non-native thistles as nectar sources. Prolonged, intensive grazing disturbance reduces the vigor of native plant species and disturbs the site, allowing the establishment of invasive non-native weedy plant species. One such weed is the invasive, non-native iceplant, a competitive threat to several native plant species that provide this butterfly with nectar. This plant and other non-native grasses and forbs have undoubtedly displaced larval and adult food plants of the silverspot and contributed to overall degradation of habitat quality.

6. Conservation Measures

Substantial areas of habitat and potential habitat for Myrtle's silverspot are conferred a degree of long-term protection at the Point Reyes National Seashore. The Seashore has conducted or commissioned a number of studies of the status and biology of the butterfly, and the recent management plan for the Tule Elk Range in the Seashore contains provisions to assess elk grazing effects on butterfly habitat.

7. Recovery Strategy

The recovery strategy for the Myrtle's silverspot butterfly includes the following measures:

- 1) protect habitat where remaining populations occur
- 2) identify and establish vegetation management that benefits the native ecosystem of larval host plants and adult nectar sources
- 3) re-introduce populations of the butterfly to prioritized areas
- 4) control illegal collecting
- 5) conduct or fund research to identify critical recovery needs or actions
- 6) monitor existing populations and survey historic and unsurveyed locations

Habitat protection will be essential to Myrtle's silverspot butterfly recovery. Two populations of the Myrtle's silverspot are protected at Point Reyes National Seashore, but the Seashore does not yet have a management plan for the butterfly. Under the agreement that established the Seashore, much of its area is leased for grazing, mostly by cattle. Tule elk have been reintroduced to the peninsula and are confined to a limited area, separate from cattle. Controlled burns are conducted on about 40 to 80 hectares (100 to 200 acres) of the park annually, with an eventual target of burning up to 400 hectares (1000 acres) or more per year. The areas burned are largely outside the known occurrences of the butterfly in the Seashore. In 1995, despite control efforts, a substantial fraction of the Seashore burned in an unplanned fire called the "Vision" fire. This fire did not burn any areas known to support the butterfly, and to date no butterflies are known to have moved into the burned area (G. Fellers, *pers. comm.* 1998).

The third known existing population of the butterfly is on private land, some of which is currently proposed for development. Conserving this population will require protection of a substantial area of land with suitable habitat elements. Habitat protection should include buffer zones and dispersal corridors as necessary. Because controlled grazing practices appear to be consistent with conservation of the Myrtle's silverspot, protective measures short of full fee-title land acquisition may be possible. For example, ranchers wishing to preserve their way of life might do so (while contributing to Myrtle's silverspot conservation) by selling development rights on their lands in perpetuity. Grazing may be less compatible with certain rare plants than with the butterfly, however, so such arrangements will have to be approached on a case by case basis.

More needs to be known about vegetation management practices to benefit the Myrtle's silverspot. While heavy grazing is thought to have adverse impacts on nectar plants for the butterfly, and possibly also on the larval host plant *Viola*, complete absence of grazing may also have adverse effects. Heavy growth of non-native grasses and other plants and accumulation of dead plant litter on top of the ground can result in overgrowth or shading of *Viola*. Little is known about how to balance these factors in California coastal prairie or dune scrub. Fire is another vegetation management tool that needs further investigation. A study of Midwestern tallgrass prairie found that populations of three *Speyeria* species were all immediately reduced by fire, but that over the longer term two species benefitted or were unaffected, while the third was depressed (Swengel 1996). The long-term effects of controlled burning on Myrtle's silverspot are unknown.

Vegetation management should initially be approached as an experiment, and tested outside of or on a small fraction of butterfly habitat. Any vegetation management strategy ultimately adopted should be adaptive and should incorporate a variety of approaches simultaneously, to allow for unanticipated or long-term effects as well as environmental extremes.

Certain invasive non-native plants are unambiguously bad for butterfly habitat and should be eradicated or controlled in areas of butterfly habitat. For example, sea fig crowds out all food plants and in some areas may encroach on coastal prairie as well as stabilizing dunes. Beachgrass (*Ammophila* sp.) may reduce habitat quality in some backdune areas. Dune restoration activities, including control of non-native invasive plants, are likely to enhance nectar plants and perhaps larval food plants for Myrtle's silverspot. However, the Myrtle's silverspot lives in an ecosystem that has been greatly changed, perhaps forever, by introduced plants, and certain non-native plants have now taken over vital roles in the butterfly's life cycle. In particular, bull thistle (*Cirsium vulgare*) is an important nectar resource, especially in the late season, and should not be eradicated in the absence of a comparable replacement. A variety of techniques are available for controlling invasive plants, some of which are discussed in previous sections. Use of herbicides in the vicinity of butterfly food plants should be carefully controlled to prevent drift.

Reintroduction of populations is likely to be a useful tool to increase the number of Myrtle's silverspot individuals and populations, and thus reduce extinction risk. Reestablishing Myrtle's silverspot populations should be done in the historic range of the taxon, on protected public lands and private lands with the full permission and cooperation of the landowners. Apparently suitable but unoccupied habitats adequate to support large populations are obvious candidates for reintroduction, as are areas important to the metapopulation dynamics of the species.

One high-priority area of potentially suitable but apparently unoccupied habitat exists around and south of Dillon Beach, extending to south of Tom's Point. Much of this area overlaps or adjoins areas targeted for plant recovery actions in this plan, and could thus serve more than one recovery need. The feasibility of protecting this habitat, restoring habitat if needed, and re-introducing the Myrtle's silverspot butterfly should be investigated with the highest priority. Several other potential sites for reintroduction

exist, and will require further evaluation and prioritization. A partial list of areas to be considered north of the Golden Gate might include unoccupied portions of the Point Reyes Peninsula, coastal portions of Golden Gate National Recreation Area, the Bolinas area, east of Tomales Bay and Bodega Bay area, and points north to Jenner. Areas south of the Golden Gate might include North Baker Beach in the Golden Gate National Recreation Area, Fort Funston, Half Moon Bay, and points south to Año Nuevo State Reserve and vicinity. Initial screening of sites should be followed by seeking protection of sites by availability and priority, restoration of habitat as needed, and reintroductions. Captive rearing of Myrtle's silverspots to produce large numbers for reintroductions may be appropriate.

Collecting endangered species is illegal, and collecting any butterflies is specifically prohibited in the PRNS, providing an additional layer of protection. Controlling illegal collecting outside the Seashore may be best achieved by a public education effort in the northwest Marin/southwest Sonoma area. Any such outreach effort should not mention specific butterfly localities.

The need for new research is implicit in several of the recovery strategies listed above. The Myrtle's silverspot butterfly has been little studied to date, and some work will be essential to making scientifically informed conservation decisions. High priority will be studying vegetation management, including grazing levels and fire. Research on dune and coastal prairie vegetation restoration may be needed to enhance existing populations or to prepare for reintroductions. Basic information about the butterfly, its life history, demography, and ecological interactions is needed to understand the population dynamics of the species and to develop efficient and effective strategies for its recovery.

I. STRATEGY OF RECOVERY FOR THE PLANTS

Because Myrtle's silverspot butterfly has distinct needs, its recovery strategy is discussed separately on page 60

The common threat to all of the plant species in this plan is the displacement of habitat by development and habitat degradation caused by non-native plant species. This has reduced the species' ranges, numbers of populations, and population sizes. The

fundamental strategy for recovery of these species is to protect existing populations and habitat from further losses, restore degraded habitat, and ensure the establishment of larger and more numerous populations over a greater proportion of species' historic ranges. These restored habitats and populations must be assured that their conservation will continue over the long term.

Plant Species

The plant species will be recovered by restoring and protecting dune habitats on which they (and when applicable, their pollinators) depend. Assuring long-term protection of public and privately-owned habitat is essential. Carrying out existing land-use plans will be very important, and habitat conservation plans, as provided for listed animals by the Endangered Species Act, are likely to contribute to long-term habitat protection. Once land is protected, the primary means to accomplish recovery is through an aggressive program to control non-native invasive plant species. Sound, peer reviewed site-specific management plans will be necessary. Long-term commitment of resources by public agencies to management will be essential to the long-term conservation of these species. A certain amount of trial and error (adaptive management) will be needed to ensure that management procedures work as intended. Habitat restoration and protection of existing populations of the existing plants must be conducted as integrated experiments aimed at expanding these plants' populations and ranges. While reintroduction cannot be allowed to substitute for protection of existing populations, it is worth investing in reintroduction experiments because there is ample evidence that plants like the species of *Chorizanthe* are efficient colonists, and *Gilia tenuiflora* spontaneously colonizes recently stabilized dunes. When dune vegetation is restored, "natural" colonization by listed (and other) plants will be effective only when source populations are nearby. When they are not, intervention to accelerate colonization may be justified. The dubious record for reintroductions to date is partly due to lack of replication, use of small sample sizes and small habitat patches, and to lack of experience in dune management, restoration, or reintroduction. This recovery plan encourages managers to gain experience, then to experiment with reintroductions that could accelerate the return of these plants to areas from which they have been extirpated.

Table 2. Summary of Occurrence Data for *Chorizanthe howellii*

Occurrence¹ and Location	Approximate Size (hectares)²	Number of Individuals	Ownership
NDDB No. 1 MacKerricher State Park, Mendocino County	50.6 hectares (125.0 acres)	20,000 (1988) 20 (1993)	MacKerricher State Park, Calif. Dept. of Parks and Recreation (DPR); Private
NDDB No. 3 Ten Mile Dunes, Mendocino County	–	100 (1983)	MacKerricher State Park (DPR)
NDDB No. 4 Inglenook, Mendocino County	–	100 (1983) 3,150+ (1988)	MacKerricher State Park (DPR)
NDDB No. 6 Ten Mile Dunes, Mendocino County	–	350 (1988)	MacKerricher State Park (DPR)
NDDB No. 7 Ten Mile Dunes, Mendocino County	–	210 (1988)	MacKerricher State Park (DPR); Private
NDDB No. 9 South of Fort Bragg	–	– (1958)	Unknown
NDDB No. 10 Mendocino County	–	– (1993)	Private, Grange Hall
(no NDDB No. available) Cleone, Mendocino County	–	100 (1996)	Private, Cleone subdivision
TOTAL	50.6 hectares+ (125.0 acres)	23,800	

¹ Occurrences are identified by the numbers listed in the 1997 California Department of Fish and Game (CDFG) Natural Diversity Data Base (NDDB).

² A dash (–) indicates no data are available at this time.

Table 3. Summary of Occurrence Data for *Chorizanthe pungens* var. *pungens*

Occurrence¹ and Location	Approximate Size (hectares)²	Number of Individuals	Ownership
NDDB No. 3 (NDDB Nos. 11,22, 23) Ft. Ord, Monterey County	–	Herbarium sheets (1919, 1988[2])	to transfer from DOD
NDDB No. 4 Point Pinos, Monterey County	62.3 hectares (153.9 acres)	Herbarium sheet (no date)	Unknown
NDDB No. 5 Cypress Pt., Monterey Co.	–	Herbarium sheet (1940)	Unknown
NDDB No. 6 Arroyo Seco, Monterey Co.	–	Herbarium sheet (1920)	Unknown
NDDB No. 7 Manzanita Park, Monterey County	12.1 hectares (29.9 acres)	Herbarium sheet (1989)	County of Monterey
NDDB No. 8 Naval Postgraduate School, Monterey County	11.3 hectares (27.9 acres)	– (1992)	U.S. Department of Defense (DOD)
NDDB No. 10 Pacific Grove, Monterey County	–	Herbarium sheet (1908)	Unknown
NDDB No. 12 Pajaro River, Monterey County	–	Herbarium sheet (1936)	Unknown
NDDB No. 13 Seaside, Monterey County	–	Herbarium sheet (1950)	Unknown
NDDB No. 14 Watsonville Junction, Monterey County	–	Herbarium sheet (1936)	Unknown
NDDB No. 16 Marina Dunes, Monterey County	4.5 hectares (11.1 acres)	Map (1987)	Private
NDDB No. 17 Marina Dunes, Monterey Co	–	Map 1987)	Private
NDDB No. 18 Marina Dunes, Monterey Co	5.7 hectares (14.1 acres)	Map (1987)	Private

Table 3. Summary of Occurrence Data for *Chorizanthe pungens* var. *pungens* (Cont.)

Occurrence¹ and Location	Approximate Size (hectares)²	Number of Individuals	Ownership
NDDB No. 19 Manresa State Beach, Santa Cruz County	–	50 (1986)	DPR
NDDB No. 20 Castroville, Monterey Co.	–	Herbarium sheet (1929)	Unknown
NDDB No. 21 Moss Landing, Monterey County	23.5 hectares (58.1 acres)	Herbarium sheet (1952)	Unknown
NDDB No. 24 Del Rey Oaks, Monterey County	–	Herbarium sheet (1988)	Unknown
NDDB No. 25 Marina Dunes, Monterey County	–	Map (1987)	Private
NDDB No. 26 San Simeon, San Luis Obispo Co.	–	– (1842)	Unknown
Fort Ord Monterey County	4,224 hectares (10, 456 acres)	14,000,000± (1992)	DOD
Sunset State Beach, Santa Cruz County	10.0 hectares (24.7 acres)	–	DPR
Day Valley, Santa Cruz County	<0.1 hectare (<0.25 acre)	100–1,000 (1994)	Private
Freedom Blvd., Santa Cruz County	2.0 hectares. (4.9 acres)	1,000+ (1994)	Private
East Bellmar Drive, Santa Cruz County	0.1 hectares (0.25 acre)	10,000 (1994)	Private
Cox Road, Santa Cruz County	<0.1 hectares (0.25 acre)	100 (1994)	Private
Marina State Beach, Monterey County	10.0 hectares (24.7 acres)	1,000+ (1994)	Marina State Beach (DPR)
TOTAL	6,402+ hectares. (26,837+ acres)	14,012,000+	

¹ Occurrences are identified by numbers listed in the 1997 CDFG NDDB when available.

² A dash (–) indicates no data are available at this time.

Table 4. Summary of Occurrence Data for *Chorizanthe valida*

Occurrence¹ and Location	Approximate Size (hectares)²	Number of Individuals	Ownership
NDDB No. 1 Russian Colony	–	– (1877)	–
NDDB No. 2 Lunny Pasture/ Abbotts Lagoon, Marin County	1.7 hectares (4.2 acres)	100 (1980) 2,000 (1984) 1,000 (1986) 2,500 (1988) 3,000 (1989) 2,000 (1990) 25,000 (1991) 27,000 (1992) 30,000 (1993) 7570 (1994)	Point Reyes National Seashore (PRNS), National Park Service (NPS)
NDDB No. 4 Sebastopol, Sonoma County	–	–	–
NDDB No. 5 Petaluma, Sonoma County	–	Herbarium label (no date)	–
TOTAL	1.7 hectares (4.2 acres)	30,000(±)	

¹ Occurrences are identified by numbers listed in the 1997 CDFG NDDB.

² A dash (–) indicates no data are available at this time.

Table 5. Summary of Occurrence Data for *Erysimum menziesii* ssp. *menziesii*

Occurrence¹ and Location	Approximate Size (hectares)²	Number of Individuals	Ownership
NDDB No. 1 Pacific Grove, Monterey County	1.9 hectares (4.7 acres)	<100 (1987) 0 (1991) (extirpated)	U.S. Coast Guard, City lease
NDDB No. 4 Ten Mile River, Mendocino County	577.1 hectares (1,425.9 acres)	Large discontinuous population (1993)	Private; (MacKerricher State Park (DPR))
NDDB No. 5 Pudding Creek, Mendocino County	3.7 hectares (9.1 acres)	<50 (1982) 100+ (1994)	Private <i>E. m. menziesii</i> × <i>E. m. concinnum</i>
NDDB No. 7 Asilomar State Park, Monterey County	4.9 hectares (11.6 acres)	<100 (1982)	Asilomar State Park (DPR)
NDDB No. 8 Spyglass Hill, Monterey County	–	<100 (1987)	Private
NDDB No. 35 Point Pinos Lighthouse, Monterey County	–	<20 (1987) (few plants remain)	Private
NDDB No. 37 Signal Hill road., Monterey County	–	–	Private
NDDB No. 38 Bird Rock Road., Monterey County	–	<10 (1988)	Private
NDDB No. 39 Virgin Creek, Sonoma County	2.8 hectares (6.9 acres)	>100 (1990)	MacKerricher State Park (DPR), pvt.
NDDB No. 40 Spanish Bay Golf Course, Monterey County	7.7 hectares (19.0 acres)	Unsuccessful outplanting (1987)	Private: restoration site in golf course (Pebble Beach)
TOTAL	598.1+ hectares (1,477.9+ acres)	600+	

¹ Occurrences are identified by numbers listed in the 1994 CDFG NDDB.

² A dash (–) indicates no data are available at this time.

Table 6. Summary of Occurrence Data for *Erysimum menziesii* ssp. *eurekaense*

Occurrence¹ and Location	Approximate Size (hectares)²	Number of Individuals	Ownership
NDDB No. 1 Lanphere Dunes Humboldt County	20.3 hectares (50.2 acres)	>6,000 (1988)	U.S. Fish and Wildlife Service
NDDB No. 2 NW of Mad River Slough, Humboldt County	18.5 hectares (45.7 acres)	500 (1988)	Bureau of Land Management (BLM); Louisiana Pacific; Private
NDDB No. 3 North of Manila, Samoa Peninsula, Humboldt County	5.0 hectares (12.4 acres)	136 (1988)	Private
NDDB No. 4 Coast Guard Station, Samoa Peninsula, Humboldt County	262.9 hectares (649.6 acres)	12,000 (1988)	BLM; City of Eureka; Private; U.S. Coast Guard
NDDB No. 5 South Spit, Humboldt Bay, Humboldt County	—	178 (1991) 75? (1998)	Private (Texaco; Pacific Lumber Company)
NDDB No. 6 Manila, Humboldt County	4.6 acres	39 (1995)	Private
TOTAL	904.8 + hectares (2,235.7+ acres)	18,800	

¹ Occurrences are identified by numbers listed in the 1997 CDFG NDDB.

² A dash (—) indicates no data are available at this time.

Table 7. Summary of Occurrence Data for *Erysimum menziesii* ssp. *yadonii*

Occurrence¹ and Location	Approximate Size (hectares)²	Number of Individuals	Ownership
NDDB No. 1 South of Salinas River, Monterey County	10.0 hectares (24.7 acres)	possibly extirpated (1980)	US Fish and Wildlife Service (FWS)
NDDB No. 2 West of Lapis Siding, Monterey County	8.9 hectares (21.9 acres)	13,900 (1987)	Private (RMC Lonestar Cement Company)
NDDB No. 3 Lonestar, Monterey County	–	(1982)	Private (RMC Lonestar Cement Company)
NDDB No. 4 Marina Dunes, Monterey County	–	500 (1991)	Unknown
NDDB No. 5 Marina State Beach, Reservation Road, Monterey County	10.0 hectares (24.7 acres)	300 (1985) 7,038 (1996) combined Nos. 5 and 6	DPR
NDDB No. 6 Marina State Beach, near Fort Ord, Monterey County	2.2 hectares (5.4 acres)	8,000 (1986) 5,000 (1987) propagated occurrence	DPR
TOTAL	31.1 hectares+ (76.9 acres+)	14,700	

¹ Occurrences are identified by numbers listed in the 1997 CDFG NDDB.

² A dash (–) indicates no data are available at this time.

Table 8. Summary of Occurrence Data for *Gilia tenuiflora* ssp. *arenaria*

Occurrence¹ and Location	Approximate Size (hectares)²	Number of Individuals	Ownership
NDDB No. 1 Spanish Bay Golf Course, Monterey County	8.0 hectares (19.8 acres)	700–1,000 (1993)	Pebble Beach Company
NDDB No. 2 Naval Postgraduate School Dunes, City of Monterey	11.0 hectares (27.2 acres)	1498 (1991) 1950 (1986) 8–13,000 (1993)	DOD, U.S. Navy
NDDB No. 3 Tioga Ave., City of Sand City	–	10,000 (1986) 5,000 (1987) 25,000 (1993)	Private
NDDB No. 4 Marina State Beach, Monterey County	10.0 hectares (24.7 acres)	10,000 (1985) 300 (1986) 20 (1992) 325 (1993)	DPR
NDDB No. 5 Salinas River State Beach, Monterey County	10.0 hectares (24.7 acres)	<10,000 (1985) 10,000 (1986) 1,665 (1987) 13,500 (1993)	DPR
NDDB No. 6 Spanish Bay Golf Course, Monterey County	–	Extirpated	Pebble Beach Company
NDDB No. 10 Del Rey Oaks, Monterey County	–	50 (1985) Extirpated (1996)	Unknown
NDDB No. 11 Spanish Bay Golf Course, Monterey County	–	Extirpated	Pebble Beach Company, transplanted occurrence,
NDDB No. 12 Fort Ord, Monterey County	–	Map (1992)	DOD
NDDB No. 13–19 Fort Ord, Monterey County	–	Map (1992)	DOD
NDDB No. 20 Fort Ord, Monterey County	(420 acres)	42,600 (1993) 2 million (1995)	DOD

Table 8. Summary of Occurrence Data for *Gilia tenuiflora* ssp. *arenaria* (Continued).

Occurrence¹ and Location	Approximate Size (hectares)²	Number of Individuals	Ownership
NDDB No. 21 Fort Ord, Monterey County	(9.4 acres)	515 (1993)	DOD
NDDB No. 22 Fort Ord, Monterey County	–	20 (1992)	DOD
NDDB No. 23 Reservation/Seaside Monterey County	0.01 hectares (0.02 acre)	500 (1994)	Private
NDDB No. 24–26 Marina/Reservation Road Monterey County	–	Report (1987)	–
NDDB No. 27 Marina Dunes Monterey County	5.9 hectares (14.8 acres)	2,295 (1987)	Private
NDDB No. 28 Marina, Monterey County	–	Report (1987)	–
NDDB No. 29 Mulligan Hill, Salinas River Lagoon, Monterey County	4.0 hectares (9.9 acres)	3,000–5,000 (1993)	Private (Scattini and Sons)
NDDB No. 30 Watertower Hill, Moss Landing, Monterey County	4.0 hectares (9.9 acres)	400–600 (1993) 200–500 (1994)	Private

Table 8. Summary of Occurrence Data for *Gilia tenuiflora* ssp. *arenaria* (Continued).

Occurrence¹ and Location	Approximate Size (hectares)²	Number of Individuals	Ownership
NDDB No. 31 Fort Ord/Imjin, Monterey County	13.7 hectares (34.1 acres)	698 (1993)	DOD
NDDB No. 32 Asilomar State Park, Monterey County	5.0 hectares (12.4 acres)	550 (1993)	DPR
NDDB No. 33 Sunset State Beach, Monterey County	4.1 acres	5,000 (1995)	DPR
Sand Dollar Shopping Center, Monterey County	–	<200 (1994) (experimental)	Private: conservation easement
TOTAL	1,833.6+ hectares (4,531.2+ acres)	110,435+	

¹ Occurrences are identified by numbers listed in the 1997 CDFG NDDB where they exist.

² A dash (–) indicates no data are available at this time.

Table 9. Summary of Occurrence Data for *Layia carnosa*

Occurrence¹ and Location	Approximate Size (hectares)²	Number of Individuals	Ownership
NDDB No. 1 Santa Barbara County	–	extirpated?	DOD, Vandenberg Air Force Base
NDDB No. 2 North Spyglass Hill, Monterey County	–	0 (1984) 0 (1989) seeded 1993	Private (Del Monte Forest Foundation)
NDDB No. 3 Spyglass Hill Dunes, Monterey County	–	<100 (1987) Extirpated	Private (Pebble Beach company)
NDDB No. 4 Point Pinos, Monterey County	–	Type location (1912) 0 (1987)	DOT
NDDB No. 5 Pico Ave., Pacific Grove, Monterey County	–	5 (1990)	Private
NDDB No. 7 (PRNS#10,13) Kehoe Beach Dunes, Marin County	–	100+ (1987) 125 (1990)	PRNS (NPS)
NDDB No. 8 (PRNS# 2) Abbotts Lagoon, Marin County	13.13 hectares (32.5 acres)	118 (1988) 1,500 (1989) 3,700 (1990)	PRNS (NPS)
NDDB No. 9 McNutt Gulch, Humboldt County	20.6 hectares (50.9 acres)	>500 (1987)	Private
NDDB No. 10 Mattole River Mouth, Humboldt County	10.9 hectares (26.9 acres)	>1,000 (1987)	BLM, Arcata Resource Area
NDDB No. 11 Lanphere Dunes Humboldt County	58.3 hectares (144.1 acres)	30,000+ (1991)	FWS; Private
NDDB No. 12 Samoa Peninsula, Humboldt County	196.3 hectares (485.1 acres)	30,000+ (1991)	BLM; City of Eureka; DOD; U.S. Coast Guard
NDDB No. 14 Mouth of Mad River, Humboldt County	–	– (1963) 0 (1987) Extirpated	Private

Table 9. Summary of Occurrence Data for *Layia carnosa* (Continued).

Occurrence¹ and Location	Approximate Size (hectares)²	Number of Individuals	Ownership
NDDB No. 15 Little River State Beach, Humboldt County	–	– (1937) 0 (1987) Extirpated	DPR
NDDB No. 17 Manila, Samoa Peninsula, Humboldt County	109.7 hectares (271.1 acres)	42,000 (1991) 200,000–500,000 (1993)	PVT, BLM,
NDDB No. 19 (PRNS # 6) Marin County	8.1 ha (20.1 acres)	40 (1988) more (1989)	PRNS (NPS)
NDDB No. 20 Marin County	2.1 ha (5.3 acres)	99 (1989)	PRNS (NPS)
NDDB No. 21 (PRNS# 5), Marin County	12.8 ha (31.8 acres)	12 (1988) few (1992)	PRNS (NPS)
NDDB No. 22 (PRNS#2), Marin County	5.5 ha (13.7 acres)	78 (1988) 2,290 (1989)	PRNS (NPS)
NDDB No. 23, (PRNS#8) Marin County	–	12 (1989)	PRNS (NPS)
NDDB No. 24, (PRNS#4) Marin County	–	36 (1988)	PRNS (NPS)
NDDB No. 25, (PRNS#1) (PRNS# 7) Marin County (PRNS#12)	– – –	#1 2,140 (1988) #7 790 (1984) #12 200 (1991)	PRNS (NPS)
NDDB No. 26, (PRNS #11) Marin County	–	107 (1991)	PRNS (NPS)
NDDB No. 27 South Spit, Humboldt County	103.1 hectares (255.4 acres)	20,000 abundant (1998)	Private-Simpson Timber, Texaco
NDDB No. 28 Vandenberg AFB, Santa Barbara County	0.1 hectares (0.25 acre)	80 (1998) Additional 200 in nearby colony (1998)	DOD, U.S. Air Force
TOTAL	562.1+ hectares (1,390.2+ acres)	300,000	

¹ Occurrences are identified by numbers listed in the CDFG NDDB.

² A dash (–) indicates no data are available at this time.

Table 10. Summary of Occurrence Data for *Lupinus tidestromii*

Occurrence ¹ and Location	Approximate Size (hectares) ²	Number of Individuals	Ownership
NDDB No. 1 Point Pinos, Monterey County	–	Observation (1985)	Department of Transportation (DOT); U.S. Coast Guard
NDDB No. 2 Asilomar State Park, Monterey County	9.9 hectares (24.5 acres)	Observation (1987)	DPR
NDDB No. 3 17 Mile Drive, Monterey County	–	Herbarium sheet (1919)	Private
NDDB No. 4 17 Mile Drive at Bird Rock, Monterey County	–	–	Private (Pebble Beach Company)
NDDB No. 5 Moss Beach, Monterey County	–	2 colonies (1985)	Moss Beach (DPR); Private
NDDB No. 6 Sawmill, Monterey County	–	Extirpated (1985)	Private
NDDB No. 7 Moss Beach, Monterey Co.	–	Extirpated (1985)	Private
NDDB No. 8 17 Mile Drive, Monterey County	–	(1948)	Private
NDDB No. 10 Signal Hill Road, Monterey County	–	Map (1987)	Private
NDDB No. 11 Spanish Bay Golf Course, Monterey County	7.7 hectares (19.0 acres)	Transplant	Private (Pebble Beach Company)
NDDB No. 12 (PRNS#3) Old Life Saving Station, Marin County	–	93 (1983) 107 (1987)	PRNS (NPS)
NDDB No. 13 (PRNS #1) Abbotts Lagoon, Marin County	155.0 hectares (383.0 acres)		PRNS (NPS)

Table 10. Summary of Occurrence Data for *Lupinus tidestromii* (Cont'd.)

Occurrence¹ and Location	Approximate Size (hectares)²	Number of Individuals	Ownership
NDDB No. 14 (PRNS#2) North Beach, Marin County	7.2 ha (18 acres)	6 (1983) 9 (1988) 152 (1993)	PRNS (NPS)
NDDB No. 15 (PRNS#4) Abbotts Lagoon, north, Marin County	–	30 (1990)	PRNS (NPS)
NDDB No. 16 Navy test site, Marin County	1.4 hectares (3.6 acre)	21 (1991)	PRNS (NPS)
NDDB No. 17 Goat Rock, Sonoma County	0.01 hectares (0.02 acre)	100+ (1987) 30 (1994)	DPR
NDDB No. 18 Dillon Beach, Marin County	–	2 (1992) 0 (1995–6)	Private (Lawsons Landing)
NDDB No. 19 Ocean View Blvd., Marin County	–	Map (1987)	Unknown
NDDB No. 20 Point Reyes National Seashore, Marin County	32 acres	5,940 (1995)	NPS
No number Bodega Head, Sonoma County	–	–	Unknown. Reported from this area by Best (1996).
TOTAL	202+ hectares (500+ acres)	6,373	

¹ Occurrences are identified by numbers listed in the 1997 CDFG NDDB and Calif. Dept. of Fish and Game 1985b.

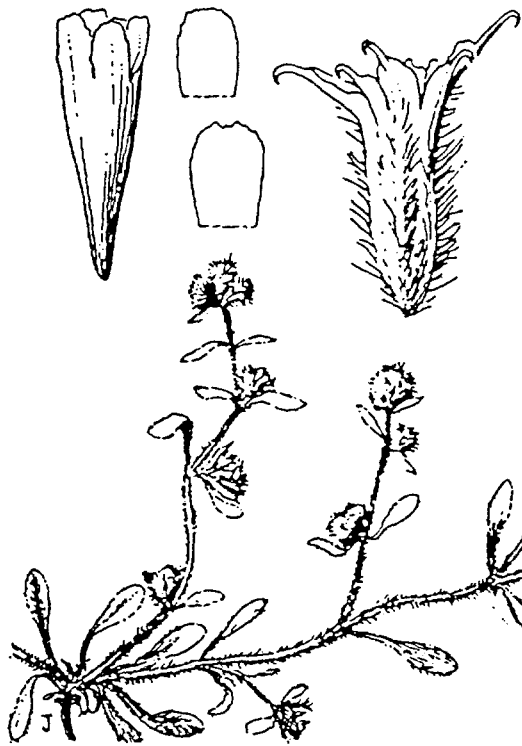
² A dash (–) indicates no data are available at this time.



Source: Abrams, L. 1950.
Illustrated Flora of the Pacific States, Vol. II, Fig. 1326.
Stanford University Press, Stanford, CA.

Plant Identification
Chorizanthe howellii
RECOVERY PLAN

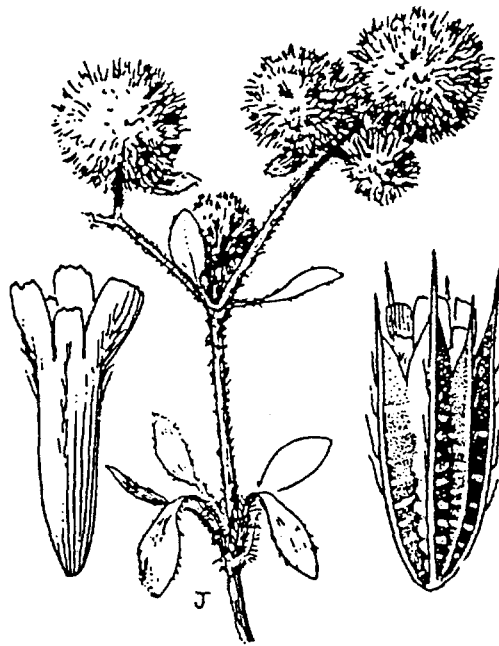
FIGURE 1



Source: Abrams, L. 1950.
Illustrated Flora of the Pacific States, Vol. II, Fig. 1321.
Stanford University Press, Stanford, CA.

Plant Identification
Chorizanthe pungens var. *pungens*
RECOVERY PLAN

FIGURE 2



Source: Abrams, L. 1950.
Illustrated Flora of the Pacific States, Vol. II, Fig. 1325.
Stanford University Press, Stanford, CA.

Plant Identification
Chorizanthe valida
RECOVERY PLAN

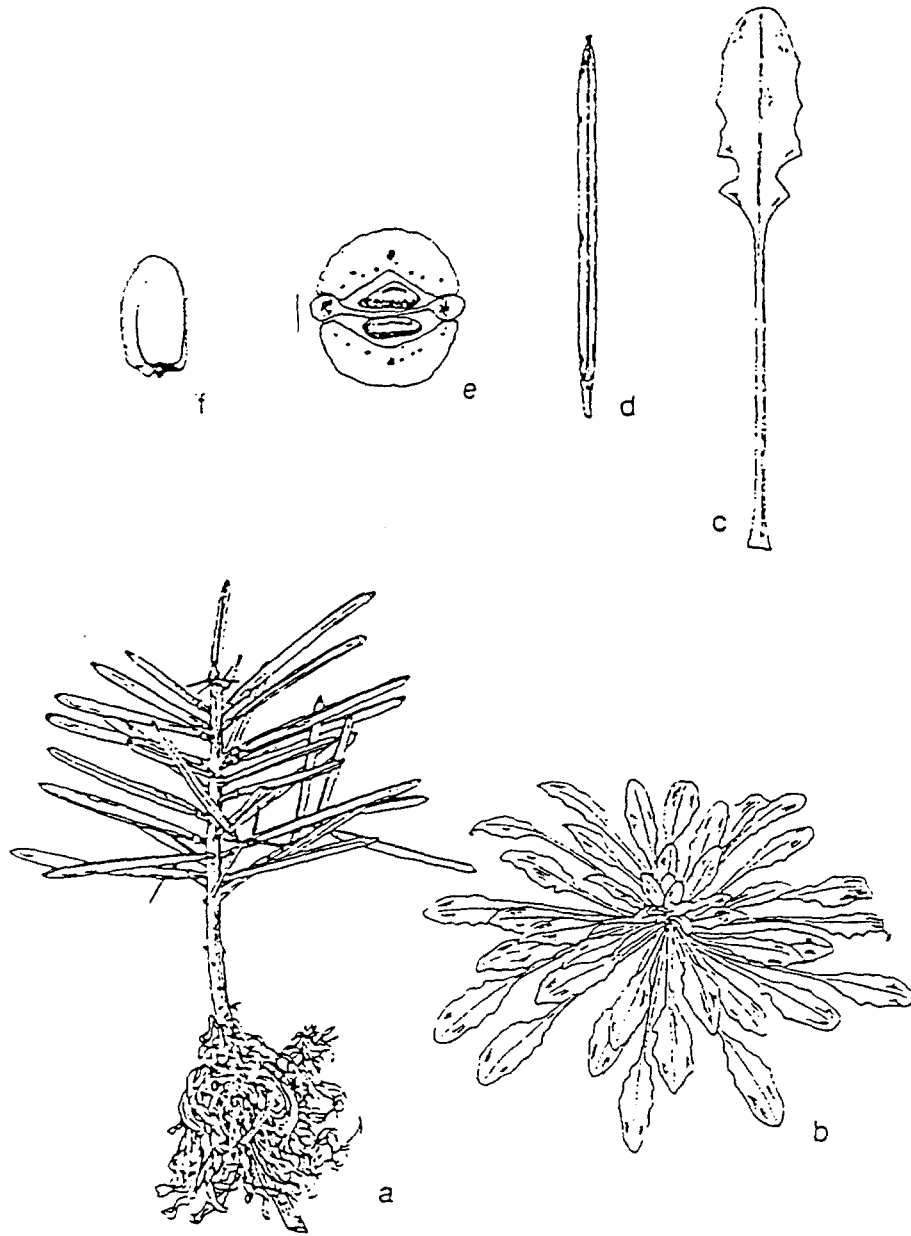
FIGURE 3



Source: Price, R.A. (1987); Price 573, Fig. 28.

Plant Identification
Erysimum menziesii ssp. *eurekaense*
RECOVERY PLAN

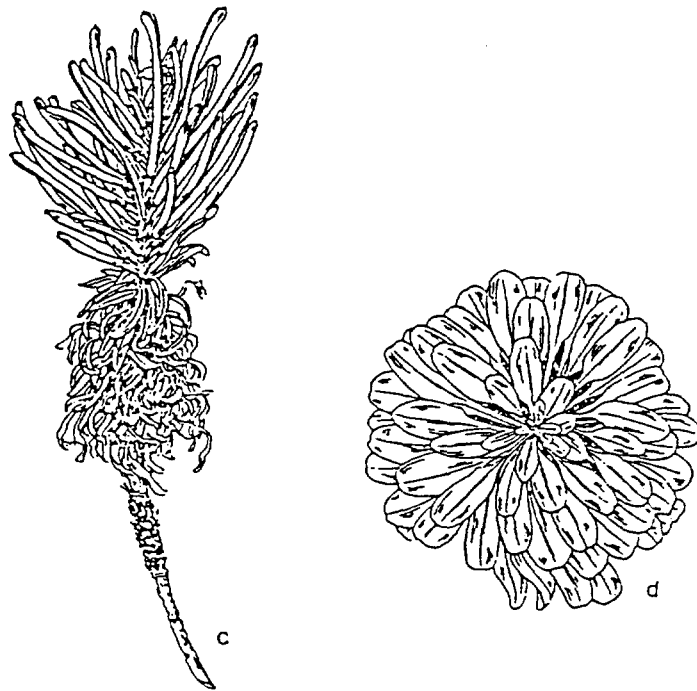
FIGURE 4



Source: Price, R.A. (1987); Price 571, Fig. 27.

Plant Identification
Erysimum menziesii ssp. *menziesii*
 RECOVERY PLAN

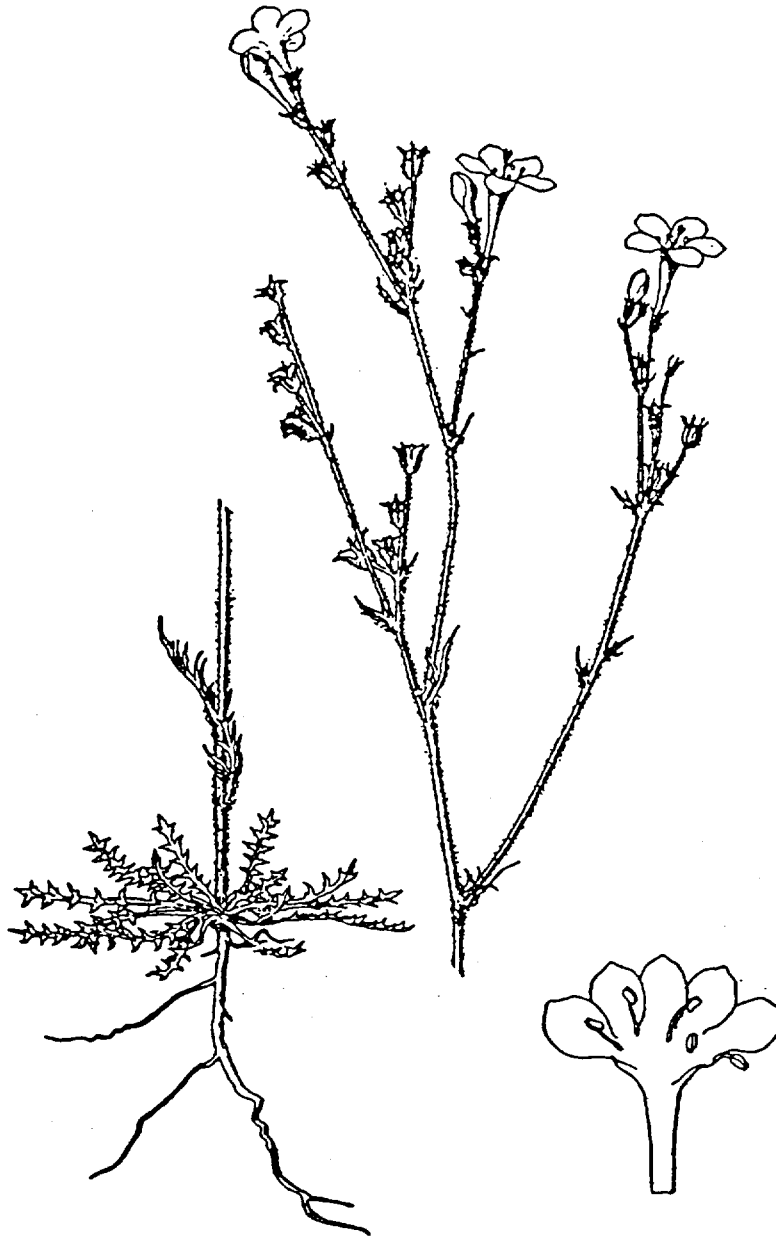
FIGURE 5



Source: Price, R.A. (1987); Price 807, Fig. 28.

Plant Identification
Erysimum menziesii ssp. *yadonii*
RECOVERY PLAN

FIGURE 6



Source: Abrams, L. 1951.
Illustrated Flora of the Pacific States, Vol. III, Fig. 4024.
Stanford University Press, Stanford, CA.

Plant Identification
Gilia tenuiflora
RECOVERY PLAN

FIGURE 7



Source: Abrams, L. and R. Ferris, 1960.
Illustrated Flora of the Pacific States, Vol. IV, Fig. 5250.
Stanford University Press, Stanford, CA.

Plant Identification
Layia carnosa
RECOVERY PLAN

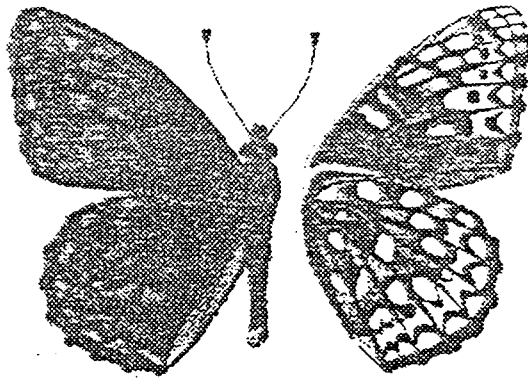
FIGURE 8



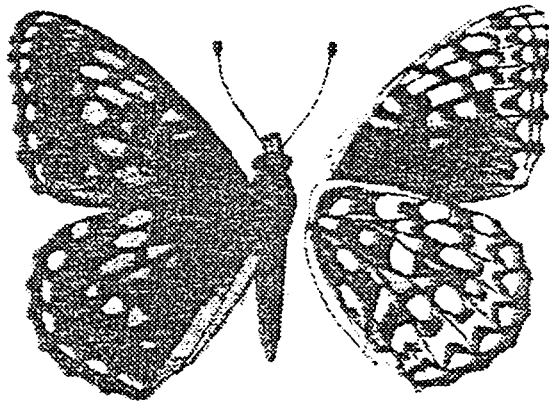
Source: Abrams, L. 1950.
Illustrated Flora of the Pacific States, Vol. II, Fig. 2625.
Stanford University Press, Stanford, CA.

Plant Identification
Lupinus tidestromii
RECOVERY PLAN

FIGURE 9



Speyeria zerene myrtleae, male



Speyeria zerene myrtleae, female

Source: William H. Howe, 1975.
The Butterflies of North America.

Identification
Myrtle's Silverspot Butterfly
RECOVERY PLAN

FIGURE 10

II. RECOVERY

A. OBJECTIVE AND CRITERIA

The immediate objective of this recovery plan is to minimize the threats to the species and the habitats upon which they depend.

The plan's primary objective is to delist all eight taxa covered by the plan in a minimum of twenty years, with the possible exception of *Chorizanthe valida*, which is known from only one site. Reclassification to threatened status will come before delisting for the endangered *Chorizanthe howellii*, *C. valida*, *Erysimum menziesii*, *Gilia tenuiflora* ssp. *arenaria*, *Layia carnosa*, *Lupinus tidestromii*, and Myrtle's silverspot butterfly. The recovery objective for the threatened *Chorizanthe pungens* var. *pungens* is delisting, possibly in 10 years if recovery actions proceed quickly and effectively.

Although knowledge of the life histories of these taxa is limited with respect to requirements for their short- and long-term survival, criteria for downlisting and delisting are established here using the best available information. These criteria will be revised and quantified as additional information is provided by monitoring programs and documented management results.

Recovery Criteria

A. Downlisting Criteria for the Plants

For *Chorizanthe howellii*, *Chorizanthe valida*, the three endangered subspecies of *Eryngium menziesii*, *Layia carnosa*, *Lupinus tidestromii*, and Myrtle's silverspot butterfly (*Speyeria zerene myrtleae*), the following conditions must be met before considering their reclassification to threatened status:

1. Habitat occupied by the species that is needed to allow delisting has been secured, with long-term commitments and, if possible, endowments to fund to conservation of the native vegetation,

2. Management measures are being implemented to address the threats of invasive species and other problems, including grazing, pedestrians, and off-road vehicles at some sites.
3. Monitoring reveals that management actions are successful in reducing threats of invasive non-native species.
4. Additional restored habitat has been secured, with evidence of either natural or artificial long-term establishment of additional populations, and long-term commitments (and endowments, where possible) to fund conservation of the native vegetation.

In addition to these criteria, for *Chorizanthe valida* (Sonoma spineflower) to be considered for downlisting,

1. Management plans must be approved and implemented for the one population, and
2. Two additional populations have been established and sustained with long-term management.

B. Delisting Criteria for the Plants

Full recovery of these taxa will be achieved when the dune systems they inhabit are secure, with experience to demonstrate that exotic plants and other threats (recreational use, off-road vehicles, etc.) are controlled and managers have demonstrated their ability to keep the threats under control. The taxa need to be secure in their presently-occupied ranges, and opportunities should be taken to introduce these plants to restored habitat in or near historic ranges. To be counted toward recovery, (re)introduced populations should be naturally reproducing in vegetation that also appears to be persisting without excessive maintenance or “gardening.” The area occupied by the plants should increase commensurate with improving habitat conditions. The determination that delisting is possible must be based on at least fifteen years of monitoring for the endangered taxa, to include wet and drought years. For some of the species, aspects of demography and population biology must be understood to be assured that populations are likely to persist. The species can be considered for delisting when sites are secure from habitat modification (development), occupied habitat is stable or improving and free of weed invasion.

The threatened *Chorizanthe pungens* var. *pungens* (Monterey spineflower) may be considered for delisting when: 1) the Fort Ord disposal and reuse process has led the

management agencies to develop, fund, and implement permanent protection plans for the species' habitat including permanent iceplant suppression programs, and 2) beach-dune occurrences on State Park and private lands throughout its current range from Santa Cruz to the Monterey Peninsula are covered under a permanent protection plan. Plans at the time of writing to conserve roughly 60 percent of Fort Ord appear sufficient for recovery of the interior occurrence. A reassessment would be made should plans call for conservation of less habitat. Existing management along the coast at the State Parks units need to be supplemented with protection and management on private lands to be determined after a thorough analysis of the beach populations.

The specific dune systems required for the recovery of each species are as follows:

- *Chorizanthe howellii* (Howell's spineflower) may be considered for delisting when restoration of habitat at MacKerricher State Park and vicinity (Ten Mile Dunes), including eradication of European beachgrass and expansion of populations into restored habitat, has been accomplished. Monitoring and history studies should, by then, demonstrate that the area occupied by the plant is increasing and that populations are not being lost to recreational activity.

- *Erysimum menziesii* (Menzies' wallflower) can be considered for delisting when studies have elucidated its life history requirements so that it is possible to predict the responses of populations to management and their viability and:

1. The dune systems with the plan's three subspecies are actively protected from recreational violations, particularly by ORVs (guaranteed funding to enforce ordinances), development, invasive weeds (including European beach grass, iceplant, and yellow bush lupine for subspecies *eurekaense* in Humboldt County and iceplant for the entire species), and predators (deer in Monterey County).
2. Each occupied dune system has reasonable numbers of plants distributed widely enough to minimize the risk from accidental or catastrophic events. Because these are short-lived plants in a fluctuating environment, this plan provides only tentative recommendations pending results of demographic and monitoring studies over a decade from now. For *E. m. ssp. eurekaense*, the plan suggests that 3 populations in the Humboldt Bay dune systems with 300 individuals and 2 populations with 5,000 or more individuals. For *E. m. ssp. menziesii*, the plant should be present at 4 or more distinct sites, with 5 separate populations with an average of 300 plants and 2 populations with an average of 5,000 individuals. For *E. m. ssp. yadonii*, the plant should be present throughout its

present range from south of Salinas River to Marina Dunes and potentially the Fort Ord area. At least 2 populations should average at least 5,000 individuals and 3 should average 300 or more.

• *Gilia tenuiflora* ssp. *arenaria* (Monterey gilia) can be considered for delisting when habitat throughout its range in the Monterey Bay Dunes from Moss Landing to about Sand City, and from dunes in and near Asilomar State Park on the Monterey Peninsula is:

1. Protected from encroachment of non-native species, recreational activity (including ORVs and horses), and development;
2. restored to native vegetation at proper densities to allow natural colonization by this plant,
3. monitored sufficiently to assure that local threats are spotted promptly and
4. has enough plants at enough locations within the protected vegetation to reasonably assure the viability of the species. Specifically:
 - a. Occurrences on private lands are protected and managed for at least 1,000 individuals per site at NDDDB# 1 (Spanish Bay Golf Course), 23 (Reservation/Seaside), 27 (Marina Dunes), 29d (Mulligan Hill, Salinas River Lagoon), 30 (Watertower Hill, Moss Landing), up to 20,000 individuals at NDDDB# 3 (Tioga Avenue). All of these sites are parts of the Monterey Bay Dunes, except for Spanish Bay Golf Course.
 - b. At least four occurrences on DOD (or lands transferred from DOD ownership at Fort Ord or Naval Postgraduate School) sites are protected and managed for 1,000 (NDDDB# 21 and 31) to 10,000 to 40,000 (NDDDB# 2 [Postgraduate School] and 20 [Fort Ord]) individuals per site, and
 - c. Occurrences on DPR lands are protected and managed for 1,000 (NDDDB# 4 and 23) to 10,000 (NDDDB# 5) individuals per site.

Layia carnosa (beach layia) can be considered for delisting when

1. the Humboldt Bay dune system, on both the north and south spits, has substantially all of the European beachgrass removed from the foredune. Dune stabilization to protect buildings and roads can probably be accomplished using native grasses; the extra cost and effort would be outweighed by the benefit of getting *Ammophila* out of storm erosion areas. Iceplant, yellow bush lupine, and pampas grass (*Cortaderia jubata*) must be greatly reduced, degraded dunes restored, and vehicle management implemented (including fencing and/or

- patrolling where needed). New colonies of *Layia carnosa* must be established and persist for at least 10 years, and monitoring for at least 15 years should demonstrate that *Layia carnosa* numbers are increasing in response to the availability of restored habitat. There must be written assurance of long-term support for continued management of the dunes and for biological monitoring.
2. The extended population at Point Reyes National Seashore is expanded in response to the same measures described for the Humboldt dunes. The main exotic plant problems to be addressed are foredune European beachgrass and iceplant.
 3. The occurrences south of San Francisco in the Monterey Bay and Vandenberg dune systems (NDDDB# 3 [Spyglass Hill Dunes], 4 [Point Pinos], 5 [Pico Ave., Pacific Grove], and 28 [Vandenberg Air Force Base]) have received foredune beachgrass control, iceplant management, are managed and enhanced to protect 5,000 individuals or more per site.

Lupinus tidestromii (Tidestrom's lupine) can be considered for delisting when

1. the numbers of individuals in the extended habitat at Point Reyes National Seashore averages 10,000, as shown by at least 15 years of monitoring and the Seashore is making progress in removing European beachgrass from foredunes and eradicating iceplants.
2. DPR manages an average of 5,000 individuals in the Monterey region (Asilomar State Beach and vicinity) and the plant can be restored and managed to have an equally large population in the Sonoma region (Dillon Beach). Habitat restoration (including allowing enough bare sand for it and associated short-lived plants) must have been successful, and it would be strongly desirable to have *Lupinus tidestromii* establishing itself in restored habitat; and
3. Privately-owned dune systems with this plant are protected and enhanced and are stable or improving (NDDDB occurrences # 4, 8, 10, 11, 18, and 19).

C. Downlisting Criteria for Myrtle's Silverspot Butterfly

The Myrtle's silverspot can be reclassified to threatened status when —

1. The habitat of the northwestern Marin County/southwestern Sonoma County population of this species is protected in perpetuity.
2. Two new populations have been discovered or re-introduced at suitable sites that have been protected in perpetuity.

3. Adequate funding for management of all sites is assured and adaptive management plans have been developed and are being implemented.
4. Annual monitoring has shown the five populations (three existing, two new) cumulatively to have a total of more than 10,000 adults in each of ten years, with no individual population having fewer than 200 adults in any year and no recent severe declines.

D. Delisting Criteria for the Myrtle's silverspot Butterfly

1. Nine populations of the species have been established (three existing, six discovered or re-introduced) on habitat protected in perpetuity. If appropriate sites have been identified in the screening and prioritization process, at least two of these populations should be south of the Golden Gate.
 2. Adequate funding for management of all sites is assured and adaptive management plans have been developed and are being implemented.
 3. Annual monitoring has shown the nine populations cumulatively to have a total of more than 45,000 adults in at least eight of ten years, no fewer than 10,000 adults cumulatively in any year, no individual population having fewer than 100 adults in any year, and no recent severe declines.
-

B. NARRATIVE OUTLINE FOR RECOVERY ACTIONS ADDRESSING THREATS

1. Protect habitat of the listed species and their occurrences on private lands.

The listed species addressed in this plan should be secured where they occur on private lands through conservation easements, conservation agreements, or purchase where there are willing sellers. This is necessary to prevent further declines in distribution and abundance of the listed species from loss and degradation of habitat. The development of cooperative weed control programs will greatly facilitate recovery of these species, so it is a high priority to develop landowner incentives and providing funds for control of invasive exotic vegetation is a high priority. This task regularly refers to “occurrences” as defined by the NDDDB. Readers are reminded that “occurrences” are convenient units for storing data, and do not necessarily coincide with biological populations nor with geographic units of vegetation or geological features such as the dune fields upon which these plants depend (see comment on page 14).

1.1 Protect habitat for *Chorizanthe howellii*.

Two occurrences of *Chorizanthe howellii* (“A” Springer-Sheppard and Ward Avenue occurrences) on private lands within Mendocino County (Table 2) must be protected.

1.11 Inform landowners

The California Department of Parks and Recreation is knowledgeable of occurrences under its jurisdiction and can provide local expertise in soliciting voluntary assistance from private landowners for the protection of this species. Landowner contributions to achieve conservation for the species and habitat will assist in providing for successful recovery and delisting the species.

Options to protect private lands should be pursued through establishing conservation easements or purchase where there are willing sellers.

1.12 Consult and inform local lead agencies

The Mendocino County Planning Department should be consulted regarding conservation opportunities for easements, acquisition opportunities, and to determine if there are existing easements. The Planning Department should be informed and made aware of the need to appropriately use and manage land to preserve the plant and its habitat. Occurrences can be secured using several mechanisms — solicit private landowner participation and support for recovery, establish conservation easements by the property owner, establish permanent resource management easements, or fee acquisition from willing sellers. Support from the local lead agencies for the protection of habitat for the species is essential for species recovery. The Service and California Department of Fish and Game should review development proposals and comment on the adequacy of the protective measures for the species.

1.2 Protect habitat for *Chorizanthe pungens* var. *pungens*.

Several known occurrences of *Chorizanthe pungens* var. *pungens* occur on private lands within Monterey and Santa Cruz counties (Table 4).

1.21 Inform landowners

Affected landowners should be informed of efforts to recover the species and invited to participate in recovery effort and to prevent inadvertent destruction of habitat. See task 1.11.

1.22 Consult and inform local lead agencies

The planning departments of Monterey and Santa Cruz Counties should be consulted to determine what existing easements are in place and to explore opportunities for easements and acquisition. See task 1.12.

1.3 Protect habitat for *Lupinus tidestromii*.

Five occurrences of *Lupinus tidestromii* occur on private lands in Monterey County (Table 10). Two occurrences are on lands owned by the Pebble Beach Company and

the Spanish Bay Company with active management to provide protection for this species (Table 10, NDDDB No. 4 and 11). Four occurrences are on other privately-held lands (Table 10, NDDDB No. 3, 8, 10, and 18).

1.31 Inform landowners

Several landowners have existing restoration projects that provide examples of positive cooperation that could be used to solicit support from other landowners in recovery of the species. See task 1.11.

1.32 Consult and inform local lead agencies

The Monterey County Planning Department (NDDDB Nos. 3, 8, 10) and Marin County (NDDDB No. 18) should be consulted regarding conservation opportunities for easements, acquisition opportunities, and to determine if there are existing easements. See task 1.12.

1.4 Protect habitat for *Layia carnosa*.

Several occurrences of *Layia carnosa* occur on private lands in Monterey and Humboldt counties (Table 9). Two occurrences are in Monterey County, one on lands owned by the Pebble Beach Company. One occurrence (Pico Avenue) occurs on private land in the City of Pacific Grove. In Humboldt County, five occurrences may be on privately held lands. One occurrence is on lands owned by the Fish and Wildlife Service as the Lanphere Dunes unit of the Humboldt Bay Refuge (NDDDB No. 11).

1.41 Inform landowners

See task 1.11.

1.42 Consult and inform local lead agencies

The Humboldt and Monterey County Planning Departments should be consulted regarding conservation opportunities for easements, acquisition opportunities, and to determine if there are existing easements. See task 1.12.

1.5 Protect habitat for *Gilia tenuiflora* ssp. *arenaria*.

Nine occurrences of *Gilia tenuiflora* ssp. *arenaria* occur on private lands in Monterey County (Table 8). Two occurrences are on lands owned by the Pebble Beach Company (NDDDB No. 6 and 11). Another occurrence is on privately-held lands owned by RMC Lonestar Cement Company (Table 8). The other occurrences are on other private lands. It is not known if the landowners are aware of the presence of these species on their land.

1.51 Inform landowners

See task 1.11.

1.52 Consult and inform local lead agencies

The Monterey County Planning Department should be consulted regarding conservation opportunities for easements, acquisition opportunities, and to determine if there are existing easements. See task 1.12.

1.6 Protect habitat for *Erysimum menziesii*.

Five occurrences of *Erysimum menziesii* ssp. *menziesii* are on private lands in Monterey County, in the vicinity of Spyglass Hill, Point Piños Lighthouse, Signal Hill Road, Bird Rock Road and the Spanish Bay Golf Course (Table 5). In Mendocino County a portion of one occurrence of subspecies *menziesii* occurs on private land in the Ten Mile River area (NDDDB No. 4). Presently the owner/manager for the Pudding Creek occurrence (No. 5) is unknown. The City of Fort Brag has recommended that a joint public agency acquisition/protection plan for the site be developed, including State Coastal Conservancy, State Parks, the City and others.

Four occurrences of *Erysimum menziesii* ssp. *eurekaense* are on private lands in Humboldt County (Table 6). One occurrence is on lands owned by the Fish and Wildlife Service and is protected (NDDDB No. 1). There are occurrences on private lands in the vicinity of the south spit at Humboldt Bay (NDDDB No. 5) and north of Manila (Samoa Peninsula; NDDDB No. 3).

Two occurrences of *Erysimum menziesii* ssp. *yadonii* are on private lands in Monterey County and are owned by Lone Star Cement Company (Table 7, NDDDB No. 2 and 3).

1.61 Inform landowners

See task 1.11.

1.62 Consult and inform local lead agencies

The Humboldt and Monterey County Planning departments should be consulted regarding conservation opportunities for easements, acquisition opportunities, and to determine if there are existing easements. See task 1.12.

1.7 Protect habitat for Myrtle's silverspot butterfly.

Habitat for the butterfly at the Marin Coast Ranch should be secured and managed to benefit the silverspot. This habitat may be secured by agreement with the landowner to protect from development those areas of highest value to the silverspot butterfly. The landowner has communicated that the conservation of the butterfly is consistent with the objectives with the plans for the property (Sproul *in litt.* 1997). A formal agreement between the land owner and the Service should be pursued. If other privately-owned lands in Marin County and coastal portions of Sonoma County are determined to support occurrences of the silverspot, they should be secured by agreement with the landowners.

2. Minimize threats to the plants and butterfly.

Invasive non-native plant species are immediate biological threats to all of the listed plant species. Invasive plants are also a problem for Myrtle's silverspot (i.e., competition with native larval and adult food plants). Infestations of invasive plant species need to be controlled.

2.1 Minimize the threats from invasive, non-native plants. Apply control measures.

Removal and control of non-native invasive plants is one of the most critical requirements to recover the species and their habitats in this plan. Major pests to be controlled are iceplant (*Carpobrotus* spp.), European beachgrass (*Ammophila arenaria*), French broom (*Genista monspessulana*), and yellow bush lupine (*Lupinus arboreus*), as well as others (*Ehrharta*, *Conicosia*, *Bromus*, etc.).

2.11 Minimize threats on private lands.

With agreement from private landowners, the infestation of the following non-native plants should be controlled: *Carpobrotus* spp. and *Ammophila* sp. (at numerous locations), *Genista monspessulana* (affecting *Chorizanthe pungens* var. *pungens* and *Lupinus arboreus* where it is not). Control measures should be initiated by hand removal, herbicide application, or other effective methods that have least adverse long-term consequences for the listed species.

2.12 Minimize threats on public lands.

Establish or continue programs on publicly-owned lands to control non-native plant infestations. Personnel at Point Reyes National Seashore, Marina State Beach, Asilomar State Beach, Sunset State Beach, MacKerricher State Park and Lanphere Dunes are implementing management programs to control the spread of invasive non-native species near the known occurrences of *Chorizanthe valida*, *C. pungens* var. *pungens*, *Erysimum menziesii*, *Layia carnosa*, and *Lupinus tidestromii* (Tables 3, 4, 5, 6, 7, 9 and 10). A more aggressive program to control non-natives on BLM lands needs to be supported by that agency through recognition and funding. Techniques that succeed in enhancing habitats and occurrences of these listed species should be made available to other managers to augment recovery efforts.

2.2 Deter poaching of Myrtle's silverspot butterfly.

Collecting by unscrupulous individuals was identified as a threat in the final rule for the butterfly and specific efforts may be needed to prevent poaching. Such actions

may include regular patrol of known silverspot habitat at PRNS by law enforcement personnel during peak flight days to prevent unauthorized collecting. Support from private land managers to cooperate with the prohibition of take will enhance efforts to recover the species.

3. Develop management strategies through a research program to document the listed species' life histories and their responses to vegetation management.

Habitat management for the species in this recovery plan is needed to control the threats to their existence. Data must be obtained to determine how to conduct the management.

3.1 Examine the interactions of cattle grazing on the habitat of the listed plant species.

Additional studies (i.e., cattle enclosure studies, seed set studies, population size and density studies) are needed to understand the effects of cattle on these plant species and to determine the best management practices to achieve recovery objectives.

3.2 Determine specifics of the life history for the listed plant species and the silverspot butterfly, as well as effects of vegetation management on the plants.

3.2.1 Obtain life history and response-to-management data for the listed plants.

For the plants, life history and response-to-management information is generally needed in the following areas:

- seed production and dispersal. For example, studies focused on seed dispersal, germination and other population attributes conducted for *Erysimum menziesii* at the Lanphere Dunes by several researchers have been documented in Pickart and Sawyer (1998) that should be used as a reference to develop guidelines for management of the habitats that contain the listed species. Opportunities for long term studies occur at several of the State Parks, Lanphere Dunes, BLM lands and at PRNS.

- seed dormancy, seed germination and seedling establishment with respect to soil conditions and competition from other plants.
- effects of soil and vegetation disturbance (gaps in vegetation) on recruitment of seedlings. For example, substrate disturbance from recreational uses, such as pedestrian and/or equestrian trails and ORV use, has been reported to result in a decrease in the overall distributions and population sizes of *Chorizanthe howellii*, *C. pungens* var. *pungens*, *Gilia tenuiflora* ssp. *arenaria* and *Layia carnosa*. The amount of open area around *Lupinus tidestromii* has been observed to affect natural regeneration. Preliminary observations of *Chorizanthe pungens* var. *pungens* at Fort Ord (Table 3, NDDDB No. 22 and 23) and *Layia carnosa* in Humboldt County (Table 9) suggest that these species occur in areas with some level of substrate disturbance, such as afforded by low-intensity roadway or recreational use. High-intensity recreational uses, such as uncontrolled ORV use, however, have been documented to cause excessive soil disturbance and habitat loss.
- tolerance to sand burial and erosion
- experimental results on effects of removal of non-native species.
- effects of vegetation management (burning, herbicide, scraping, etc.) on mixed stands of non-native and target species.
- the relationship between substrate disturbance and invasion by plants that threaten open habitat required by the listed species and the host and nectar plants used by the Myrtle's silverspot butterfly

3.2.2 Myrtle's silverspot butterfly life history.

The variables influencing the length of diapause in the larvae should be determined. Major mortality factors also should be elucidated. Studies of the life history requirements of each of the listed plant species and the host and nectar plants of the butterfly should be conducted to better understand their specific habitat characteristics.

3.3 Study differing management techniques of cattle grazing to improve the habitat of the Myrtle's silverspot butterfly.

Myrtle's silverspot butterfly occurs in separate populations whose long-term persistence may depend upon intercolony movement. The loss of suitable habitat

containing larval food plants and adult nectar sources would make movements between populations more difficult. The effect of grazing on the silverspot butterfly and its host plant (*Viola* sp.) requires further study. Intensive grazing could cause the loss of larval food plants and adult nectar sources, while a managed grazing regime may control the spread of invasive non-native plant species which would ultimately outcompete the larval food plants. Opportunities to conduct such studies may occur at Point Reyes National Seashore.

3.4 Investigate the ecological and limiting factors essential for habitat management and recovery of the silverspot.

Information on the autecology of the silverspot's larval foodplant and its response to both natural successional changes and competition from introduced plants is necessary to develop management plans to maintain viable populations of the silverspot. Although applicable information on this matter may be available from ongoing studies of the threatened Oregon silverspot (*S. z. hippolyta*), site-specific information may need to be developed for the Myrtle's silverspot.

Like the Oregon silverspot, Myrtle's silverspot visits both native and introduced plants for nectar. The current utilization of non-native thistles as nectar resources should be reduced by managing the habitat for native nectar species. Non-native thistles are an indicator of disturbed habitats and could possibly pose a threat to the integrity of surrounding native habitat. Replacement of habitat occupied by the thistle with native species will restore natural habitat and provide essential resources for the Myrtle's silverspot. Those native plant species need to be identified and a restoration plan developed and implemented for outplanting.

3.5 Continue investigation on crucifer rust effects on *Erysimum menziesii*.

Studies that have been initiated on the white crucifer rust affecting the population viability of *Erysimum menziesii* should continue as a recovery action if they indicate potential significant impacts and the possibility of intervention to control the disease. Cases of management of fungal pathogens in wild plant populations might be found in the realms of range management or forestry. The only known case of antifungal agents being considered for use on endangered plants is with *Torreya taxifolia*, a conifer native to northwest Florida.

4. Manage occurrences and habitats

Management of the listed plant species and their habitat will depend upon information gained from monitoring, threat analysis and the evaluation of protection alternatives. It will be important to involve the expertise of local landowners, land managers, and species experts to develop conservation programs. There may be different management programs for each species. The management program selected will require periodic review to ensure that it is effective in protecting the species.

4.1 Manage *Chorizanthe pungens* var. *pungens* occurrences.

Develop and implement management practices for *Chorizanthe pungens* var. *pungens* occurrences to ensure conservation of the species.

4.1.1 Establish a working group to collaborate with private and public landowners and appropriate agencies to develop specific management guidelines.

See discussion in 4.5.1 regarding the establishment of a successful collaborative effort between private and agency efforts to provide for the conservation of the listed species and their habitats. Detailed restoration recommendations for coastal dune systems can be found in Pickart and Sawyer (1998).

For both publicly and privately-owned occurrences in Monterey and Santa Cruz counties and Cities of Marina and Sand City, agencies and landowners should collaborate to develop species-specific resource management guidelines. The Service should participate with the Marina Dunes Task Force to collaborate on plans for the Marina Dunes. The City of Sand City should continue with plans for the dunes within the City as part of their habitat conservation planning. DPR should continue to collaborate on actions at Marina, Sunset, and Asilomar State Beaches.

Working groups of land managers and biologists, organized informally or under auspices of government or non-government conservation organizations, should develop site-specific management practices to ensure conservation of

the species. This should include the preparation of management guidelines to address control of invasive non-native plant species, insect/disease infestation, potential for reintroduction, buffer zones to non-compatible adjacent land uses, compatible levels of recreational uses, and monitoring strategies.

4.1.2 Implement species management guidelines.

Investigate cost-sharing funding mechanisms to implement plan with landowners. This could involve multi-parcel funding and management. Implement of the management guidelines may also be possible through volunteer or donated labor, agency funding or a combination thereof.

4.2 Manage *Chorizanthe howellii*.

Develop and implement management practices for *Chorizanthe howellii* occurrences to ensure conservation of the species.

4.2.1 Establish a working group to collaborate with private and public landowners and appropriate agencies to develop specific management guidelines.

See discussion in 4.5.1 regarding the establishment of a successful collaborative effort between private and agency efforts to provide for the conservation of the listed species and their habitats. Detailed restoration recommendations for coastal dune systems can be found in Pickart and Sawyer (1998).

For privately-owned occurrences in Mendocino County, establish an interagency-landowner(s) collaboration to develop resource management guidelines. The California DPR should continue to work on conserving occurrences within MacKerricher State Park.

Working groups should develop management practices to ensure conservation of the species. The preparation of management guidelines should address control of invasive non-native plant species, insect/disease infestation, potential

for reintroduction, buffer zones to non-compatible adjacent land uses, compatible levels of recreational uses, and monitoring strategies.

4.2.2 Implement species management guidelines.

Seek cost-sharing funding mechanisms to implement plan with landowners. This could involve multi-parcel funding and management. Implementation of the management guidelines may also be possible through volunteer/donated labor, agency funding or a combination thereof.

California DPR should continue to implement management actions at MacKerricher State Park (e.g., Ten Mile Dunes Restoration Plan). These actions include plant/habitat protection, fencing, revegetation and invasive, non-native plant species eradication.

4.3 Manage *Chorizanthe valida* populations.

Develop and implement management practices for *Chorizanthe valida* populations to ensure conservation of the species.

4.3.1 Establish a working group to collaborate with the National Park Service (NPS) and appropriate agencies to develop management guidelines.

See discussion in 4.5.1 regarding the establishment of a successful collaborative effort between private and agency efforts to provide for the conservation of the listed species and their habitats. Detailed restoration recommendations for coastal dune systems can be found in (Pickart and Sawyer 1998).

Establish an interagency collaboration to develop resource management guidelines. The California Native Plant Society Marin Chapter should continue to collaborate with NPS on monitoring the species.

The NPS has monitored the population and have conducted grazing enclosure studies. Based upon more detailed grazing studies, a grazing policy should be developed that enhances the species survival. Investigate establishing additional populations within suitable habitat areas. Sites should be identified that would be ecologically appropriate for potential introduction in historic localities (Fort Ross, Sebastopol, Petaluma) as well as sites at Point Reyes National Seashore.

4.3.2 Implement species management guidelines.

Investigate cost-sharing funding mechanisms to implement the management plan. This could involve multi-parcel funding and management. Funding to implement the management guidelines are expected to continue to be available from volunteer/donated labor; additional agency funding should be pursued.

4.4 Manage *Lupinus tidestromii* occurrences.

Develop and implement management practices for *Lupinus tidestromii* occurrences to ensure conservation of the species.

4.4.1 Establish a working group to collaborate with private landowners and appropriate agencies to develop specific management guidelines.

See discussion in 4.5.1 regarding the establishment of a successful collaborative effort between private and agency efforts to provide for the conservation of the listed species and their habitats. Detailed restoration recommendations for coastal dune systems can be found in Pickart and Sawyer (1998).

For privately-owned occurrences, establish an interagency-landowner(s) collaboration to develop resource management guidelines. DPR and NPS should continue to collaborate on plans for the occurrence at Asilomar State Beach and PRNS, respectively.

Working groups should develop management practices to ensure conservation of the species. Management guidelines should be developed to address control of invasive non-native plant species, insect/disease infestation, potential for artificial regeneration, buffer zones to non-compatible adjacent land uses, compatible levels of recreational uses, and monitoring protocols.

Within PRNS, the occurrences of *Lupinus tidestromii* (Table 10, NDDDB No. 12, 13, 14, 15, 16, and 20) are in areas largely excluded from cattle grazing. Part of a rare plant survey at PRNS recommended reducing grazing on dune areas to protect sensitive habitat and species (Fowler and Fellers 1984). All occurrences are away from trails. Invasive non-native plants are an increasing threat and some removal has been initiated. Guidelines should be developed to monitor encroachment and remove such species.

4.4.2 Implement species management guidelines.

Investigate cost-sharing funding mechanisms to implement the management plan. This could involve multi-parcel funding and management. Support for implementing the management guidelines may also be available through volunteer/donated labor, agency funding or a combination thereof.

4.5 Manage *Layia carnosa* occurrences.

Develop and implement management practices for *Layia carnosa* occurrences to ensure conservation of the species.

4.5.1 Establish a working group to collaborate with private landowners and appropriate agencies to develop specific management guidelines

A model working group in Humboldt County called The Dunes Forum is a local coalition of landowners, community members, private organizations, and public agencies. Through monthly meetings they promote coordinated, regional ecosystem management to conserve and restore dune ecosystems in Humboldt County. They should be contacted to provide suggestions on

formation of working groups in other areas as well as providing information on successful dune restoration techniques, trend analysis of *Layia carnosa*, and monitoring techniques and results. Currently the Bureau of Land Management hosts the meetings (contact Jennifer Anthony-Wheeler, Botanist, 707/825-2316). Detailed restoration recommendations for coastal dune systems can be found in Pickart and Sawyer (1998).

Within the Humboldt County Beach and Dunes Planning Area, the County has initiated a pilot study to test various sampling techniques for occurrence trend analysis for *Layia carnosa* (Table 9, No. L-1 through L-26). The two major issues for these occurrences are habitat loss and invasion by *Ammophila arenaria*, *Lupinus arboreus* and *Carpobrotus* spp.

Working groups should develop management practices to ensure conservation of the species. Management guidelines should be developed to address control of invasive non-native plant species, insect/disease infestation, potential for reintroduction, buffer zones to non-compatible adjacent land uses, compatible levels and/or seasonality of recreational uses, and monitoring strategies.

Within PRNS, the occurrences of *Layia carnosa* are in areas excluded from cattle grazing (Table 9, NDDB No. 7 and 8, and 19 through 26). There is little or no foot traffic, but invasive non-native plants, including *Ammophila arenaria* and *Carpobrotus* spp. are a likely threat. Guidelines to monitor and control encroachment of such species should be developed.

Vandenberg AFB should take immediate steps to conserve seeds from the single, southernmost known locality for the species. Vandenberg should develop specific guidelines for its long-term persistence, including control of exotic plants and habitat restoration accompanied by reintroduction, if necessary.

4.5.2 Implement species management guidelines.

Investigate cost-sharing funding mechanisms to implement the management plan. This could involve multi-parcel funding and management. Support for

implementing the management guidelines may also be available through volunteer/donated labor, agency funding or a combination thereof. Investigate the use of California ORV Division funds for dune restoration, protective fencing, signs and environmental education. The DOD should implement management actions for the occurrence at Vandenberg AFB.

4.6 Manage *Gilia tenuiflora* spp. *arenaria* occurrences.

Develop and implement management practices for *Gilia tenuiflora* ssp. *arenaria* occurrences to ensure conservation of the species.

4.6.1 Establish a working group to collaborate with private landowners and appropriate agencies to develop specific management guidelines.

See discussion in 4.5.1 regarding the establishment of a very promising collaborative effort between private and agency efforts to provide for the conservation of the listed species and their habitats. Detailed restoration recommendations for coastal dune systems can be found in Pickart and John Sawyer (1998).

For privately-owned occurrences, agencies and landowners should collaborate to develop resource management guidelines. The DOD and BLM should continue to coordinate on activities at Fort Ord, as outlined in the Fort Ord HMP. The DPR should continue to collaborate on actions at Marina, Salinas, and Asilomar State Beaches.

Working groups should develop management practices to ensure conservation of the species. Prepare management guidelines to address control of invasive non-native plant species, insect/disease infestation, potential for reintroduction, buffer zones to non-compatible adjacent land uses, compatible levels of recreational uses, and monitoring strategies.

4.6.2 Implement specific management guidelines.

Investigate cost-sharing funding mechanisms to implement the management plan. This could involve multi-parcel funding and management. Support for implementing the management guidelines may also be available through volunteer/donated labor, agency funding or a combination thereof.

Existing plans are being implemented for dune restoration and protection at Marina and Asilomar State Beaches.

4.7 Manage *Erysimum menziesii* occurrences.

Remove exotic plants, control trampling, and control off-road vehicles at *Erysimum menziesii* occurrences to ensure conservation of the species. Identify and implement any other necessary management practices.

4.7.1 Establish a working group to collaborate with private landowners and appropriate agencies to develop specific management guidelines.

See discussion in 4.5.1 regarding the establishment of a successful collaborative effort between private and agency efforts to provide for the conservation of the listed species and their habitats. Participants in The Dunes Forum have been active in providing for the protection and management of *Erysimum menziesii* in Humboldt County. Detailed restoration recommendations for coastal dune systems can be found in Pickart and Sawyer (1998).

For privately-owned occurrences, establish an interagency-landowner(s) collaboration to develop resource management guidelines. In Humboldt County, BLM and the Fish and Wildlife Service should continue to collaborate with the County, State and other Federal agencies on management practices.

Working groups should develop management practices for each parcel to ensure conservation of the species. Prepare management guidelines to address control of invasive non-native plant species, insect/disease infestation, potential

for reintroduction, buffer zones to non-compatible adjacent land uses, compatible levels of recreational uses, and monitoring strategies.

Major issues for all the *E. menziesii* occurrences are habitat loss, invasion by *Ammophila arenaria*, *Lupinus arboreus* (in Humboldt County) and *Carpobrotus* spp. and ORV trespass violations in Humboldt County.

4.7.2 Implement specific management guidelines.

Investigate cost-sharing funding mechanisms to implement the management plan. This could involve multi-parcel funding and management. Support for implementing the management guidelines may also be available through volunteer/donated labor, agency funding or a combination thereof.

DPR should continue to implement management actions at Marina State Beach (*E. menziesii* ssp. *yadonii*, NDDDB No. 5 and 6), Asilomar State Beach (*E. menziesii* ssp. *menziesii*, NDDDB No. 7), and MacKerricher State Park (e.g., Ten Mile Dunes Restoration Plan, affecting *E. menziesii* ssp. *menziesii*, Table 5, NDDDB No. 4). These actions include plant/habitat protection, fencing, revegetation and eradication of invasive, non-native plant species. The Fish and Wildlife Service should continue to implement actions to eradicate *Lupinus arboreus* from *E. menziesii* ssp. *menziesii* habitat at Lanphere Dunes (NDDDB No. 1). The Fish and Wildlife should support the monitoring of *Erysimum menziesii* occurrences at the preserve and conduct periodic monitoring of the other occurrences along Humboldt Bay.

4.8 Manage Myrtle's silverspot butterfly habitat.

Develop and implement management practices for Myrtle's silverspot butterfly populations to ensure conservation of the species.

4.8.1 Establish a working group to collaborate with private landowners and appropriate agencies to develop specific management guidelines.

See discussion in 4.5.1 regarding collaboration between private and agency efforts to provide for the conservation of the listed species and their habitats.

For privately-owned populations, establish an interagency-landowner(s) collaboration to develop resource management guidelines.

Working groups should develop management practices to ensure conservation of the silverspot, including prescribed/controlled burning, mowing, control of brush and invasive exotic plants, regulation of thatch levels, enhancement of natural seedbeds of *Viola adunca* and native nectar plants.

4.8.2 Implement specific management guidelines.

Investigate cost-sharing funding mechanisms to implement the management plan. This could involve multi-parcel funding and management. Support for implementing the management guidelines may also be available through volunteer/donated labor, agency funding or a combination thereof.

5. Monitor occurrences and threats to determine effectiveness of management and to establish delisting criteria.

5.1 Monitor occurrences to establish trends.

Wide population fluctuations, both spatially and temporally, have been observed within populations of *Chorizanthe valida* and *Layia carnosa*. While this may also be true for other listed species, data to confirm this are lacking. Studies should be conducted to document population dynamics and cycles to determine population trends for each species. Standard monitoring methods need to be used to track population data from one year to the next and compare results between sites.

Several techniques have been applied to sampling *Layia carnosa* habitat at the Lanphere Dunes. The refinements have reduced variation and compensate for

patchiness of occurrences increasing the accuracy of estimation. Plots have been made longer and narrower as described in the revised monitoring plan for *Layia carnosa* at the Lanphere Dunes (Pickart 1997).

Knowledgeable individuals that have prepared monitoring programs include:

Anni Eicher and Mignonne Bivin, Botanica Northwest Associates, P.O. Box 527, Arcata, CA 95521, (707) 826-7235. *Layia carnosa*, developed sampling design and mapped populations.

Joan Dorrell-Canepa, 26185 Carmelo St., Carmel, CA 93923. *Gilia tenuifolia* monitoring.

Gary Fellers, USGS Biological Resources Division, Point Reyes National Seashore, Point Reyes Station, CA 94956. *Chorizanthe valida*, *Layia carnosa*, *Lupinus tidestromii*, Myrtle's Silverspot butterfly, sampling techniques and monitoring.

Linda Miller, Restoration Manager, Center for Natural Lands Management, 6800 Lanphere Rd., Arcata, CA 95521, (707) 822-6378. *Erysimum menziesii*, *Layia carnosa*, mapping and monitoring.

Tom Moss, California Department of Parks and Recreation, 804 Crocker Ave., Pacific Grove, CA 93950. *Chorizanthe pungens*, *Erysimum menziesii*, *Layia carnosa*, *Lupinus tidestromii*, dune restoration and recreation management.

Renee Pasquinelli, California Department of Parks and Recreation, P.O. Box 440, Mendocino, CA 95460. *Chorizanthe howellii*, *Erysimum menziesii*, dune restoration and recreation management.

Andrea Pickart, U.S. Fish and Wildlife Service, Humboldt Bay National Wildlife Refuge, 1020 Ranch Road, Loleta, CA 95551, (707) 733-5406). *Erysimum menziesii*, *Layia carnosa*, long term monitoring design, sampling techniques and dune restoration.

Jennifer Anthony-Wheeler, Botanist, BLM Arcata Resource Area, 1696 Hendron Road, Arcata CA 95521, (707) 825-2316. *Erysimum menziesii*, *Layia carnosa*, dune management and monitoring.

5.2 Monitor effectiveness of reducing threats.

Standards to measure the success in reducing the levels of threats need to be developed. This will assist in the determination of the appropriateness to downlist or delist the species that no longer have active, serious threats and review the stability of their habitats.

5.3 Survey likely habitat for additional occurrences of listed taxa.

Recently, new occurrences have been discovered for several of the listed species. This may be due to an increase in field surveys within potential habitat, and/or an increased awareness of the species due to their regulatory status. Surveys may find additional occurrences. When discoveries are made it is the responsibility of the survey biologists to report those occurrences, preferably within two months, to the California Department of Fish and Game's Natural Diversity Data Base. Every effort should be made to initiate protective recovery actions for newly-discovered populations.

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

Other rare and endangered wildlife species occur within the ranges of the seven listed plant species. Management actions, such as the removal of invasive non-native plant species through herbicide application, may affect these species. Management actions should avoid adverse impacts to these species and their habitats, and actively include them in recovery actions to facilitate their reoccupation of historic ranges and prevent range collapse or declines in their abundance.

- The Smith's blue butterfly (*Euphilotes enoptes smithi*) is Federally listed as endangered. It typically occurs in fore and rear sand dunes in the Monterey Bay region. South of the Carmel River the species also occurs in grassland and coastal scrub and the interface between these two habitat types. Recovery actions for *Chorizanthe pungens* var.

pungens, *Layia carnosa*, *Lupinus tidestromii*, *Gilia tenuiflora* ssp. *arenaria*, and *Erysimum menziesii* may affect the Smith's blue butterfly where they co-exist. Management actions involving Federal funding or permits must be coordinated with the U.S. Fish and Wildlife Service, Ventura, California.

- The western snowy plover (*Charadrius alexandrinus nivosus*) is listed as threatened by the Service. Nesting habitat occurs along sandy beaches and might overlap with *Chorizanthe pungens* var. *pungens*, *Gilia tenuiflora* ssp. *arenaria*, *Erysimum menziesii*, *Layia carnosa*, and *Lupinus tidestromii*. Recovery actions for those species may affect the western snowy plover where they co-exist. Western snowy plover habitat should be fully considered in planning protection management, and restoration strategies for beach-dune systems pursuant to this recovery plan, in order to maximize multi-species, ecosystem-level benefits. Management actions involving Federal funding or permits must be coordinated with the U.S. Fish and Wildlife Service, Arcata, Sacramento or Ventura, California. Management actions should be coordinated with Service biologists from the Ventura and Sacramento Fish and Wildlife Offices.

- Marsh sandwort (*Arenaria paludicola*) and Gambel's watercress (*Rorippa gambelii*). Recovery actions for these federally endangered species, which occur in dune slack wetlands in the Santa Maria dune complex, should be coordinated with recovery actions of this plan. Proposed draft recovery actions for *A. paludicola* include establishment of reintroduced populations. This should be coordinated with the development of a dune restoration project at a historic locality at the Presidio, San Francisco.

- Nipomo mesa lupine (*Lupinus nipomoensis*). This state-listed endangered species is endemic to Pleistocene dunes of the Santa Maria dune complex, and is threatened by coastal development. It should be incorporated in protection, restoration, and reintroduction plans within this dune complex.

- Seaside bird's-beak (*Cordylanthus rigidus* ssp. *littoralis*). This state-listed endangered species is threatened by coastal development, and should be included in restoration, management, and protection plans within the Monterey Bay dune complex. Inclusion in recovery actions should avoid inadvertent adverse impacts, and maximize benefits of restoration or reintroduction for this species.

- San Francisco Lessingia (*Lessingia germanorum*). This federally endangered local endemic of the San Francisco peninsula dune remnants should be included in restoration, management and protection plans for coastal dune habitats there.

The following species are of conservation concern, although they are not federally or state listed. Some are very rare. Others are have declined to uncommon or rare status. These species should also be given full consideration in recovery actions:

- The Point Reyes blue butterfly (*Icaricia icarioides* undescribed subspecies) occurs in fore and rear dunes in the Point Reyes area. The species pupate in ground and their larval food is *Lupinus chamissonis*. Recovery actions for *Chorizanthe valida* and *Layia carnosa* may affect the Point Reyes blue butterfly where they co-exist.
- The Marin elfin butterfly (*Incisalia mossii* undescribed subspecies) inhabits the Dillon Beach area of Marin County where it inhabits rock outcrops and bluffs. Its larval food is *Sedum spathulifolium*. *Lupinus tidestromii* is recorded at Dillon Beach, although it has possibly been extirpated. Protection and restoration of Dillon Beach dunes should benefit *L. tidestromii*.
- Monterey dunes scorpion (*Pauroctonus maritimus*) occurs in sand dunes in the Monterey Bay area. Recovery actions for *Chorizanthe pungens* var. *pungens*, *Layia carnosa*, *Lupinus tidestromii*, *Gilia tenuiflora* ssp. *arenaria*, and *Erysimum menziesii* may affect the Smith's blue butterfly where they co-exist.
- Little bear scarab beetle (*Lichnanthe ursina*) occurs on coastal dunes at Point Reyes and likely in Sonoma, Marin, San Francisco, and San Mateo Counties. Recovery actions for Myrtle's silverspot butterfly, *Layia carnosa*, *Lupinus tidestromii*, western snowy plover, and other species may affect the little bear scarab beetle where they coexist.
- Globose dune beetle (*Coelus globosus*) occurs on foredunes from Bodega Bay south to Ensenada, Baja California, Mexico. Recovery actions for Myrtle's silverspot butterfly, *Layia carnosa*, *Lupinus tidestromii*, western snowy plover, and other species may affect the globose dune beetle where they coexist.
- barrier beach tiger beetle (*Cicindela hirticollis gravida*) occurs on sandy beaches from Bodega Bay south to Ensenada, Baja California, Mexico. Recovery actions for Myrtle's

silverspot butterfly, *Layia carnosa*, *Lupinus tidestromii*, and western snowy plover may affect the barrier beach tiger beetle where they coexist.

- Pink sand verbena (*Abronia umbellata* ssp. *breviflora*) occurs on the strand and foredunes and populations are widely scattered from Sonoma County north. Subspecies *umbellata* is somewhat less rare and ranges from Sonoma County south. Recovery actions for *Layia carnosa* and *Erysimum menziesii* may affect pink sand verbena where they co-exist. Recovery actions should incorporate protection and reintroduction of *A. umbellata*, particularly in the northern portion (north of Monterey Bay) of its historic range.

- Point Reyes horkelia (*Horkelia marinensis*) occurs on early Holocene and pre-Holocene dune soils from the vicinity of Fort Bragg to Santa Cruz County. Recovery actions for *Chorizanthe valida*, *Chorizanthe pungens* var. *pungens*, *Layia carnosa*, *Lupinus tidestromii*, *Gilia tenuiflora* ssp. *arenaria*, and *Erysimum menziesii* may affect Point Reyes horkelia where they co-exist.

- Gairdner's yampah (*Perideridia gairdneri* ssp. *gairdneri*) occurs in coastal flats from Sonoma County to Monterey County. Recovery actions for *Chorizanthe valida*, *Chorizanthe pungens* var. *pungens*, *Layia carnosa*, *Lupinus tidestromii*, *Gilia tenuiflora* ssp. *arenaria*, and *Erysimum menziesii* might affect Gairdner's yampah where its coastal flats habitat is close to dunes occupied by the listed species.

- Blasdal's bentgrass (*Agrostis blasdalei*). Potential recovery actions involving eradication of non-native vegetation could have indirect adverse impacts to this rare species at Point Reyes and Dillon Beach. Conversely, this species could benefit from dune protection and restoration, and should be incorporated in restoration, management, and protection plans.

- Coastal dunes milk-vetch (*Astragalus tener* var. *titi*). Potential recovery actions in Monterey Bay dune complex could have indirect adverse impacts to this extremely rare taxon. Conversely, this species should benefit from dune protection, restoration, and reintroduction, should be incorporated in restoration, management, and protection plans.

- Round-headed Chinese houses (*Collinsia corymbosa*) and northcoast phacelia (*Phacelia insularis* var. *continentis*). Potential recovery actions in north coast and north-central

coast dune systems (and in San Francisco) could have indirect adverse impacts to these very rare endemic north coastal dune species. Conversely, these species should benefit from dune protection, restoration, and reintroduction, and should be incorporated in restoration, management, and protection plans.

- Many other coastal dune plant species which have undergone significant declines in distribution and abundance within north-central or central coast dune systems (including dune slacks) should be incorporated in restoration, management, and protection plans developed as recovery actions within their current and historic ranges, in order to avoid inadvertent adverse impacts. By maximizing benefits of dune restoration and reintroduction for these species, future range collapse and endangerment may be avoided. They include: Nuttall's milk-vetch (*Astragalus nuttallii*), California saltbush (*Atriplex californica*), Monterey Indian paintbrush (*Castilleja latifolia*), spineflower (*Chorizanthe cuspidata*, including formerly-recognized varieties *cuspidata* and *villosa*), coast wallflower (*Erysimum ammophilum*), San Francisco wallflower (*Erysimum franciscanum*), yarrowleaf gilia (*Gilia millefoliata*), Kellogg's horkelia (*Horkelia cuneata* ssp. *sericea*), coast wildrye (*Leymus pacificus*), Monardella undulata (curly-leaved monardella), California ragwort (*Senecio californica* — distinctive coastal dune populations formerly recognized as *S. ammophilus* E. Greene), and dune tansy (*Tanacetum camphoratum*). Former dominant species *Leymus mollis*, now diminished to very low frequency and abundance in foredunes, should also be targeted for ancillary benefits of dune ecosystem recovery actions.

- Coastal dune plant species which have undergone significant declines in distribution and abundance within the south-central coast dune systems (including dune slacks) should be incorporated in restoration, management, and protection plans developed as recovery actions within their current and historic ranges, in order to avoid inadvertent adverse impacts. By maximizing benefits of dune restoration and reintroduction for these species, future range collapse and endangerment may be avoided. They include: beach spectaclepod (*Dithyrea maritima*), La Graciosa Thistle (*Cirsium loncholepis*), surf thistle (*Cirsium rhotophilum*), compact cobwebby thistle (*Cirsium occidentale* var. *compactum*), Blochman's leafy daisy (*Erigeron blochmaniae*), subshrubby wallflower (*Erysimum insulare* ssp. *suffrutescens*), and curly-leaved monardella (*Monardella undulata*).

7. Develop ecosystem restoration and multi-species reintroduction projects at degraded dune systems.

Numerous dune systems within the historic range of listed species and species of concern have either reduced value or none for them because of past or ongoing degradation of habitat quality. Benefits for multiple species can be efficiently regained by establishing habitat and population restoration programs for these undermanaged or degraded dune systems. By returning independent dune systems within historic range of rare species to current ecological function, the risk of species extinction can be substantially decreased. Dune systems with potential high “yield” for multiple rare species include:

- North spit to Mad River spit, Humboldt Bay (multiple ownership). To maintain the benefits of habitat restoration and population protection at the Lanphere dunes (now a National Wildlife Refuge), exotic plants invading from adjacent dunes in the dispersal area must be controlled. Extant (and presumed extant) species are *Layia carnosa*, *Erysimum menziesii* ssp. *menziesii*, western snowy plover, *Leymus mollis*, *Abronia umbellata*, and *Collinsia corymbosa*.
- Manchester dunes (Point Arena, Mendocino County). Dominated by *Ammophila* resulting from early 20th century plantings; also *Lupinus arboreus*. Potential target species are *Erysimum menziesii*, *Layia carnosa*, *Collinsia corymbosa*, *Leymus mollis*, *Abronia umbellata*, *Phacelia insularis*, *Horkelia marinensis*, and western snowy plover.
- Bodega Head and Doran Spit. This area is dominated by European beachgrass (*Ammophila*) resulting from mid-twentieth century plantings. Potential target species are *Layia carnosa*, *Lupinus tidestromii*, western snowy plover, *Collinsia corymbosa*, *Leymus mollis*, *Leymus pacificus*, *Abronia umbellata*, *Horkelia marinensis*, *Agrostis blasdalei*, *Chorizanthe cuspidata*, and *Gilia millefoliata*.
- Dillon Beach dune complex. This area has European beachgrass in foredunes, uncontrolled cattle grazing and recreational impacts elsewhere. Extant (presumed) species are *Lupinus tidestromii*, western snowy plover, *Chorizanthe cuspidata*, *Agrostis blasdalei*. Potential species are Myrtle’s silverspot butterfly, *Layia carnosa*, *Leymus mollis*, *Abronia umbellata*, *Horkelia marinensis*, and *Gilia millefoliata*.

- San Francisco (Fort Funston, Ocean Beach, Baker Beach and Lobos Creek dunes). Extant species are *Lessingia germanorum*, western snowy plover, *Leymus mollis*, *Leymus pacificus*, *Abronia umbellata*, *Tanacetum camphoratum*, *Erysimum franciscanum*,. Potential species: *Layia carnosa*, *Arenaria paludicola*, *Collinsia corymbosa*, *Horkelia cuneata* ssp. *sericea*, *Castilleja latifolia*, *Astragalus nuttallii*, *Monardella undulata*.
- Monterey Bay sand mine (Lonestar) is a connector between Salinas River State Beach and Salinas River National Wildlife Refuge. Extant species are *Erysimum menziesii* ssp. *yadonii* (largest natural population), *E. m.* ssp. *menziesii*, western snowy plover, *Castilleja latifolia*, *Atriplex californica*, and *Senecio californica*. Potential species include *Lupinus tidestromii*, *Gilia tenuiflora* ssp. *arenaria*, *Layia carnosa*, *Erysimum ammophilum*, *Cordylanthus rigidus* ssp. *littoralis*, and *Astragalus tener* var. *titi*.
- Santa Maria dune complex (multiple ownership, public and private). Many segments of this large system are undermanaged for benefits to endangered or rare species, or are subject to threats. Extant target species include *Arenaria paludicola*, *Rorippa gambelii*, western snowy plover, *Senecio blochmaniae*, *Dithyrea maritima*, *Erysimum insulare*, *Cirsium rhotophilum*, *Cirsium occidentale* var. *compactum*, *Cirsium loncholepis*, and *Lupinus nipomoensis*.

Individual dune ecosystem restoration projects would commence by initial screening and inventory in cooperation with landowners, followed by feasibility studies for restoration of geomorphic processes and vegetation, including reintroductions.. Restoration in most cases would be based on large-scale removal of exotic vegetation and mass revegetation with common native species, followed by focused reintroduction experiments with demographic design and monitoring, involving listed species and species of concern.

Within dune systems currently supporting populations of listed species, extensive areas of potentially suitable habitat exist which have become unsuitable because of adverse land use practices or detrimental neglect. Such areas, when contiguous with or within relatively short dispersal range of extant populations of listed species, should be restored (primarily by eliminating exotic vegetation), and be monitored for spontaneous recolonization by listed species. When such areas are remote from extant populations (beyond predictable dispersal distances within the timeframe of this recovery plan), they

should be subject to scientifically designed and conducted reintroduction experiments, and followed with demographic monitoring methods.

7. Develop and implement an outreach program.

Increasing public awareness of the seven endangered plant species and the Myrtle's silverspot butterfly will facilitate efforts to preserve these species,, associated rare species, and the coastal dune ecosystem. Prepare and distribute regionally specific informational brochures and audio-visual and sign programs on preservation and recovery. Through the cooperative interagency working groups, prepare brochures and audio-visual materials that describe the plight of the listed species and the regional efforts being undertaken for their recovery. Disseminate the brochures to affected landowners and other community facilities. Provide the audio-visual materials to public facilities, such as park interpretive programs and school programs. Prepare interpretive educational signs for PRNS and other locations.

C. LITERATURE CITED

- Arnold, R.A. 1988. Ecological and behavioral studies on the threatened Oregon silverspot butterfly at its Rock Creek, Cascade Head, Mt. Hebo, and Clatsop Plains populations in Oregon. Unpublished report prepared for the U.S. Fish and Wildlife Service, Olympia, WA. 63 pp. + figures.
- Arnold, R.A. 1990. Candidate insect surveys at Marin Coast Golf Ranch site. Unpublished report to Harding Lawson Associates, Novato, Calif.
- Barbour, M.G. and A.F. Johnson. 1977. Beach and Dune Pp. 223–261. *In* M.G. Barbour and J. Major (eds.). *Terrestrial Vegetation of California*. John Wiley & Sons, New York. (reprinted 1988 as California Native Plant Society Special Publication 9).
- Bentham, G. 1836. *Trans. Linn. Soc. London* 17:419.
- Best, C., J. T. Howell, W. Knight, I. Knight, and M. Wells. 1996. A flora of Sonoma County: manual of the flowering plants and ferns of Sonoma County, California. California Native Plant Society Press, Sacramento. xi + 347 pp.
- Boggs, C.L. and C.L. Ross. 1993. The effect of adult food limitation on life history traits in *Speyeria mormonia* (Lepidoptera: Nymphalidae). *Ecology* 74:433-441.
- Bolander, H. N. 1863. Enumeration of shrubs and trees growing in the vicinity of the mouth of San Francisco Bay. *Proc. Cal. Acad. Sci.* 2: 78-83
- Botanica Northwest Associates. 1992. Monitoring Plan for Menzies' Wallflower (*Erysimum menziesii*) in the Humboldt County Beach and Dunes Planning Area. Unpublished draft report, August, 1992.
- Brewer, W.H. S. Watson, and A. Gray. 1880. *Geological Survey of California. Botany. Second Edition.* John Wilson and Son, Cambridge, Massachusetts
- California Department of Fish and Game. 1985a. California native plant status report, *Chorizanthe howellii*. CDFG Endangered Plant Program and CNPS Rare Plant Program.

- California Department of Fish and Game. 1985b. California native plant status report, *Lupinus tidestromii* var. *tidestromii*. CDFG Endangered Plant Program and CNPS Rare Plant Program.
- California Native Plant Society. 1980. Marin Chapter newsletter, September 1980. 7(1).
- Clark, R.A. and G.M. Fellers. 1986. Rare plants of Point Reyes National Seashore. Cooperative National Park Resources Studies Unit, Tech. Rpt. No. 22. University of California, Davis.
- Collins, N.M. and M.G. Morris. 1985. Threatened swallowtail butterflies of the world. The IUCN Red Data Book. International Union for Conservation of Nature and Natural Resources, Gland, Switzerland.
- Cooper, W.S. 1936. The strand and dune flora of the Pacific coast of North America: a geographic study. In: T.H. Goodspeed (ed.) Essays in Geobotany. University of California Press. pp. 141-187.
- Cooper, W.S. 1958. The Coastal Dunes of Oregon and Washington. Geol. Soc. Amer. Mem. 72. 169 pp.
- Cooper, W.S. 1967. Coastal dunes of California. Geol. Soc. Amer. Mem. 104:1-125.
- Cowan, B. 1994. Dune restoration, Naval Postgraduate School. Unpublished report, U.S. Fish and Wildlife Service.
- Davis, L. 1988a. Rare plant status of Lunny Ranch, south of and bordering Abbott's Lagoon. Report to Bill Shook, Resource Management Specialist, Pt. Reyes National Seashore.
- Davis, L. 1988b. Letter to Dr. James Reveal, University of Maryland, dated 12 October 1988.
- Davis, L. 1988c. Management recommendation on Abbott's Lagoon. Report submitted 20 October 1988 to Pt. Reyes National Seashore park management.
- Davis, L. and R.J. Sherman. 1990. The rediscovered Sonoma spineflower at Point Reyes National Seashore. *Fremontia* 18(1):17-18.
- Dempster, J.P. 1983. The natural control of populations of butterflies and moths. *Biol. Rev.* 58:461-481.

- Department of Parks and Recreation. 1991. Letter to Wayne White, USFWS. Dated May 21, 1991.
- Department of the Interior, Fish and Wildlife Service (see U.S. Fish and Wildlife Service).
- Department of Justice. 1993. United States v. Skalski et al. (indictment by the U. S. Attorney's Office). San Jose, California.
- Dorrell-Canepa, Joey. 1992. Annual Report on *Gilia tenuiflora* ssp. *arenaria*. Prepared for Calif. Dept. of Fish and Game. Sacramento, CA. [not cited in text]
- Dorrell-Canepa, Joey. 1994. An Autoecological Study of *Gilia tenuiflora* ssp. *arenaria*. Prepared for Calif. Dept. of Fish and Game. Sacramento, CA.
- dos Passos, C.F. and L.P. Grey. 1945. A new species and some new subspecies of *Speyeria* (Lepidoptera, Nymphalidae). Amer. Mus. No. 1297.
- Duebendorfer, T. 1985. Habitat Survey of *Erysimum menziesii* on the North Spit of Humboldt Bay. Unpublished report, Humboldt County Public Works Dept. Eureka, Calif. [not cited in text]
- Eastwood, A. 1938. The perennial lupines of California, Part I. Leaf. W. Bot. 2:86.
- Erter, B. 1990. Report on the results of a panel to evaluate the taxonomic validity of *Chorizanthe robusta* var. *hartwegii*. Unpublished report submitted to the U.S. Fish and Wildlife Service.
- Ferreira, J. 1989. Project status report on dune restoration at Sunset State Beach. Unpublished report no. 219-410-01-04. CDFG.
- Ferris, R.S. 1960. Illustrated flora of the Pacific states. Vol. IV. Stanford Univ. Press.
- Fowler, R.C. and G.M. Fellers. 1984. Rare plants of Point Reyes National Seashore. Tech. Rpt. 22, Cooperative National Park Studies Unit, U.C. Davis. Calif. 117 pp.
- Gall, L.F. 1984. Population structure and recommendations for conservation of the narrowly endemic alpine butterfly, *Boloria acrocneuma* (Lepidoptera: Nymphalidae). Biol. Cons. 28:111-138.

- Godfrey, P. J., S.P. Leatherman, and R. Zaremba 1979. A geobotanical approach to classification of barrier beach systems. *In* Leatherman, S.P., ed. Barrier Islands from the Gulf of St. Lawrence to the Gulf of Mexico. Academic Press.
- Goodman, G.L. 1934. A revision of the North American species of the genus *Chorizanthe*. *Annals of the Missouri Botanical Garden* 21:44.
- Grant, Verne and Alva Day Grant. 1956. Cobwebby Gilias. *El Aliso* 3:3(246–247).
- Greene, E.L. 1892. Studies in the Compositae. *Pittonia* 2:244–248.
- Greene, E.L. 1895. Novitates occidentales-X. *Erythea* 3:17.
- Hammond, P. and D. V.McCorkle. 1983 (1984). The decline and extinction of *Speyeria* populations resulting from human environmental disturbances (Nymphalidae: Argynninae). *J. Res. Lepidoptera* 22:217-224.
- Hickman, J.C. (ed.). 1993. *The Jepson Manual Higher Plants of California*. Berkeley: Univ. of Calif. Press. 1,400 pp. (Individual treatments in the Manual treatments are cited under their own authors).
- Howe, W.H. 1975. *The Butterflies of North America*. Doubleday & Co., Inc. Garden City, NY. 633 pp.
- Jepson, W.L. 1911. *A Flora of Middle Western California*. Cunningham, Curtiss and Welch, San Francisco (Reprinted corrected edition of 1901 publication).
- Launer, A.E. and D.D. Murphy. 1993. Field studies and management recommendations for Myrtle's silverspot butterfly at Point Reyes National Seashore. Center for Conservation Biology, Stanford University. [not cited]
- Launer, A.E. and D.D. Murphy. 1994. The decline of Myrtle's silverspot butterfly. *Tideline* 14(1):1–3.[not cited]
- Launer, A.E., D.D. Murphy, J.M. Hoekstra, and H.R. Sparrow. 1992 (1994). The endangered Myrtle's silverspot butterfly: present status and initial conservation planning. *J. of Res. on the Lepidoptera* 31(1–2):132–146.
- Little, R.J. 1993. Violaceae: Violet family. Pp. 1089–1092 *in* J.C. Hickman, ed., *The Jepson Manual: Higher Plants of California*. University of California Press, Berkeley.

- Mattoon, S., R. Davis, and O. Spencer. 1971. Rearing techniques for species of Speyeria (Nymphalidae). *J. Lep. Soc.* 25:247–256.
- McCorkle, D. V. 1980. Ecological investigation report: Oregon silverspot butterfly (*Speyeria zerene hippolyta*). Unpublished report to the Siuslaw National Forest, U.S.D.A. Forest Service, Corvallis, OR. 117 pp.
- McCorkle, D. V. and P. Hammond. 1988. Biology of *Speyeria zerene hippolyta* (Nymphalidae) in a marine-modified environment. *Jour. Lep. Soc.* 42:184–183.
- McIver, J., S. Muttillinja, D. Pickering, and R. Van Buskirk. Undated, circa 1990. Population dynamics and habitat selection of the Oregon silverspot butterfly (*Speyeria zerene hippolyta*): a comparative study at four primary sites in Oregon. Unpublished report to the Siuslaw National Forest, U.S.D.A. Forest Service, Corvallis, OR, submitted by The Nature Conservancy, Portland, OR. 61 pp.
- McLaren, J. 1924. Gardening in California: Landscape and Flower. A.M. Robinson Publ. San Francisco.
- Miller, L.M. 1987. The introduction history of yellow bush lupine (*Lupinus arboreus* Sims) on the north spit of Humboldt Bay, California. Unpublished report for the Nature Conservancy, California Field Office, San Francisco
- Miller, L.M. 1988. How yellow bush lupine came to Humboldt Bay. *Fremontia* 16: 6-7.
- Moldenke, A.R. 1976. California pollination ecology and vegetation types. *Phytologia* 34(4):305–361.
- Munz, P.A. 1958. California miscellany IV. *Aliso* 4:92.
- Munz, P.A. and D.D. Keck. 1959. A California Flora. Univ. Calif. Press, Berkeley.
- Murphy, D.D. 1988. Are we studying our endangered butterflies to death? *J. Res. Lepidoptera* 26(104):236–239.
- Murphy, D.D. and A.E. Launer. 1991. Report on the status of Myrtle's silverspot butterfly, *Speyeria zerene myrtleae*, at the proposed Marin Coast Golf Ranch site and in surrounding areas. Unpublished report. Center for Conservation Biology, Stanford Univ., Stanford, CA.
- NDDB. 1996. Natural Diversity Data Base, California Department of Fish and Game

- Norris, Virginia. 1988. CNDDDB Field Survey Form, submitted to CNDDDB, May 27, 1988, Sacramento, CA.[cited in text as “in litt”]
- Nuttall, T. 1841. Descriptions of new species and genera of plants in the natural order of the Compositae. Amer. Phil. Soc. Trans. II 7:283–453.
- Parry, C. 1889. Proc. Davenport Acad. Nat. Sci. 5:175.
- Pickart, A.J. 1988. 1988 Monitoring Report for Menzies’ Wallflower (*Erysimum menziesii*) at the Lanphere-Christian Dunes Preserve.
- Pickart, A.J. 1997. Monitoring plan for beach layia (*Layia carnosa*) at the Lanphere-Christian Dunes Preserve.
- Pickart, A.J., L. Miller, and T. Duebendorfer. 1990. An integrated approach to enhancing rare plant populations through habitat restoration III. Restoration of altered coastal dunes. Pp. 478–487 in H. Hughs and T. Bonnicksen, eds. Restoration 89; The new management challenge. Society for Ecological Restoration. Madison, Wisconsin.
- Pickart, A.J., L.M. Miller, and T. E. Duebendorfer. 1998. Yellow bush lupine invasion in northern California Coastal Dunes. I. Ecological Impacts and manual removal techniques. Restoration Ecology 6: 59-68.
- Pickart, A.J., and J. Sawyer. 1998. Ecology and restoration of northern California coastal dunes. California Native Plant Society.
- Price, R.A. 1986. Letter to Ken Berg, Humboldt State University Herbarium, dated May 12, 1986. [not cited]
- Price, R.A. 1987. Systematics of the *Erysimum capitatum* alliance (Brassicaceae) in North America. Ph.D. Dissertation, Univ. Calif., Berkeley.
- Price, R.A. 1993. *Erysimum*. Pp. 421–422 in J.C. Hickman, ed., The Jepson Manual: Higher Plants of California. University of California Press, Berkeley.
- Ranwell, D.S. 1972. Ecology of Salt Marshes and Sand Dunes. Chapman and Hall, London. 258 pp.
- Renner, M.A. (ed.), K. Berg, K.L. Clark, T. Duebendorfer and G.A. Newton. 1986. Draft Menzies’ Wallflower Dunes Mitigation Bank Enhancement Plan, Monitoring

- Plan, Implementation Schedule. Unpublished technical report, September 15, 1986. [not cited]
- Reveal, J.L. and C.B. Hardham. 1989. A revision of the annual species of *Chorizanthe* (Polygonaceae: Eriogonoideae). *Phytologia* 66(2):98–198.
- Riggins, R. and T. Sholars. 1993. *Lupinus*. Pp. 622–636 in J.C. Hickman, ed., *The Jepson Manual: Higher Plants of California*. University of California Press, Berkeley.
- Sawyer, J.O., Jr. 1991. The Menzies Wallflower Research Program. Unpublished report, Humboldt State University Department of Biological Science, Arcata, California.
- Sawyer, J.O. and T. Keeler-Wolf. 1995. *A manual of California Vegetation*. California Native Plant Society.
- Schaeffer, K.J. and S.L. Kiser. 1994. Hypotheses concerning population decline and rarity in insects. In W.W. Covington and L.F. DeBano (eds.), *Sustainable Ecological Systems: Implementing an Ecological Approach to Land Management*. U.S.D.A. Forest Service, General Technical Report RM-247. Rocky Mountain Forest and Range Experiment Station, Fort Collins, CO, pp. 78-84.
- Schlocker, J. 1974. *Geology of the San Francisco North Quadrangle, California*. U.S. Geological Survey Professional Paper 782, United States Government Printing Office, Washington.
- Scott, J.A. 1986. *The butterflies of North America*. Stanford University Press, Stanford, CA.
- Seabloom, E.W. and A.M. Wiedemann. 1994. Distribution and Effects of *Ammophila breviligulata* Fern. (American beachgrass) on the foredunes of the Washington Coast. *J. Coastal Research* 10: 178-188.
- Singer, M.C. and P.D. Wedlake. 1981. Capture does affect probability of recapture in a butterfly species. *Ecological Entomology* 6:215–216.
- Swengel, A.B. 1996. Effects of fire and hay management on abundance of prairie butterflies. *Biol. Conserv.* 76:73-85.
- Thomas, J.H. 1961. *Flora of the Santa Cruz Mountains of California: A Manual of the Vascular Plants*. Stanford University Press.

- Thomas Reid Associates. 1987. Marina Dunes Plan, Supporting Technical Studies. Prepared for Marina Coastal Zone Planning Task Force. Palo Alto, CA.
- Torrey, J. and A. Gray. 1843. *Fl. N. Amer.* 2:394.
- U.S. Army Corps of Engineers (COE), Sacramento District. 1992. Flora and fauna baseline study of Fort Ord, California. With technical assistance from Jones & Stokes Associates, Inc. (JSA 90–214). Sacramento, Calif.
- U.S. Army Corps of Engineers (COE), Sacramento District. 1993. Installation-wide Multispecies Habitat Management Plan for Fort Ord, California. Sacramento, CA. [not cited]
- U.S. Fish and Wildlife Service. 1991. Endangered and threatened wildlife and plants; emergency rule to list the Mitchell's Satyr as endangered. *Federal Register* 56:28825-28828, June 25, 1991
- U.S. Fish and Wildlife Service. 1992. Endangered and threatened wildlife and plants: six plants and Myrtle's silverspot butterfly from coastal dunes in northern and central California determined to be endangered. *Federal Register* 57 (120): 27848–27859.
- U.S. Fish and Wildlife Service. 1994. Endangered and Threatened Wildlife and Plants: Endangered Status for Three Plants and Threatened Status for One Plant from Sandy and Sedimentary Soils of Central Coastal California. *Federal Register* 59(24): 5499–5510.
- U.S. Fish and Wildlife Service. 1998. Draft Recovery Plan for Serpentine Soil Species of the San Francisco Bay Area. U.S. Fish and Wildlife Service, Portland, OR. 330 pp.
- Zoger, A. and B. Pavlik. 1987. Marina Dunes rare plant survey. Report prepared for Marina Coastal Zone Planning Task Force.

III. IMPLEMENTATION SCHEDULE

The Implementation Schedule is a guide for meeting the objectives discussed in Part II of this plan. This schedule indicates task priorities, task numbers, brief task descriptions, duration of tasks, the responsible agencies, and lastly, estimated costs. These actions, when accomplished, should bring about the recovery of the species and protect its habitat. Priorities in column one of the following implementation schedule 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 the species' population/habitat quality or some other significant negative impact short of extinction.
- Priority 3: All other actions necessary to meet the recovery objective.

Key to Acronyms used in Implementation Schedule

VFO	U.S. Fish and Wildlife Service (Ventura Field Office)
SFO	U.S. Fish and Wildlife Service (Sacramento Field Office)
PLO	Private Land Owners
TBD	To be determined
NPS	National Park Service
BLM	Bureau of Land Management
ACOE	Army Corps of Engineers
WG	Working Group
ongoing	To continue until the action is no longer necessary for recovery
AGENCIES	Refers to the local lead agencies with planning authority for actions that may affect the listed species

PRIORITY NO.	TASK NO.	TASK DESCRIPTION	DURATION [YEARS]	RESPONSIBLE PARTY	TOTAL COST ESTIMATES (in thousands of dollars)					
					COST	YR1	YR2	YR3	YR4	YR5
Need 1. Protect existing populations and habitats										
1	1.11	Inform land owners – <i>Chorizanthe pungens</i> var. <i>pungens</i>	3	FWS	10	2	2	2	2	2
1	1.12	Consult agencies – <i>Chorizanthe pungens</i> var. <i>pungens</i>	ongoing	FWS/VFO	10	2	2	2	2	2
1	1.21	Inform land owners – <i>Chorizanthe howellii</i>	3	FWS/SFO	10	2	2	2	2	2
1	1.22	Consult agencies – <i>Chorizanthe howellii</i>	ongoing	FWS/SFO	10	2	2	2	2	2
1	1.31	Inform land owners – <i>Lupinus tidestromii</i>	3	FWS/SFO	10	2	2	2	2	2
1	1.32	Consult agencies – <i>Lupinus tidestromii</i>	ongoing	FWS/SFO	10	2	2	2	2	2
1	1.41	Inform land owners – <i>Layia camosa</i>	3	FWS/SFO	10	2	2	2	2	2
1	1.42	Consult agencies – <i>Layia camosa</i>	ongoing	FWS/SFO	10	2	2	2	2	2
1	1.51	Inform land owners – <i>Gilia tenuiflora</i> ssp. <i>arenaria</i>	3	FWS/VFO	10	2	2	2	2	2
1	1.52	Consult agencies – <i>Gilia tenuiflora</i> ssp. <i>arenaria</i>	ongoing	FWS/VFO	10	2	2	2	2	2
1	1.61	Inform land owners – <i>Erysimum menziesii</i>	3	FWS/SFO/VFO	11	3	2	2	2	2
1	1.62	Consult agencies – <i>Erysimum menziesii</i>	ongoing	FWS/SFO/VFO	10	2	2	2	2	2
1	1.7	Protect Myrtle's silverspot butterfly habitat	5(+)	TBD(PRIVATE)	0	0	0	0	0	0
1	6	Protect other listed & sensitive taxa	ongoing	TBD(AGENCY & PRIVATE)	5	1	1	1	1	1
NEED 1 SUBTOTALS.....					126	26	25	25	25	25
Need 2. Establish active management for the reduction of non-native invasive plant species. Minimize threats										
1	2.11	Minimize invasive plant threats on private land	ongoing	PLO	25	5	5	5	5	5
1	2.12	Minimize invasive plant threats on public lands	ongoing	AGENCIES	100	20	20	20	20	20
1	2.2	Deter poaching –silverspot	ongoing	AGENCIES	10	2	2	2	2	2
NEED 2 SUBTOTALS.....					135	27	27	27	27	27

PRIORITY NO.	TASK NO.	TASK DESCRIPTION	DURATION [YEARS]	RESPONSIBLE PARTY	TOTAL COST ESTIMATES (in thousands of dollars)					
					COST	YR1	YR2	YR3	YR4	YR5
Need 3. Develop management strategies										
1	3.1	Examine effects of cattle grazing on plant habitat	5	TBD	25	5	5	5	5	5
1	3.21	Investigate grazing effects on plant habitat	5	TBD	25	5	5	5	5	5
1	3.22	Myrtle's silverspot butterfly life history	5							
1	3.3	Investigate grazing effects on Myrtle's silverspot butterfly	5	TBD	25	5	5	5	5	5
2	3.4	Determine habitat requirements for plants	5	TBD	25	5	5	5	5	5
2	3.5	Determine habitat requirements for butterfly	5	FWS	25	5	5	5	5	5
				TBD	25	5	5	5	5	5
2	3.6	Investigate crucifer rust for <i>Erysimum menziesii</i>	5	BLM,FWS,TNC	25	5	5	5	5	5
NEED 3 SUBTOTALS.....					150	30	30	30	30	30
Need 4. Manage populations and habitats										
2	4.11	Establish working group – <i>Chorizanthe pungens</i>	3	FWS	20	10	5	5	0	0
2	4.12	Implement guidelines -- <i>Chorizanthe pungens</i>	4	TBD	25	0	5	10	5	5
2	4.21	Establish working group – <i>Chorizanthe howellii</i>	3	FWS	20	10	5	5	0	0
2	4.22	Implement guidelines -- <i>Chorizanthe howellii</i>	4	TBD	25	0	5	10	5	5
2	4.31	Establish working group – <i>Chorizanthe valida</i>	3	FWS, NPS	20	10	5	5	0	0
2	4.32	Implement guidelines – <i>Chorizanthe valida</i>	4	TBD	25	0	5	10	5	5
2	4.41	Establish working group – <i>Lupinus tidestromii</i>	3	FWS	20	10	5	5	0	0
2	4.42	Implement guidelines – <i>Lupinus tidestromii</i>	4	TBD	25	0	5	10	5	5
2	4.51	Establish working group – <i>Layia camosa</i>	3	FWS	20	10	5	5	0	0
2	4.52	Implement guidelines – <i>Layia camosa</i>	4	TBD	25	0	5	10	5	5
2	4.61	Establish working group – <i>Gilia tenuiflora ssp. arenaria</i>	3	FWS	20	10	5	5	0	0
2	4.62	Implement guidelines – <i>Gilia tenuiflora ssp. arenaria</i>	4	TBD	25	0	5	10	5	5
2	4.71	Establish working group – <i>Erysimum menziesii</i>	3	FWS	20	10	5	5	0	0
2	4.72	Implement guidelines – <i>Erysimum menziesii</i>	4	TBD	25	0	5	10	5	5

PRIORITY NO.	TASK NO.	TASK DESCRIPTION	DURATION [YEARS]	RESPONSIBLE PARTY	TOTAL COST ESTIMATES (in thousands of dollars)					
					COST	YR1	YR2	YR3	YR4	YR5
2	4.81	Establish working group – Silverspot	3	FWS	20	10	5	5	0	0
2	4.82	Implement guidelines – Silverspot	4	TBD	25	0	5	10	5	5
NEED 4 SUBTOTALS.....					360	80	80	120	40	40
Need 5. Monitor populations and threats.										
3	5.1	Monitor populations – trends	5	TBD	25	5	5	5	5	5
				FWS	5	1	1	1	1	1
3	5.2	Monitor success at reducing threats	5	TBD	25	5	5	5	5	5
				FWS	5	1	1	1	1	1
3	5.3	Survey likely habitat	ongoing	TBD	25	5	5	5	5	5
				FWS	5	1	1	1	1	1
NEED 5 SUBTOTALS.....					90	18	18	18	18	18
Need 6. Coordinate recovery actions to protect other listed and sensitive species.										
3	6	Protect other listed and sensitive species	ongoing	FWS	5	1	1	1	1	1
				AGENCIES	5	1	1	1	1	1
NEED 6 SUBTOTALS.....					10	2	2	2	2	2
Need 7. Develop and implement outreach program										
3	7	Outreach program	ongoing	TBD	25	5	5	5	5	5
				FWS	5	1	1	1	1	1
NEED 7 SUBTOTALS.....					30	6	6	6	6	6
TOTAL COSTS.....					901	189	188	228	148	148

APPENDIX I. Summary of the Agency and Public Comments on the Draft Recovery Plan.

On September 30, 1997, the Service released the Draft Recovery Plan for seven coastal plants and a butterfly for a 90-day comment period that ended on December 29, 1997, for Federal agencies, State and local governments, and members of the public (62 Federal Register 51122).

Ten letters were received, each containing varying numbers of comments. Local jurisdictions and agencies that responded included the City of Fort Bragg, the Bureau of Land Management Arcata Office, the U.S. Geologic Survey Biologic Resources Division Point Reyes, and the Department of the Army Presidio of Monterey. Copies of the draft recovery plan were sent to a total of 48 interested parties. Peer review of a pre-draft version of the document and issues had been accomplished by a recovery planning meeting on November 16, 1996. The meeting was sponsored by the California Department of Fish and Game, funded through Section 6 of the Endangered Species Act. Participants are named in the acknowledgments section at the front of the recovery plan.

The number of letters received, by affiliation:

Local governments	1
Environmental/conservation organizations	5
Federal Agencies	3
Private parties	1

Summary of Significant Comments and Service Responses

The Service reviewed all of the comments received during the comment period. Comments that were technical in nature or updated the information in the draft recovery plan have been incorporated into the appropriate sections of the recovery plan.

Summarized below are comments that were more substantive, along with the Service's response to each, and an indication as to what modifications were made to the plan, if any:

Comment 1: The general approach to recovery presented in the plan is not specific enough to be applied to pending development proposals.

Response: The recovery plan is intended to provide guidance and direction on the actions needed to protect and manage the six taxa to achieve recovery. It is not intended to provide specific and rigid instructions for these activities. Differing situations will necessarily require that the appropriate activities be tailored for each situation.

Comment 2: The scientific background for downlisting criteria is lacking.

Response: Section 4(f)(1)(B) of the Endangered Species Act directs the Service to incorporate objective and measurable criteria for recovery, as well as to estimate the time required and the costs to carry out measures that would achieve intermediate and final goals toward recovery. The Service endeavors to make the best determination regarding threshold levels to be reached to trigger downlisting, and eventually delisting, based on the best information that is available when the recovery plan is prepared. The Service fully expects that these criteria may be revised in the future as additional information is gathered through monitoring, research, and implementation of recovery actions.

Comment 3: The use of introduction into unoccupied, potential or historic habitats should not be considered a “last ditch” effort for the recovery

Response: The plan has been revised to more clearly emphasize the need to restore dunes habitats that have been degraded by invasive weeds and recreational disturbance. The plan encourages efforts to re-establish these plants in restored habitats. However, recovery of listed taxa will seldom require the reoccupation of their entire historic distributions. The participation of land owners of unoccupied, potential habitat would be encouraged under guidance but is not generally considered essential for recovery. In a number of cases, if the existing distributions are protected from those threats, downlisting and recovery are possible.

APPENDIX II. Mailing List.

Karen Miller
U. S. Fish and Wildlife Service
3310 El Camino Ave. Suite 130
Sacramento, CA 95821-6340

Amy Dickerson
Chambers Group
17671 Cowan Ave. - Suite 100
Irvine, CA 92614

B.D. "Diann" Beene
Phillips Petroleum Company
Laws & Regs Dept.
P.O. Box 1967
Houston, TX 77251

Bruce Delgado
Hollister BLM
20 Hamilton Court
Hollister, CA 95023

California State Coastal Commission
Capitol Office
921 11th Street, Room 1200
Sacramento, CA 95814

California Native Plant Society
Attn: Dave Tibor
1722 J Street # 17
Sacramento, CA 95814

California Department of Fish and Game
Natural Heritage Section
1416 Ninth Street
Sacramento, CA 95814
Attn: Sandra Morey

California State Department of Parks
and Recreation
Monterey State Beaches
210 Oilvier Street
Monterey, CA 93940

California Department of Parks
and Recreation
Sonoma Coast State Beach
Bodega Bay, CA 94923

Carlita Payne
U. S. Fish and Wildlife Service
1 Federal Drive
Fort Snelling, MN 55111

David Sox
c/o U.S. Coast Guard, MILPAC
SE Bldg. 54D
Coast Guard Island
Alameda CA 94501-5100

Ed Lorentzen
California State Office BLM
2135 Butand Dr.
Sacramento CA 95825

Ellen J. Piazza
Parsons Harland Bartholomew &
Associates
2233 Watt Ave., Suite 330
Sacramento, CA 95825

Eureka Community
Development Department
531 K Street, Room 207
Eureka, CA 95501

Fort Bragg Planning Department
416 N. Franklin Street
Fort Bragg, CA 95437

Georgia Pacific Corporation
P.O. Box 105605
Atlanta, GA 30348

Granite Rock Company
P.O. Box 151
Watsonville, CA 95706

Gray Hayes
Room 254
Applied Sciences
C/O Natural Reserve Office
Santa Cruz, CA 95060

H. Paul Friesema - Professor
Institute for Policy Research
Northwestern University
2040 Sheridan Road
Evanston, IL 60208-4100

Humboldt County Planning Department
and Building Department
3015 H Street
Eureka, CA 95501

Jack H. Tasoff
1337 South Cabrillo Ave
San Pedro, CA 90731

Jennifer Wheeler
Bureau of Land Management
1695 Heindon Road
Arcata, CA 95521

Julian P. Donahue
Entomology Section
Natural History Museum
900 Exposition Blvd.
Los Angeles, CA 90007

Kenneth and Francis Shanahan
P.O. Box 25
Petrolia, CA 95558

Lonestar Aggregates
P.O. Box 5252
Pleasanton, CA 94566

Marina Planning Department
211 Hillcrest Ave.
Marina, CA 93933

Mendocino County Planning and
Building Services Department
589 Low Gap Road
Courthouse
Ukiah, CA 95482

Monterey Peninsula County Club
P.O. Box 2090
Pebble Beach, CA 93953

Monterey County Planning Department
P.O. Box 1208
Salinas, CA 93902

Monty Knudsen
U. S. Fish and Wildlife Service
Office of Technical Support,
Forest Resources
333 S.W. First Avenue
Portland, OR 97208-3623

Mr. Bob Soost
P.O. Box 589
Inverness, CA 94937

Mr. Tom Moss
California Department of Parks
and Recreation
804 Crocker Avenue
Pacific Grove, CA 93950

Mr. Dave Allen
616 Shore Road
Port Angeles, WA 98362

Mr. Anthony Lobay
Community Development Department
City of Pacific Grove
300 16th Street
Pacific Grove, CA 93950

Mr. Ken Gray
California Department of Parks and
Recreation
2211 Garden Road
Monterey, CA 93940

Mr. Bruce Cowan
P.O. Box 671
Pacific Grove, CA 93950

Mr. Dean Taylor
3212 Redwood
Aptos, CA 95003

Mr. J.T. Wick
Marin County Planning Department
Civic Center, Room 308
San Rafael, CA 94903

Mr. Lee Otter
California Coastal Commission
725 Front Street, Suite 300
Santa Cruz, CA 95060

Mr. Vern Yadon
1119 Buena Vista Avenue
Pacific Grove, CA 93950

Ms. Deb Hillyard
Department of Fish and Game
P.O. Box 4003
Aromas, CA 95004

Ms. Corky Matthews
P.O. Box 381
Carmel, CA 93924

Ms. Jane Holte
641 Spruce Street
Pacific Grove, CA 93950

Ms. Patti Kreiberg
Sunset Coast Nursery
2745 Tierra Way
Watsonville, CA 95076

Ms. Sarah Koenig
Pt. Reyes National Seashore
Pt. Reyes Station, CA 94956

Ms. Andrea Pickart
The Nature Conservancy
6800 Lanphere Road
Arcata, CA 95521

Ms. Cynthia Roye
California Department of Parks
and Recreation
Natural Heritage Section
P.O. Box 942896
Sacramento, CA 94296-0001

Ms. Renee Pasquinelli
California Department of Parks
and Recreation
P.O. Box 1528
Mendocino, CA 95460

Ms. Joan Dorell-Canepa
P.O. Box 222652
Carmel, CA 93922-2652

Ms. Diane Elam
U.S. Fish and Wildlife Service
3310 El Camino Ave., Suite 130
Sacramento, CA 95821

National Park Service
Point Reyes National Seashore
Point Reyes, CA 94956
Attn: Kim Cooper

National Park Service
Pacific West Field Area
600 Harrison # 600
San Francisco, CA 94107-1372

Pacific Grove Community
Development Department
300 16th Street
Pacific Grove, CA 93101

Paul Miller
P.O. Box 51306
Pacific Grove, CA 93950

Pebble Beach Company
P.O. Box 567
Pebble Beach, CA 93953

Peter Baye
U.S. Fish and Wildlife Service
P.O. Box 2012, Mare Island
Vallejo, CA 94592

Rachel Thomas
P.O. Box 4637
Huachuca City, AZ 85616

Ranger Terri Thomas
Golden Gate National Recreation Area
Fort Mason, Building 201
San Francisco, CA 94123

Rick Spaulding
Ogden Environmental
1 East Anapamu Street
Santa Barbara, CA 93101

Robert E. Preston, Ph.D.
Jones & Stokes Associates, Inc.
2600 V Street, Suite 100
Sacramento, CA 95818-1914

Salinas Wildlife Management Area
c/o San Francisco Bay NWR
P.O. Box 524
Newark, CA 94560

Sand City Planning Department
City Hall
One Sylvan Park
Sand City, CA 93955

Santa Barbara County Resource
Management Department
123 East Anapamu Street
Santa Barbara, CA 93101

Seaside Community Development
Department
440 Harcourt Ave.
Seaside, CA 93955

Sonoma County Planning Department
575 Administration Drive
Room 105A
Santa Rosa, CA 95405

The Nature Conservancy
201 Mission St. 4th floor
San Francisco, CA 94105

Tim McKay
Northcoast Environmental Center
879 Ninth Street
Arcata, CA 95521

Chris Gillespe
30 CES/CEVPN
806 13th Street # 116
Vandenberg AFB, CA 93437-5242

Brendan Cummings
Pacific Biodiversity Project
P.O. Box 192
Canyon CA 94516

Connie Calica
LSA Associates, Inc.
157 Plark Place
Point Richmond, CA 94801

Lisa Hartman
Jones and Stokes Associates, Inc.
2600 V Street
Sacramento, CA 95818

The Nature Conservancy
Conservation Science
1815 North Lynn Street
Arlington, VA 22209

attn:

Kat Maybury
Diana Hickson
Natural Heritage Program
1220 S Street
Sacramento, CA 95814

Richard A. Marovich
Department of Pesticide Regulation
1020 N Street, Room 332
Sacramento, Ca 95814

Endangered Species Protection Program
EFB/FEAB/OPP (7506C)
U.S. EPA
401 M Street S W
Washington D.C., WA 20460

John Mendoza
U.S. Fish and Wildlife Service
P.O. Box 4401
Chico, CA 95927

Rudi Mattoni
9620 Heather Road
Beverly Hills, CA 90210

John Emmel
26500 Rim Road
Hemet, CA 92544

Gordon Pratt
825 Apache Trail
Riverside, CA 92507

Kim Forrest
Humboldt Bay NWR
1020 Ranch Road
Loleta, CA 95551