

Menzies' Wallflower
(Erysimum menziesii)

**5-Year Review:
Summary and Evaluation**



**U.S. Fish and Wildlife Service
Arcata Field Office
Arcata, California**

June 2008

5-YEAR REVIEW

Species reviewed: Menzies' wallflower (*Erysimum menziesii*)

TABLE OF CONTENTS

- I. General Information
 - A. Methodology
 - B. Reviewers
 - C. Background
- II. Review Analysis
 - A. Application of the 1996 Distinct Population Segment (DPS) Policy
 - B. Recovery Criteria
 - C. Updated Information and Current Species Status
 - 1. Biology and Habitat
 - 2. Five-Factor Analysis
 - D. Synthesis
- III. Results
- IV. Recommendations for Future Actions
- V. References

5-YEAR REVIEW
Menzies' wallflower (*Erysimum menziesii*)

I. GENERAL INFORMATION

A. Methodology used to complete the review: This review was conducted by David Imper, Ecologist, with the Arcata Fish and Wildlife Office of the U.S. Fish and Wildlife Service (Service or USFWS), based on all information contained in files at that office and provided by other agencies. No comments were received from the public or other agencies in response to the Federal Notice.

B. Reviewers

Lead Region – Region 8, California and Nevada; Diane Elam, Deputy Division Chief for Listing, Recovery, and Habitat Conservation Planning, and Jenness McBride, Fish and Wildlife Biologist; (916)414-6464

Lead Field Office – Arcata Fish and Wildlife Office; Mike Long (707)822-7201

Cooperating Field Office(s) – Ventura, California

C. Background

1. FR Notice citation announcing initiation of this review:

Federal Register 71(55):14538-14542, March 22, 2006

2. Listing history

Original Listing

FR notice: 50 Federal Register 27848-27859

Date listed: June 22, 1992

Entity listed: *Erysimum menziesii* (species)

Classification: Endangered

Revised Listing, if applicable: NA

3. Associated actions

4. Review History: No status reviews have been conducted since the taxon was listed in 1992.

5. Species' Recovery Priority Number at start of review:

The recovery priority is 2C, reflecting a high degree of threat, high recovery potential, a taxonomic rank of full species, and potential conflict with construction or other development or economic activity.

6. Recovery Plan or Outline

Recovery Plan for Seven Coastal Plants and the Myrtle's Silverspot Butterfly
Approved September 29, 1998
No revisions.

II. REVIEW ANALYSIS

A. Application of the 1996 Distinct Population Segment (DPS) policy

1. Is the species under review listed as a DPS?

Yes
 No

The Endangered Species Act (Act) defines species as including any subspecies of fish or wildlife or plants, and any distinct population segment of any species of vertebrate wildlife. This definition limits listings as distinct population segments (DPS) only to vertebrate species of fish and wildlife. Because the species under review is a plant and the DPS policy is not applicable, the application of the DPS policy to the species listing is not addressed further in this review.

B. Recovery Criteria

1. Does the species have a final, approved recovery plan?

Yes
 No

2. Does the recovery plan contain recovery (i.e., downlisting or delisting) criteria?

Yes
 No

3. Adequacy of recovery criteria.

a. Do the recovery criteria reflect the best available (i.e., most up-to-date) information on the biology of the species and its habitat?

Yes
 No

- b. **Are all of the 5 listing factors that are relevant to the species addressed in the recovery criteria (and there is no new information to consider regarding existing or new threats)?**

Yes
 No

In the recovery plan, we identify which of the 5 listing factors each recovery criterion addresses. However, the criteria are not strictly threats-based in that they are not specifically framed in terms of the 5 listing factors.

4. **List the recovery criteria as they appear in the recovery plan, and discuss how each criterion has or has not been met, citing information. For threats-related recovery criteria, please note which of the 5 listing factors are addressed by that criterion (A, present or threatened destruction, modification, or curtailment of the species' habitat or range; B, overutilization for commercial, recreational, scientific, or educational purposes; C, disease or predation; D, inadequacy of existing regulatory mechanisms; and E, other natural and manmade factors affecting its continued existence). If any of the 5 listing factors are not relevant to this species, please note that here.**

Listing Factor B (overutilization for commercial, recreational, scientific, or educational purposes) is not relevant to this taxon. At the time of listing, no evidence existed to indicate Listing Factor C (disease or predation) was relevant. However, more recent evidence indicates both predation and disease are threats to some populations.

Currently, all downlisting and delisting criteria are considered adequate and appropriate with respect to recovery of the species. The conservation strategy outlined by these criteria addresses all the currently known threats to *Erysimum menziesii*. Components of the conservation strategy and criteria include habitat protection and management secured by appropriate agreements (such as conservation easements, covenants) to address listing factors A (habitat loss or modification, etc.), C (predation), D (inadequate regulatory mechanisms), and E (other natural or manmade factors).

Reclassification to threatened status will be evaluated when:

Downlisting Criterion 1 (Addresses Listing Factors A, C, D and E)
Habitat occupied by the three endangered subspecies of *Erysimum menziesii* needed to allow delisting has been secured, with long-term commitments and, if possible, endowments to fund conservation of the native vegetation.

This criterion has been partially met. There has been substantial improvement in the long-term protection status of *Erysimum menziesii* ssp. *eurekaense* in Humboldt

County, and moderate improvement in the long-term protection status of *E. m. ssp. menziesii* and *E. m. ssp. yadonii* since the species was listed. See Section C.3 for a description of conservation actions implemented for this species since listing.

Downlisting Criterion 2 (In part, addresses Listing Factors A, C, D and E)
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.

This criterion has been partially met in some protected areas (see Sections C.3.a and C.3.e).

Downlisting Criterion 3 (In part, addresses Listing Factor E)
Monitoring reveals that management actions are successful in reducing threats of invasive non-native species.

This criterion has been partially met. Abundant monitoring evidence indicates that removal of invasive species (primarily European beachgrass (*Ammophila arenaria*), bush lupine (*Lupinus arboreus*), and iceplant (*Carpobrotus* spp.) has reduced the threat to *Erysimum menziesii* ssp. *eurekense*, although those efforts do not always benefit the population immediately (Pickart et al. 2000). Monitoring data documenting the response of *E. m. ssp. menziesii* and *E. m. ssp. yadonii* to past restoration efforts are generally lacking, or if available, do not distinguish between habitat improvement and artificial propagation as the factor responsible for any population changes. However, abundant anecdotal evidence indicates both subspecies have benefited substantially from removal of iceplant and European beachgrass at MacKerricher State Park in Mendocino County, and iceplant at Asilomar State Beach and in the Marina Dunes in Monterey County (Moss pers. comm. 2006). See Section C.3.e. for details.

Downlisting Criterion 4 (In part, addresses Listing Factors A, C, D and E)
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.

Erysimum menziesii* ssp. *eurekense

The former “Khoaghali” and “buggy club” parcels, including 200 acres of dunes and forest, was recently acquired by the Service and Bureau of Land Management. While that property does not currently support this subspecies, it contains suitable habitat, and a plan for restoration and introduction of *Erysimum menziesii* ssp. *eurekense* is in preparation (Pickart pers. comm. 2006). The USFWS is negotiating with Texaco Corporation to acquire or otherwise protect the population of *E. m. ssp. eurekense* on the South Spit of Humboldt Bay (Pickart pers. comm. 2006). Future restoration of that habitat could be

coordinated with ongoing restoration work at the adjacent Bureau of Land Management's South Spit Wildlife Management Area. Two other parcels are in the process of being acquired (Stamps, Celestre properties) by organizations committed to the management of the wallflower (Friends of the Dunes, Manila CSD) (Pickart pers. comm. 2006). None of the currently protected habitat is subject to long-term commitments or endowments which guarantee conservation of *E. m. ssp. eurekaense* in perpetuity.

Erysimum menziesii ssp. menziesii

No additional habitat has been secured for this subspecies in either Mendocino or Monterey County since the species was listed. Various private lands supporting *Erysimum menziesii ssp. menziesii* or important to preserving the occupied dunes system are listed in the recommendations for future actions section of the recovery plan. Significant progress in removal of invasive species, particularly European beachgrass at MacKerricher State Park, and iceplant at Asilomar State Beach, should have a beneficial effect on *E. m. ssp. menziesii*, at least in the short-term. Little or no follow-up monitoring has been conducted to date to determine if *E. m. ssp. menziesii* is reoccupying the restored habitat (Pasquinelli pers. comm. 2006; Gray pers. comm. 2006). Currently, there is no assurance that the recent control efforts and presumed gains in suitable *E. m. ssp. menziesii* habitat will not be lost as invasive species recolonize during future periods of budget and staffing shortfalls, or redirection of management emphasis and resources.

Erysimum menziesii ssp. yadonii

No additional habitat known to support a natural occurrence of *Erysimum menziesii ssp. yadonii* has been secured in Monterey County since the species was listed. The Martin property, recently acquired by the Big Sur Land Trust, contains an abundance of suitable habitat for the wallflower. Although data are not yet available, that property reportedly supports at least some *E. m. ssp. yadonii*, and has the potential to contribute significantly to recovery of the species. The pending designation of Fort Ord Dunes State Park represents a tremendous opportunity to manage for the wallflower. *Erysimum m. ssp. yadonii* was introduced to those dunes several years ago with mixed results. In addition, *E. m. ssp. yadonii* was introduced onto property owned by Monterey Peninsula Regional Parks District, north of Marina State Beach (Dixon pers. comm. 2006). None of the current or pending protected habitat is subject to long-term commitments or endowments which reasonably assure the conservation of *E. m. ssp. yadonii* in perpetuity.

Delisting will be considered when, in addition to the criteria for downlisting, all of the following conditions have been met:

General Delisting Criterion (In part, addresses Listing Factors A, C, D and E)
Full recovery will be achieved when the dune system it inhabits is secure, with experience to demonstrate that exotic (invasive) 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 the presently-occupied range, and opportunities should be taken to introduce these plants to restored habitat in or near its historic range. To be counted toward recovery, (re)introduced populations should be naturally reproducing in vegetation that also appears to be persisting without excessive maintenance. 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 15 years of monitoring, to include wet and drought years. 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.

Erysimum menziesii ssp. eurekaense

Of the three subspecies, *Erysimum menziesii ssp. eurekaense* is considered the closest to achieving recovery, due to 1) the monitoring record which shows a positive trend over the past 20 years; 2) the extensive amount of research conducted on demographics and population biology; 3) the continuing acquisition of habitat by Federal, State, and local agencies interested in conservation of the wallflower; and 4) the large amount of habitat restoration work completed, with demonstrated beneficial affects on the species. Nevertheless, significant work remains to be done with respect to securing protection for privately held habitat, additional habitat restoration needs, and ensuring that restoration efforts continue so long as needed to conserve the wallflower in the face of unrelenting encroachment by invasive species.

Erysimum menziesii ssp. menziesii

This subspecies remains highly vulnerable, particularly in Monterey County. While some progress has been made in removing or minimizing recreational threats (off-road vehicles, equestrian impacts), and in restoring *Erysimum menziesii ssp. menziesii* habitat (primarily by removing European beachgrass and iceplant), monitoring has yet to be implemented that would document the baseline population and whether reestablishment and persistence of *E. m. ssp. menziesii* is occurring in restored habitat. In addition, a large amount of privately owned habitat in Monterey County lacks adequate protection and management.

In general, three of the four occupied dunes on the Monterey Peninsula, and various properties surrounding MacKerricher State Park, which either support *Erysimum menziesii ssp. menziesii* or are important to sustaining the ecological integrity of the occupied dune ecosystem, are not yet fully protected from the direct and indirect effects of development.

Erysimum menziesii ssp. yadonii

This subspecies remains highly threatened, and furthest from recovery. Only two natural populations are known, one of which (Marina State Beach) had declined to only a few hundred plants in the 1980's, and was expanded through a

propagation program. That population reportedly expanded to some 10,000 plants in the 1990's, but is thought to have declined (Dixon pers. comm. 2006). The second extant population is located on private property utilized for sand mining. Besides the potential for direct loss of plants and habitat to the mining operation, there is concern that the sand mining is contributing to beach erosion along the entire Marina Dunes system (Thornton pers. comm. 2006).

Erysimum menziesii ssp. *yadonii* was introduced at two locations within the proposed Fort Ord Dunes State Park in the 1990's, and habitat restoration has been conducted both there and at Marina State Beach for over 10 years (Dixon pers. comm. 2006). The initial introduction results were encouraging at both locations, but the populations have since declined, particularly at one of the sites. *Erysimum m.* ssp. *yadonii* was also introduced in the 1990's to dunes owned by the Monterey Peninsula Regional Parks District (Dixon pers. comm. 2006). No information was available on that population.

Specific Delisting Criterion 1 (In part, addresses Listing Factors A, C, D and E)
Studies have elucidated its life history requirements so that it is possible to predict the responses of populations to management and their viability.

Erysimum menziesii ssp. *eurekense* is the only subspecies to have been studied extensively with regard to its habitat relationships and restoration techniques (Pickart 1987; Pickart et al. 1998; Pickart et al. 1990; Pickart and Sawyer 1998; Sawyer and Andre 1990), life history characteristics (seedbank, fecundity, emergence, mortality, and disease infection rates)(Liermann 1992; Carothers 1996; McKay 1990a and 1990b; Roantree 1991; Wear 1996; Sawyer 1991), and characteristics of the fungal pathogen, *Albugo candida* (Jacobson and Ojerio 1996; Pickart and Jacobson 1997). Much of what has been learned about *E. m.* ssp. *eurekense* is undoubtedly applicable to the other two subspecies.

With respect to population viability, extensive demographic data were collected between 1991 and 2000 (see discussion of life history in Section C.2 below). That data included quantitative disease (crucifer rust) symptom measurements. Related studies were conducted on the soil seedbank, and to determine the seed-seedling transition probability. These data, when fully analyzed, will help complete a population viability analysis (Pickart pers. comm. 2006).

Specific Delisting Criterion 2 (In part, addresses Listing Factors A, C, D and E)
The dune systems supporting the 3 subspecies are actively protected from recreational violations, particularly by off-road vehicles (guaranteed funding to enforce ordinances), development, invasive weeds (including European beach grass, iceplant, and yellow bush lupine for subspecies *eurekense* in Humboldt County and iceplant for the entire species), and predators (deer in Monterey County).

(See Sections C.3.a and C.3.e).

Specific Delisting Criterion 3 (In part, addresses Listing Factors A, C, D and E)
Each occupied dune system has reasonable numbers of plants distributed widely enough to minimize the risk from accidental or catastrophic events.

Note: Because these are short-lived plants in a fluctuating environment, the recovery plan recommended the following tentative population goals, pending the results of demographic and monitoring studies:

Erysimum menziesii ssp. eurekaense (Humboldt Bay dune system) Goals: 3 populations with minimum 300 plants each; 2 populations with minimum 5,000 plants.

Erysimum menziesii ssp. eurekaense likely meets the suggested population size criteria (Pickart and Sawyer 1998). Population estimates are discussed under Section C.2 (Populations).

Erysimum menziesii ssp. menziesii (Ten Mile Dunes system/Monterey Peninsula) Goals: 4 distinct sites and 5 total populations across the range; 3 populations averaging at least 300 plants; 2 populations averaging at least 5,000 plants.

The population of *Erysimum menziesii ssp. menziesii* at Ten Mile Dunes in Mendocino County has not yet been quantified, but likely exceeds 3,000-5,000 plants (Imper pers. obs. 2005). For the four fragmented dunes on the Monterey Peninsula that support *E. m. ssp. menziesii* (Point Pinos; Asilomar; Spanish Bay; and Signal Hill), the last estimate (2002) of the population at Point Pinos was 19 plants (including 14 transplants) (USFWS Ventura FWO 2005); the last estimate for Asilomar State Beach was 5,759 plants (Madison pers. comm. 2006); and no data were available for the Spanish Bay dunes and Signal Hill dunes (including Birdrock/Spyglass Hill sites) populations. It is unlikely the suggested population size criteria for this taxon have been met.

Erysimum menziesii ssp. yadonii (Marina dune system) Goals: Taxon to be present throughout its present range from south of Salinas River to Marina Dunes and potentially the Fort Ord area, with 2 populations averaging at least 5,000 individuals, and 3 populations averaging 300 plants or more.

The Marina State Beach population is currently estimated between 5,000 and 10,000 plants (Dixon pers. comm. 2006). The RMC Cemex (former Lonestar site) population was last estimated in 1987 at 13,900 plants, including an estimated 50 percent flowering (Zoger and Pavlik 1987). No information was available for the introduced populations at the proposed Fort Ord Dunes State Park (California Department of Parks and Recreation) and Marina Dunes Preserve (Monterey Peninsula Regional Parks District). The suggested population criteria for this taxon have not been met.

C. Updated Information and Current Species Status

2. Biology and Habitat

Taxonomy

There has been an important change in the taxonomy of *Erysimum menziesii* since the Service listed the species as endangered in 1992. At that time, no subspecific taxa were recognized within *E. menziesii*, and *E. concinnum* was considered a full species. Robert Price, in his doctoral dissertation (Price 1987), had recognized subspecies *eurekense* and subspecies *yadonii*, but he had not formally published these new names. Subsequent to the listing of *E. menziesii* in June 1992, Price published his treatment of *Erysimum* in the Jepson Manual (Price 1993), recognizing three subspecies within *E. menziesii*, *E. m. ssp. menziesii*, *E. m. ssp. yadonii* R.A. Price, and *E. m. ssp. eurekense* R.A. Price. *Erysimum concinnum* was recognized as a fourth subspecies of *E. menziesii* (*E. m. ssp. concinnum* (Eastw.) R.A. Price). Because the revised taxa were never validly published, these combinations are technically considered by the Jepson Flora project (Jepson website 2006) to be *ined* (not included in the International Plant Names Index), and treated as if they had never been published. In any case, the final listing rule made it clear that what is now *E. m. ssp. concinnum* was not included in the listed entity. In order to simplify the discussion of the 3 recognized subtaxa within *E. menziesii*, the taxonomy utilized here follows the Jepson Manual (Price 1993). Under that classification, the species *E. menziesii*, includes the three listed subspecies *E. m. ssp. eurekense*, *E. m. ssp. menziesii*, and *E. m. ssp. yadonii*, as well as *E. m. ssp. concinnum*, which is not listed.

A genetics evaluation of *Erysimum menziesii* ssp. *menziesii* across its range, in conjunction with a taxonomic review, is needed to help resolve outstanding questions on the identity of several large populations of wallflower occurring on coastal dunes, in some cases highly vulnerable to invasive species, recreational, or development pressures. Populations located at the Lake Earl dunes (Del Norte County), Pudding Creek and Glass Beach (Mendocino County), and Point Reyes (Sonoma County) appear to fall outside the current taxonomy, and may or not be legitimately considered hybrids with other more common taxa.

As part of the taxonomic review, a current inventory of *Erysimum menziesii* ssp. *concinnum* across its range should be conducted to determine its present status, provide suitable populations for genetic characterization within the overall *E. menziesii* evaluation, and provide the context within which to assess the morphological, genetic, and thus taxonomic relationships within the species. Some evidence suggests that *E. m. ssp. concinnum* may have declined in recent years. *E. m. ssp. concinnum* historically occurred from southern Oregon south to Point Reyes, Sonoma County, California (Price 1993). Its habitat is typically quite different than that of the other *E. menziesii* subspecies, which always occupy coastal dunes. *Erysimum ssp. concinnum* typically occurs in scrub or open grasses on coastal bluffs, often in fine-textured soils as opposed to coastal dunes (Warner pers. comm. 2006). It has been assumed to be somewhat more common than the other *E. menziesii* subspecies. However, based on a brief review by Imper (pers. obs. 2002), *E. m. ssp. concinnum* may have been extirpated from Oregon, and with the exception of the very atypical occurrences at Lake Earl Dunes, Fort Bragg, and Point Reyes, appears to be currently known from only a few sites, including Whaler Island near Crescent City (Del Norte County; subject to intense recreational impact), the

mouth of the Mattole River (Humboldt County); and relatively short segments of the coastline in Mendocino and northern Sonoma Counties (Warner pers. comm. 2006).

Life History

Erysimum menziesii is a member of the mustard family (Brassicaceae). Its life history is that of a semelparous (monocarpic) perennial, meaning that it flowers and produces fruit only once during its life, after which it dies (*E. m. ssp. yadonii* reportedly can flower and fruit twice). The wallflower forms a basal rosette of leaves that may persist for up to 8 years before flowering. Blooming typically occurs from March through April, although it may begin as early as late February. The species is self-compatible; therefore, the reproduction of this species involves selfing and facultative outcrossing (able to produce seed either by self-pollination, or pollination by other plants). *Erysimum m. ssp. eurekaense* is pollinated by a solitary bee species (*Emphoropsis miserabilis*) in Humboldt County (USFWS 1998). The fruits mature by mid-June. However, seeds remain attached to the fruit walls after dehiscence and disperse over a long period, primarily in conjunction with winter storm events that dislodge the mature inflorescences and scatter them by way of a wind-driven tumbling action (Pickart and Sawyer 1998). Germination follows the first rains in fall or early winter.

Fecundity is high, with individual plants producing numerous seeds; however, the wallflower does not have a persistent seed bank in the soil (Carothers 1996), and seedling survivorship is low, with 98.3 percent mortality shown to occur in the first year (Pickart and Sawyer 1998). Reproduction may also be hindered by infestation of *Albugo canadensis*, an endemic fungal pathogen that causes white rust disease, at least in *Erysimum menziesii ssp. eurekaense*. Disease symptoms are more prevalent on reproductive individuals, where they can decrease fecundity by reducing seed number or viability (Pickart and Sawyer 1998).

An extensive demographic dataset, documenting all stages from seedling emergence to death, was developed between 1991 and 2000 (Pickart pers. comm. 2006). The data include samples of over 11,000 individuals. Longest leaf length (as a measure of plant size, since non-reproductive plants are rosettes) and quantitative disease (crucifer rust) symptom measurements were recorded quarterly. Related studies were conducted on the soil seedbank, and on the seed-seedling transition probability. These data, when fully analyzed, should help in completing a population viability analysis and an assessment of the impact of the rust on population viability (Pickart pers. comm. 2006). The viability analysis should also indicate whether not counting small rosettes (e.g., less than 3 centimeters diameter) is justified for census work, given the excessive cost and labor, and inherent error introduced with conducting a total plant census. Most previous population estimates conducted for *E. m. ssp. eurekaense* have utilized a minimum size threshold of 3 centimeters (Pickart pers. comm. 2006). It is not always clear what method was used for population estimates elsewhere. Further justification for using the minimum size threshold in future census work would save considerable cost and effort across the range.

Habitat and Distribution

Erysimum menziesii is known from at least 16 extant occurrences, distributed predominately in the nearshore dune community of four disjunct dune systems in northern and central California: Humboldt Bay in Humboldt County, Ten Mile River in Mendocino County, the Marina Dunes at Monterey Bay, and the Monterey Peninsula in Monterey County (Price 1993).

Erysimum menziesii* ssp. *eurekaense

Erysimum menziesii ssp. *eurekaense* occurs in the dune mat community, on the flanks or crests of dunes, in open sand areas, on sparsely vegetated dunes, and in the borders of lupine scrub (Botanica Northwest Associates 1992). The associated vegetation community (sand-verbena – beach bursage series) per Sawyer and Keeler-Wolf (1995), or the *Ambrosia chamissonis* and *Artemisia pycnocephala* alliances per the National Vegetation Classification System (Pickart and Barbour in press), is composed of low-growing perennial and herbaceous species. Common species are beach sagewort (*Artemisia pycnocephala*), dune goldenrod (*Solidago spathulata*), coast buckwheat (*Eriogonum latifolium*), sand verbena (*Abronia latifolia*), beach pea (*Lathyrus littoralis*), and sand-dune bluegrass (*Poa douglasii*).

The distribution of *Erysimum menziesii* ssp. *eurekaense* extends from the mouth of the Mad River south approximately 12 miles to the southern tip of the Samoa Peninsula (North Spit) of Humboldt Bay (Pickart et al. 2000). A moderate sized occurrence is located on the Elk River Spit, and another small colony is located on the South Spit of Humboldt Bay. Ownership includes the Lanphere-Christensen Dunes Unit of the Humboldt Bay National Wildlife Refuge (NWR), City of Eureka, Bureau of Land Management, and various private owners.

Erysimum menziesii* ssp. *menziesii

Erysimum menziesii ssp. *menziesii* exhibits a very disjunct distribution in Monterey and Mendocino Counties (California Department of Fish and Game 2006). In Mendocino County, *E. m.* ssp. *menziesii* occurs in habitat similar to that of *E. m.* ssp. *eurekaense*, i.e., primarily the *Ambrosia chamissonis* and *Artemisia pycnocephala* alliances. In Monterey, both *E. m.* ssp. *menziesii* and *E. m.* ssp. *yadonii* can also occur on the coastal strand, close to the high tide line, protected from wave action, as well as in bluff scrub and on open, sparsely vegetated dunes. On the coastal strand 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 (Price 1987). Associated species along the Monterey Peninsula include beach evening primrose (*Camissonia cheiranthifolia*), beach-bur (*Ambrosia chamissonis*), sea rocket (*Cakile maritima*), beach knotweed (*Polygonum paronychia*), sand verbena and iceplant. Monterey County populations are relatively free of the invasive European beachgrass (Price 1987).

The Mendocino County population occupies the Ten Mile Dunes, extending from the Ten Mile River approximately 5.4 miles south nearly to Fort Bragg, and up to 0.5 miles inland. Virtually the entire distribution occurs within MacKerricher State Park, with a relatively small number of plants located on private property east of the park (Imper

2005). Currently occupied dunes within the park are estimated at about 240 acres (Maslach 2005). By far the largest population, and greatest amount of habitat for *Erysimum menziesii* ssp. *menziesii*, occurs at MacKerricher State Park (Imper 2005).

In Monterey County, *Erysimum menziesii* ssp. *menziesii* is known from four isolated dune exposures on the west edge of the Monterey Peninsula, extending from Point Pinos about 5 miles south to Cypress Point. Populations are known or suspected extant, from north to south, at the former Point Pinos Coast Guard station/lighthouse (recently transferred to the City of Pacific Grove); Asilomar State Beach; the Spanish Bay dunes (largely intermingled in a golf course); and Signal Hill dunes (includes Signal Hill, Spyglass Hill Road, and Bird Rock Road sites reported by the California Natural Diversity Database (CNDDB) (California Department of Fish and Game 2006).

Erysimum menziesii* ssp. *yadonii

Erysimum menziesii ssp. *yadonii* occurs approximately 7 miles north of the Monterey Peninsula. The entire current and historical distribution occurs between the mouth of the Salinas River and the former Fort Ord military reservation, some 8 miles to the south (Dixon pers. comm. 2006). The only two known, naturally occurring sites are at Marina State Beach and the RMC Cemex sand mine site (former Lonestar Cement), which occupy a coastal strip of less than 3 miles on the west side of the City of Marina. Ownership includes the California Department of Parks and Recreation (Marina State Beach) and RMC Pacific Cement Company (RMC Cemex). In addition, the Monterey Peninsula Regional Parks District established *E. m.* ssp. *yadonii* at their Marina Dunes Preserve, located between Marina State Beach and RMC Cemex, about 10 years ago; no information is available on that population. The preserve was a former sand mine, acquired by the Monterey Peninsula Regional Parks District in 1988 after a proposal to build a large resort was denied. The California Department of Parks and Recreation also introduced *E. m.* ssp. *yadonii* into the proposed Fort Ord Dunes State Park, approximately 4 miles south of Marina State Beach; no information is available on that population either (Dixon pers. comm. 2006).

Erysimum menziesii ssp. *yadonii* historically occurred on the Salinas River NWR, on the south side of the mouth of the Salinas River, and on a private property immediately south of the refuge (Yadon pers. comm. 2006). Zoger and Pavlik (1987) indicated a large population of *E. m.* ssp. *yadonii* occurred in the strand immediately south of the Salinas River in the late 1970's (specimens from this site collected by A. Johnson, deposited at the University of California Davis Herbarium). They indicated that changes in the river mouth and storm damage had obliterated the population. In a letter to the Region 1 Director of the Service in 1984 (Howard *in litt.* 1984), Alice Howard noted that vehicle and pedestrian traffic on the Salinas River NWR were responsible for the elimination of *E. m.* ssp. *yadonii* from a swale behind the foredunes. In addition, Vern Yadon, after which the taxon was named, recalled seeing what probably was *E. m.* ssp. *yadonii* just inside the south boundary of the refuge some 40 years ago (Yadon pers. comm. 2006). The current Comprehensive Conservation Plan (CCP) for the Salinas River NWR (USFWS 2002) outlines specific management objectives for enhancing the coastal dune habitat (CCP objective 1.4) and conserving populations of special status species,

particularly federally listed species such as *E. m. ssp. yadonii* (CCP objective 2.1). Diane Kodama, Refuge Manager, indicates the refuge currently contains about 15 acres of coastal dunemat habitat, presumably suitable for the wallflower (Kodama pers. comm. 2006). She also indicated that members of the California Native Plant Society on a fieldtrip there 4 years ago encountered a wallflower that could not be identified, but was either *E. m. ssp. yadonii*, *E. ammophilum* (the coast wallflower, also known to occur on the refuge), or a hybrid. Kodama indicated that reintroduction of the wallflower to the refuge may require an amendment to their CCP. Part of the management direction for the refuge is to “protect and conserve as much of the coastal dune system in the Monterey Bay region as possible” (CCP objective 2.3). In that role, the refuge could take a lead role in negotiating and assisting in the protection of *E. m. ssp. yadonii* on the nearby RMC Cemex and Martin properties.

In her letter to the Service’s Region 1 Director, Alice Howard also indicated seeing a small population of *Erysimum menziesii* ssp. *yadonii* on the Martin property adjacent to the Salinas River NWR, consisting of 117 acres located between the refuge and the RMC Cemex property (Howard *in litt.* 1984). Majority ownership of that property is now held by the Big Sur Land Trust. The Conservation Project Manager for the Land Trust, Susanna Danner, confirmed that *E. m. ssp. yadonii* is on the species list for the property, but no survey has been done (Danner pers. comm. 2006). She indicated 33 percent ownership in the property is held by outside parties, which has complicated efforts for comprehensive planning to conserve the dunes. Efforts have been made to control iceplant in portions of that property.

Population Size

With the exception of *Erysimum menziesii* ssp. *eurekaense*, no statistically valid population estimates have been made of the subspecies of *E. menziesii*. Therefore, population data are generally inadequate for the purpose of determining trends or assessing response to past management. Current estimates of population, collected in a consistent manner across the range, are needed for *E. m. ssp. menziesii* and *E. m. ssp. yadonii*, including as many as possible on the privately held sites in Monterey County. For MacKerricher State Park and all of the privately held sites in Monterey County, these estimates would constitute the baseline from which to determine future population trends. For Asilomar State Beach, Marina State Beach, and Fort Ord Dunes State Park, current estimates will provide feedback on the response of the wallflower to management over the past decade or more, and enable an assessment of the impacts from recreational and invasive species in unrestored areas. Overall, trend data are needed to assess progress towards recovery goals.

Erysimum menziesii* ssp. *eurekaense

In 1989, Andre and Sawyer counted wallflowers (rosettes) larger than 3 centimeters in diameter on the North Spit of Humboldt Bay, and estimated the population at 20,657 plants \pm 2,344 (95 percent confidence intervals) (Pickart and Sawyer 1998). The Nature Conservancy re-sampled the North Spit population in 1998 using the same methods, producing a total population estimate of 29,657 (\pm 5,263). The observed increase varied among the North Spit colonies, some of which had declined (Pickart and Sawyer 1998).

Many of the increases were thought to be correlated with extensive restoration work and invasive plant removal since 1988 (Pickart pers. comm. 2006). The Service contracted a complete population-wide census again in 2006; those results are not yet available, but preliminary indications suggest both the extent of occupied habitat and the overall population have increased (Pickart pers. comm. 2006).

A colony of *Erysimum menziesii* ssp. *eurekaense* was discovered in 1991 on the South Spit of Humboldt Bay on land owned by Texaco Corporation (Pickart pers. comm. 2006). At that time, the population reportedly was 178 plants; 133 plants were recorded in 2002 (excluding small rosettes less than 2 centimeters in diameter), of which 32 percent were reproductive. All reproductive plants have been caged to prevent deer browsing since 2004; by 2006 the colony had increased to 457 plants (excluding small rosettes), of which 33 percent were reproductive (Clifford 2006).

In 1998, a colony of *Erysimum menziesii* ssp. *eurekaense* was also discovered on the Elk River Spit of Humboldt Bay. A census conducted in 2000 revealed 3,782 plants over 2 centimeters in diameter (13 percent reproductive), and 6,066 plants less than 2 centimeters in diameter (USFWS unpublished data 2000).

Erysimum menziesii* ssp. *menziesii

The distribution of *Erysimum menziesii* ssp. *menziesii* at MacKerricher State Park was mapped in 2004, in preparation for sampling to determine a population estimate. No formal estimate of the Mendocino population has been made, but it likely exceeds 3,000-5,000 plants (larger than 3 centimeters diameter)(Imper pers. obs. 2005).

Estimates related to *Erysimum menziesii* ssp. *menziesii* in Monterey County are generally old. No current estimates were obtained for Spanish Bay and Signal Hill dunes. The most recent Point Pinos estimate (2002) was 19 total (including 14 transplants)(USFWS Ventura FWO 2005). The population at Asilomar State Beach (2003) was initially estimated at less than 100 plants (USFWS 1998); following the onset of intensive management and artificial propagation by the California Department of Parks and Recreation in 1985, the population increased to 727 plants in 1986, and reached a peak 8,228 plants in 1998; the most recent census (2003) yielded 5,759 plants (Madison pers. comm. 2006). The CDPR census data reportedly all represent plants greater than one inch rosette diameter.

Erysimum menziesii* ssp. *yadonii

The RMC Cemex population reportedly contained 13,900 plants as of 1987(before the species was listed), about half first year rosettes, which occupied some 22 acres of strand and lower foredune between the dredge pond and the north end of the property (Zoger and Pavlik 1987). A small percentage exhibited signs a leaf fungus that caused the leaves to be shed early. No more recent estimate of population is available for this site. Dixon (pers. comm. 2006) indicates this population remains larger than that at the Marina State Beach, and is less impacted by iceplant and pedestrian use.

The Marina State Beach population was estimated at about 300 plants in 1985, before the species was listed (Zoger and Pavlik 1987). Yadon (1985a and 1985b) had estimated a

total of 800 flowering stems present. The following winter, the population was supplemented with 8,000 propagated plants, and another 5,000 plants in 1987. Survival was highly variable, resulting in some 10,000 individuals surviving by 1987 (Zoger and Pavlik 1987). Dixon (pers. comm. 2006) indicates the current population is somewhat lower, and recent propagation efforts there have not been very successful. Of 700 plants outplanted in 2003-2004, 61 percent survived by 2005 (Harlen 2006). No current estimate of the population at Marina State Beach is available.

Past Propagation Efforts

Erysimum menziesii ssp. *yadonii* was the first subspecies to be formally propagated and used for population augmentation at Marina State Beach (Ferreira and Smith 1987). California Department of Parks and Recreation staff grew the plant from seed, and planted out in dunes habitat stabilized with fencing and burial of straw bundles. Initial survival was highest in areas where sand movement was minimized by the stabilization, and where there was the least competition for moisture (Dixon pers. comm. 2006).

Propagation of *Erysimum menziesii* ssp. *menziesii* is also part of the dunes restoration plan for the Point Pinos Coast Guard Site, recently transferred to the City of Pacific Grove as part of a golf course development. Propagation of plants from this site began in the 1990's. In an effort to save the population and develop a seedling bank suitable for reintroduction efforts, Paul Kephart (Rana Creek Restoration Consultants, Monterey, California) collected seed on the property and propagated some 400 plants at the Rana Creek Nursery (USFWS Ventura FWO 2005). Kephart had also propagated about 400 plants from seed supplied by Dr. Vern Yadon. Dr. Yadon originally collected seed from near the lighthouse at Point Pinos, but seeds were grown through multiple generations in his private collection, and the resulting plants appeared phenotypically different from the plants grown from Kephart's collection (USFWS Ventura FWO 2005). The Point Pinos/Coast Guard population was nearly extirpated as of 2000. In 1997, fewer than 20 *E. m.* ssp. *menziesii* plants were observed on the property (USFWS Ventura FWO 2005). In 2000, only five plants were observed; in 2001, 64 individuals were outplanted from the Rana Creek Nursery stock, from seed collected by Paul Kephart. In 2002, 14 plants were observed from the previous years' outplanting, along with the original five native plants from 2000 (USFWS Ventura FWO 2005).

The restoration goal for *Erysimum menziesii* ssp. *menziesii* included in the Point Pinos restoration plan is establishment of 300 plants per acre in each of the planting areas proposed, amounting to a total of 1,500 plants (USFWS Ventura FWO 2005). The outplanted *E. m.* ssp. *menziesii* will be protected from deer herbivory with hardware cloth cages buried to a depth of 4 inches and anchored with bamboo stakes. Caging will continue until 500 individuals have been established. Although originating from the Point Pinos property, the plants grown from Yadon's seed collection and grown through successive generations in the greenhouse will not be used for the restoration effort (USFWS Ventura FWO 2005).

The California Department of Recreation and Parks has successfully propagated *Erysimum menziesii* ssp. *menziesii* and *E. m.* ssp. *yadonii* since the 1980's, before the

species was listed, for population enhancement projects at Asilomar State Beach and Marina State Beach, and for introduction at Fort Ord Dunes State Park (Ferreira and Gray 1987; Moss pers. comm. 2006). The California Department of Recreation and Parks have their own greenhouses at Asilomar State Beach and Marina State Beach; in addition, plants have been grown at Soledad State Prison, and by the Watershed Institute, California State University at Monterey Bay. A paid coordinator has utilized primarily school volunteers in planting out the wallflower and other native dune species to the Marina Dunes annually for some time (Moss pers. comm. 2006).

The Service (Humboldt Bay NWR) and collaborative researchers have successfully propagated *Erysimum menziesii* ssp. *eurekaense* at the Humboldt State University Greenhouse and the University of Michigan Greenhouse at Dearborne, Michigan, pursuant to Memoranda of Understanding with the California Department of Fish and Game Endangered Plant Program (Pickart pers. comm. 2006). Those plants were utilized in restoration efforts on the North Spit of Humboldt Bay.

Genetics

A relatively large population of wallflower located at the Lake Earl Dunes north of Crescent City, Del Norte County, closely resembles *Erysimum menziesii* ssp. *eurekaense* in both habitat and morphology (with the exception of fruit orientation, which more closely resembles that of *E. m.* ssp. *concinnum*) (Imper pers. obs. 2002 and 2004). Largely for this reason, Price (1987) considered this wallflower to be *E. m.* ssp. *concinnum* or a hybrid with *E. m.* ssp. *eurekaense*. Because the Lake Earl population occurs in a unique dune system that is currently impacted by non-native plant encroachment and recreational use, and because *E. m.* ssp. *concinnum* is currently unprotected by the Endangered Species Act, there is a need to clarify the identity of this population.

As a result, a genetic study (isozymes) and common-growth study at a commercial greenhouse near Humboldt Bay were initiated in 2003, which compared the Lake Earl Dunes population with a nearby *Erysimum menziesii* ssp. *concinnum* population (from Whaler Island, Crescent City), and one population each of *E. m.* ssp. *eurekaense* (from multiple sites), *E. m.* ssp. *menziesii* (from Mackerricher State Park), and *E. m.* ssp. *yadonii* (from Marina State Beach) (Wilson et al. 2004). The samples of *E. m.* ssp. *eurekaense* were collected from across its range at Humboldt Bay, including both the South and North Spits of the bay. The isozyme patterns indicated the Lake Earl Dune population most closely resembles the *E. m.* ssp. *concinnum* population. Some genetic similarity existed between the Lake Earl Dunes population and *E. m.* ssp. *menziesii*, perhaps indicating past hybridization or introgression between the Lake Earl Dunes plants and those of *E. m.* ssp. *menziesii*. The *E. m.* ssp. *eurekaense* population was very distinct genetically from any other of the populations studied, and the two most dissimilar populations were *E. m.* ssp. *concinnum* and *E. m.* ssp. *eurekaense*. The Lake Earl Dunes population was the most genetically diverse population, while the *E. m.* ssp. *eurekaense* population contained the least amount of genetic variation in the study (Wilson et al. 2004).

The common-growth study was largely inconclusive, and was abandoned after 18 months due to the poor growth or mortality of most of the taxa grown in the greenhouse (Imper pers. obs. 2004). However, morphological characteristics of the young vegetative rosettes growing in the same media and climate conditions showed clear differences among the subspecies. Contrary to isozyme patterns, the leaf shape, color, and pubescence were virtually identical between the Lake Earl population and *Erysimum menziesii* ssp. *eurekaense*. *Erysimum m.* ssp. *menziesii* and *E. m.* ssp. *yadonii* showed the greatest morphological similarity but were quite distinct from the others, and *E. m.* ssp. *concinnum* appeared the most distinct (Imper pers. obs. 2004). It appears that further, more detailed investigation incorporating both morphological and genetic comparison is warranted to identify differences within the group currently described as *E. menziesii*, inclusive of the populations currently lumped with *E. m.* ssp. *concinnum* or regarded as possible hybrids due to their significant differences from *E. m.* ssp. *concinnum* in habitat or morphology (e.g., plants from Lake Earl Dunes, Pudding Creek and Glass Beach, and Point Reyes). Even within the Monterey Peninsula populations, there may be notable differences among the populations of *E. m.* ssp. *menziesii* (Yadon pers. comm. 2006).

3. Five Factor Analysis (threats, conservation measures and regulatory mechanisms).

a. Present or threatened destruction, modification or curtailment of its habitat or range:

The activities identified which threatened the destruction, modification or curtailment of *Erysimum menziesii* habitat or range at the time it was listed included commercial and residential development, off-road vehicle use, trampling by hikers and equestrians, sand mining, and/or disposal of dredged material from adjacent bays and waterways. At that time an estimated 10 percent of occupied *E. menziesii* habitat was owned by the State or Federal government. In 2006 the Service estimated the State and Federal government owned 50 percent or more (more for Mendocino County, less for Monterey Peninsula) of occupied habitat, and perhaps 50 percent of the total number of sites for the species (Imper pers. obs. 2006). The Cities of Eureka and Pacific Grove also own occupied habitat.

As a result, the direct threat from residential and commercial development has declined substantially. Disposal of dredged materials is not a current threat. Threats from off-road vehicle use, equestrian use and sand mining remain local threats in some areas. Other kinds of uncontrolled recreational use, such as hang-gliders and hikers, continue to impact some populations (Imper pers. obs. 2006).

In general, since the species was listed, most of the occupied state parks and beaches adopted general plans that contain direction for conserving the dunes habitat and sensitive species, including *Erysimum menziesii* (CDPR 1995, 2004b, and 2004c); Marina State Beach adopted its general plan in 1990 (CDPR 1990) (see Section C.3.d. below). The remaining privately owned occurrences of *E.*

menziesii, particularly in Monterey County, are near expanding urban centers subject to growing demand for recreational opportunities (Imper pers. obs. 2006).

Little or no monitoring has been implemented to specifically assess the impacts of recreational use on any of the three subspecies. Due to the frequent occurrence of *Erysimum menziesii* ssp. *menziesii* and *E. m.* ssp. *yadonii* within state parks and other high public use areas, monitoring designed to assess their tolerance to recreational impacts seems especially important. That monitoring would also be valuable for future planning of recreational facilities.

Erysimum menziesii* ssp. *eurekense

Threats

Due to the high proportion of public-owned habitat, the threat from commercial and residential development is relatively low. Recreational hiking continues to affect the majority of *Erysimum menziesii* ssp. *eurekense* habitat around Humboldt Bay, but impacts appear to be minor (Imper pers. comm. 2006). Equestrian use is generally only a factor on the South Spit of Humboldt Bay, and does not appear to have impacted the small amount of occupied habitat there in the past (Imper pers. comm. 2006). While off-road vehicle use is largely prohibited over most of the occupied dunes habitat around Humboldt Bay, trespass continues to impact a relatively small part of its habitat. Disposal of material dredged from the bay and sand mining at one time threatened *E. m.* ssp. *eurekense*, but those activities are not current threats. Any proposal to reinstate sandmining or dredge disposal would likely require a permit from the U.S. Army Corps of Engineers, and therefore be subject to consultation under Section 7 of the Endangered Species Act.

Conservation Actions

The long-term commitment to protection of *Erysimum menziesii* ssp. *eurekense* has improved substantially since it was listed. The Bureau of Land Management and the Service recently acquired a total of 200 acres of nearshore dunes and dune forest (Khoaghali and Buggy Club parcels) near Manila on the North Spit of Humboldt Bay, which are now being managed as the Ma-le'l Dunes Cooperative Management Area (Pickart pers. comm. 2006). A public access plan is in preparation, and a dunes restoration plan for the portion of the property owned by the Service, part of the Humboldt Bay NWR, was finalized in 2005 (Pickart pers. comm. 2006). While the new additions do not currently support *E. m.* ssp. *eurekense*, the Service plans to both restore suitable habitat and introduce the wallflower on their property (Pickart pers. comm. 2006).

Another acquisition that may contribute to recovery of the subspecies is recent State acquisition of the majority of the South Spit of Humboldt Bay, since designated the South Spit Wildlife Management Area and managed by the Bureau

of Land Management (USFWS Arcata FWO 2002). Those nearshore dunes surround the only population of *E. m. ssp. eurekaense* located on the South Spit, which is on property owned by Texaco Corporation, but the proposed restoration of dunes on the Wildlife Management Area should facilitate expansion of that population.

Two other parcels containing at least some, albeit degraded, wallflower habitat are in the process of being acquired by the Friends of the Dunes, an organization dedicated to the conservation of dunes, and the Manila Community Services District, which has conducted several dunes restoration projects in the past (Pickart pers. comm. 2006; Wear pers. comm. 2006). These and other past acquisitions, and/or assumption of management of nearshore dunes around Humboldt Bay by the Bureau of Land Management, the Service, Manila CSD, and Friends of the Dunes have significantly reduced the threat of habitat destruction as a result of development and off-road vehicle impacts. Pedestrian and equestrian impacts are largely limited to dispersed recreation both on the North and South Spits of the Bay. Sand mining and disposal of dredge spoils do not currently threaten this subspecies.

Erysimum menziesii ssp. menzeisii

Threats

Hiking and equestrian trails within MacKerricher State Park continue to affect a large portion of the occupied habitat, and the impacts may soon increase (Pasquinelli pers. comm. 2006). In general, pedestrian and horse traffic can preclude establishment of *Erysimum menziesii ssp. menziesii* near the pathways, and promote access into more remote habitat within the park. In addition, trails often facilitate invasion by invasive plant species identified in the recovery plan as primary threats to *E. m. ssp. menziesii* (Pasquinelli pers. comm. 2006). Increasing residential development surrounding the park, and pending completion of the pedestrian trail between Fort Bragg and the park, are expected to cause a significant increase in recreational use in the future (Pasquinelli pers. comm. 2006). Equestrian use in the park is currently permitted on a monthly basis (Pasquinelli pers. comm. 2006).

The Monterey sites within state parks and beaches are not subject to equestrian use (Dixon pers. comm. 2006). Although pressure from pedestrian use is high at Asilomar State Beach, fencing, boardwalks, and signage have been successful in avoiding significant impacts on *Erysimum menziesii ssp. menziesii* habitat (Moss pers. comm. 2006). Joggers reportedly have a significant impact on some *E. m. ssp. menziesii* plants and on dunes in general on the Monterey Peninsula (Yadon pers. comm. 2006).

Conservation Actions

The long-term commitment to conservation of *Erysimum menziesii* ssp. *menziesii* has improved since the species was listed. Virtually the entire distribution of the subspecies in Mendocino County occurs within MacKerricher State Park, owned and managed by the California Department of Parks and Recreation. In 1995, the north portion of the park, which contains the majority of the *E. m. ssp. menziesii* population, was designated as a Natural Preserve (CDPR 1995). Under California Department of Parks and Recreation policy (CDPR 2004a), management within Natural Preserves more specifically emphasizes conservation of sensitive species than within designated State Park.

Several management measures have been implemented at MacKerricher State Park that have minimized the threats of off-road vehicle use, hiker and equestrian traffic. No off-road vehicle use is currently allowed in MacKerricher State Park, and none of the private parcels on which the species is known to occur are currently subject to this use (Imper pers. obs. 2005). When the recovery plan was completed in 1998, the California Department of Parks and Recreation was considering replacing eroded sections of the old haul road (currently a pedestrian trail) adjacent to Cleone Lake and in the north portion of MacKerricher State Park. Those improvements would have directly eliminated *E. m. ssp. menziesii* habitat. In addition, the improvements would have interfered with natural sand movement and potentially accelerated stabilization of dunes habitat east of the road. Those changes would have been detrimental to *Erysimum menziesii*, since it requires semi-stabilized dunes (CDPR 1998; EDAW 2000). Plans to replace the eroded sections of the haul road trail were eventually dropped. Depending on future changes in California Department of Parks and Recreation management priorities for MacKerricher State Park, efforts to complete the trail could be reinitiated in the future (Pasquinelli pers. comm. 2006).

The existing hiking and equestrian trails within the park are in close proximity to much of the occupied habitat, and any impacts could increase due to surrounding development and completion of the pedestrian trail between Fort Bragg and the park (Pasquinelli pers. comm. 2006).

Erysimum menziesii* ssp. *yadonii

Threats

Only two sites supporting natural populations of the subspecies are currently known, including the Marina State Beach, owned and managed by the California Department of Parks and Recreation, and the RMC Cemex site (former Lonestar Cement) just north of there. The Marina State Beach general plan (CDPR 1990) emphasizes the conservation of sensitive dune species and their habitat. RMC Cemex is under no agreement to manage *Erysimum menziesii* ssp. *yadonii* on their property, and no recent information is available on that population. *Erysimum m.*

ssp. *yadonii* was recently established on two new sites: dunes formerly included in the Fort Ord military reservation, and which will soon become the Fort Ord Dunes State Park, and dunes owned by the Monterey Peninsula Regional Parks District, located north of Marina State Beach. No current information was available for the new populations.

Due to the close proximity of *Erysimum menziesii* ssp. *yadonii* to dense population centers, the potential for recreational impacts is high. Marina State Beach has so far been successful in mitigating these impacts, but the recreational pressure will undoubtedly continue to increase (Moss pers. comm. 2006). In addition to recreation impacts, sand mining is a significant threat for *E. m.* ssp. *yadonii*. More than half the population of this subspecies likely occurs on the RMC Cemex site, an active sand mining operation within the City of Marina (Moss pers. comm. 2006). According to Thornton (pers. comm. 2006), a dragline method of mining was used starting in 1905, when mining began, until 1965, when the company switched to a beach dredge-pond system. In the dredge-pond method, sand is excavated from pits located near the beach, and replenished by natural sand deposition. Thornton estimates the average annual sand removal since 1965 at about 160,000 cubic meters (Thornton pers. comm. 2006). There appears to be widespread concern that the sand mining is a significant factor in the apparent beach retreat along the entire Marina Dunes, which receives its sand from the Salinas River north of the sand mine (Thornton pers. comm. 2006). Severe beach and foredune erosion has been repeatedly observed up and down the Marina Dunes, and is considered a potential threat to *E. m.* ssp. *yadonii* habitat (Moss pers. comm. 2006; Steeck pers. comm. 2006; Dixon pers. comm. 2006; Gray pers. comm. 2006). As a result, clarifying the threat of beach erosion to the taxon, and the contribution made by the sand mining, are relevant to future recovery of *E. m.* ssp. *yadonii*. The U.S. Geological Survey apparently recorded beach profiles in the vicinity of Marina State Beach in the past (Thornton pers. comm. 2006); repeating those profiles may indicate if beach erosion is impacting the coastal dunes, and if so, how far inland.

Conservation Actions

The long-term protection status of habitat occupied by *Erysimum menziesii* ssp. *yadonii* has improved since the species was listed. Extensive dunes restoration projects, combined with dunes stabilization (to counter dunes erosion) and wallflower population augmentation, have been conducted over the past 20 years by the California Department of Parks and Recreation at the Marina State Beach (Gray pers. comm. 2006). Fencing and signage at Marina State Beach have generally been successful at avoiding significant pedestrian impacts, but maintenance of these facilities has at times been inadequate (Dixon pers. comm. 2006). The California Department of Parks and Recreation has also conducted dunes restoration on the old Fort Ord military reservation, soon to become the Fort Ord Dunes State Park.

b. Overutilization for commercial, recreational, scientific, or educational purposes:

Overutilization has not been, and currently is not known to be a threat for this plant.

c. Disease or predation:

At the time of listing, no data existed to substantiate whether predation by grazing livestock threatened *Erysimum menziesii*. Since then deer have significantly impacted a population of *E. m. ssp. eurekaense* on the South Spit of Humboldt Bay (Clifford 2006), and nearly all *E. m. ssp. menziesii* occurrences on the Monterey Peninsula, where successful restoration efforts necessarily include routine caging to protect reproductive plants (Moss pers. comm. 2006). The Service has successfully fenced the South Spit population of *E. m. ssp. eurekaense* for the past 3 years, to preclude deer browsing, leading to a 400 percent increase in that population (Clifford 2006). On the Monterey Peninsula, deer were identified as perhaps the greatest threat to *E. m. ssp. menziesii* (Yadon pers. comm. 2006; Moss pers. comm. 2006). Caging of reproductive plants at Asilomar State Beach was begun in 1985, before the species was listed, and 300-500 plants continue to be caged per year (Madison pers. comm. 2006). A long-term plan for mitigating the deer pressure on those populations is urgently needed in order to ensure future viability of these populations.

Disease caused by the crucifer rust (*Albugo candida*), a pathogenic fungus, affects a significant portion of *E. m. ssp. menziesii* in Humboldt County (Pickart 2004). An unidentified fungus was also observed affecting *Erysimum menziesii* ssp. *yadonii* (Zoger and Pavlik 1987). In *E. m. ssp. eurekaense*, disease symptoms are more prevalent on reproductive individuals, where they can decrease fecundity by reducing seed number or viability (Pickart and Sawyer 1998). The crucifer rust was the focus of a long-term study to evaluate its effects on the population ecology of *E. menziesii* (Pickart 2004). Those results are yet to be analyzed.

d. Inadequacy of existing regulatory mechanisms:

No change in regulatory protection of this species has occurred at the State or Federal level since the species was listed. Successful mitigation of threats described under listing factors A and E are intended to address the importance of listing factor D. While the California Environmental Quality Act, Native Plant Protection Act, California Endangered Species Act, California Coastal Act, and Federal Coastal Zone Management Act all, to varying extents, provide limited protections for *Erysimum menziesii* on private and public property, many of the current threats to the wallflower are either currently unregulated, or of a kind not affected by land use regulations (e.g., invasive species encroachment, sand mining and dune mobility, deer predation, pedestrian impacts). Thus regulatory

restrictions, even when applicable, are currently inadequate to conserve this species.

Changes in ownership and/or management direction for some sites have improved regulatory protections for *Erysimum menziesii* in some cases. For example, the north portion of MacKerricher State Park was designated a Natural Preserve, subject to different guidance under the California Department of Parks and Recreation's Department Operations Manual (CDPR 2004a), and the MacKerricher State Park General Plan (CDPR 1995). The Department Operations Manual generally advances a holistic approach to natural resource management; e.g., "natural resources will be managed to preserve the composite whole of physical and biological processes, features, and native plant and animal communities except where the management purpose is otherwise established through unit classification or General Plan", and "does not attempt to solely preserve individual species except threatened or endangered species in special situations." Under the Department Operations Manual, California Department of Parks and Recreation lands important to preserving rare or endangered plant and animal species and their supporting ecosystems may be designated as Natural Preserves. The MacKerricher State Park General Plan in 1995 designated the north portion of the park as the as the Inglenook Fen – Ten Mile Dunes Natural Preserve, which includes the majority of *E. m. ssp. menziesii* distribution within the park (and Mendocino County).

The management emphasis in State natural preserves is conservation of natural values, as opposed to the State park lands category, where the management emphasis is "a composite whole, with all features and processes being considered, in order to restore, protect, and maintain its native environmental composition to the extent compatible with the primary purpose for which the park was established." MacKerricher State Park, like the Marina and Asilomar State Beaches and Fort Ord Dunes State Park, appear to have been established primarily for recreational use, where management emphasis is focused on recreational use as long as the natural, scenic, cultural, and ecological values are preserved for present and future generations. Nevertheless, the Department Operations Manual allows for waiver or modification of Department policy on a case-by-case basis by the Director or their designee (CDPR 2004a), thus making the emphasis on natural resource management within the Inglenook Fen – Ten Mile Dunes Natural Preserve largely discretionary.

The recent acquisitions of habitat by the Bureau of Land Management and the Service around Humboldt Bay have added to the protection of *Erysimum menziesii* ssp. *eurekaense*, and the Humboldt Bay NWR has implemented a 15-year Comprehensive Conservation Plan for the refuge which incorporates specific direction for long-term management of *E. m. ssp. eurekaense*. However, even where Federal agencies own or manage the property, agency limitations for implementing management policy and the uncertainty in funding from year to

year indicate a more reliable mechanism for ensuring proper management should be found.

e. Other natural or manmade factors affecting its continued existence:

Current climate change predictions for terrestrial areas in the Northern Hemisphere indicate warmer air temperatures, more intense precipitation events, and increased summer continental drying (Field et al. 1999, Cayan et al. 2005, IPCC 2007). However, predictions of climatic conditions for smaller sub-regions such as California remain uncertain. It is unknown at this time if climate change in California will result in a warmer trend with localized drying, higher precipitation events, or other effects. While we recognize that climate change is an important issue with potential effects to listed species and their habitats, we lack adequate information to make accurate predictions regarding its effects to particular species at this time.

The primary threat to *Erysimum menziesii* when it was listed, and which continues to be the major threat for most populations is displacement by invasive non-native plant species. Livestock trampling was also identified as a possible threat. However, no evidence indicates that livestock trampling is a current threat (Imper pers. obs. 2006).

Erysimum menziesii* ssp. *eurekaense

In Humboldt County the primary threats are European beachgrass, yellow bush lupine, iceplant, and jubata grass (*Cortaderia jubata*). European beachgrass and iceplant are the primary threats in Mendocino County, and iceplant in Monterey County. Invasive grass species are significant threats across the range.

Invasive species removal projects are ongoing at the Humboldt Bay NWR Lanphere Dunes Unit (formerly The Nature Conservancy Lanphere-Christensen Dunes Preserve), the Ma-le'l Dunes Cooperative Management Area (jointly managed by the Service and the Bureau of Land Management), the Manila Dunes owned by the Manila Community Services District, the Samoa Dunes Endangered Plant Area (owned and managed by the Bureau of Land Management), and the South Spit Wildlife Management Area, managed by the Bureau of Land Management (Pickart pers. comm. 2006). The Humboldt Bay Harbor, Recreation, and Conservation District also recently removed invasive species from two acres of potential *Erysimum menziesii* ssp. *eurekaense* habitat on the North Spit, in conjunction with a bay dredging project (USFWS Arcata FWO 2005).

One example of habitat restoration that benefited *Erysimum menziesii* ssp. *eurekaense* was conducted by the Manila Community Services District on the North Spit of Humboldt Bay; that effort has been ongoing since 1992, when The Nature Conservancy managed the area (Wear pers. comm. 2006). The Manila

Community Services District took over management in 1998, and currently owns approximately 100 acres of dunes; invasive species control efforts have occurred over the entire area, funded by various State and Federal grants provided by the California Coastal Conservancy, California Department of Parks and Recreation, California Department of Fish and Game, National Fish and Wildlife Foundation, and the Service's Partners for Fish and Wildlife Program. The Manila Community Services District is in the process of acquiring another 56 acres adjacent to the 100 existing acres. *Erysimum m. spp. eurekaense* on Manila Community Services District property was censused in 1997 and again in 2002 (excluding small seedlings). Most of the population occurs on the nearshore dunes where a majority of the restoration work has been performed. Past census results for the property were: 359 adult plants occupying 5,302 square meters (1997); and 866 adult plants occupying 14,541 square meters (2002). The census will be repeated in spring 2007 (Warner pers. comm. 2006). The increase in population was attributed to the restoration.

Erysimum menziesii ssp. menziesii

Significant progress has been made in removal of European beachgrass and to a lesser extent iceplant at MacKerricher State Park in Mendocino County, and in removal of iceplant at Asilomar State Beach, both of which have benefited *Erysimum menziesii ssp. menziesii* (Warner pers. comm. 2006; Gray pers. comm. 2006).

Efforts to map and remove European beachgrass at MacKerricher State Park began in 1997 (CDPR 1997), supported by private donations and funding under Endangered Species Act Section 6 grants to the States (CDPR 2002). As of 2004, European beachgrass had been removed from approximately 16 acres of dune habitat in the north end of the park (Pasquinelli pers. comm. 2006). Plans are underway now, under the California Department of Parks and Recreation's Natural Heritage Stewardship Program, to continue the beachgrass removal over the next few years utilizing integrated pest management techniques (Pasquinelli pers. comm. 2006), including fire and/or manual removal combined with herbicide treatment for resprouts. The park burned approximately 65 acres of European beachgrass this fall, and results are being monitored (Pasquinelli pers. comm. 2006).

Iceplant was first mapped over the entire MacKerricher State Park in 2005 (Warner pers. comm. 2006). A small-scale removal project was implemented in 1996 (Pasquinelli pers. comm. 2006), and there is an ongoing project, funded by an Endangered Species Act Section 6 grant, to determine the best methods and benefits associated with iceplant removal (Warner 2006).

No efforts have yet been made to control or map burclover (*Medicago polymorpha*), ripgut brome (*Bromus rigidus*), or other invasive species that may be competing with *E. m. ssp. menziesii* within MacKerricher State Park. The park

has recently obtained new software which will be used to map all iceplant, European beachgrass, and cape ivy (*Delairea odorata*) infestations within the park in 2007 (Warner pers. comm. 2006).

In Monterey County, extensive dunes restoration has been conducted over the past 20 years (Gray pers. comm. 2006). An estimated 100 acres has been treated at the Asilomar State Beach, and restoration has been pursued at the Spanish Bay dunes (Pebble Beach Company) for a similar period, as part of requirements for golf course development. Current methods generally employ manual removal of iceplant to minimize substrate disturbance, followed by herbicide for resprouts. The City of Pacific Grove has also proposed a restoration plan for dunes at Point Pinos, recently acquired from the Coast Guard (USFWS Ventura FWO 2005). That plan would improve some 20 acres of dunes on the property, located adjacent to their Point Pinos Golf Course, of which five acres would be dedicated to establishment of listed plant species, including *Erysimum menziesii* ssp. *menziesii*. The city plans to fund the multi-year restoration project with funds set aside by the city for the associated golf course (USFWS Ventura FWO 2005).

Erysimum menziesii* ssp. *yadonii

Extensive dunes restoration projects have been conducted over the past 20 years by the California Department of Parks and Recreation at their Marina State Beach and future Fort Ord Dunes State Park (Gray pers. comm. 2006). As part of the ownership transfer agreement, the California Department of Parks and Recreation is mandated to restore 700 acres of the 1,000 acres of the property to natural vegetation (Gray pers. comm. 2006). A preliminary management plan was prepared (CDPR 2004c), and a conservation plan is in preparation. The dunes restoration has been ongoing for about 10 years (Gray pers. comm. 2006), and has targeted iceplant on about 200 acres. The restoration is intended to benefit *Erysimum menziesii* ssp. *yadonii*, as well as other listed species. Introduction of *E. m.* ssp. *yadonii* was attempted at two locations, with mixed results (Gray pers. comm. 2006).

California Department of Parks and Recreation restoration efforts notwithstanding, the monitoring record to date appears inadequate to document *Erysimum menziesii* ssp. *yadonii* population trends, response to recreational disturbance, or expansion into the restored habitat. Demonstration that habitat restoration efforts and the current management of recreation in the park are consistent with a stable wallflower population will require routine population and habitat monitoring necessary to establish trends.

While the California Department of Parks and Recreation, Bureau of Land Management, and Humboldt Bay NWR at Humboldt Bay have made great progress in invasive species control and habitat restoration across the range of *Erysimum menziesii*, those results may be short-lived if not combined with a permanent re-treatment program. With one possible exception, no mechanism has

been yet implemented which ensures continued funding and implementation of an invasive species control program, or the monitoring necessary to effectively implement and evaluate such a program. The Asilomar State Beach Preliminary General Plan (CDPR 2004b) emphasizes the conservation of sensitive dune species and their habitat, and the Asilomar State Beach has a steady funding source, mandated by language in the concessionaire contract for the Asilomar Conference Center dedicating a portion of proceeds generated to resource management within the state beach (Gray pers. comm. 2006). Thus the Asilomar State Beach may be the closest of any *E. menziesii* occurrence to having a dedicated, permanent funding source for habitat maintenance.

D. Synthesis

At the time of listing, *Erysimum menziesii* was known to occupy four isolated dune systems, ranging from the Mad River north of Humboldt Bay south nearly to Cypress Point of the Monterey Peninsula. Population data are inadequate to assess the relative changes in population size and distribution since then, other than the more recent discovery of a small population on the South Spit of Humboldt Bay. It is clear that the proportion of its habitat owned by Federal and State agencies, estimated at about 10 percent at the time of listing, has increased substantially. Currently the proportion of its habitat publicly owned, including lands owned by special districts or covered under conservation easements, probably exceeds 60 percent. Threats to *E. menziesii* at the time it was listed included displacement by invasive plant species; direct impacts from commercial and residential development; off-road vehicle use; trampling by hikers and equestrians; sand mining; disposal of dredged materials from adjacent bays and waterways; and lack of regulatory protection. The increase in public ownership or other protective management has largely mitigated the direct threats from residential and commercial development, off-road vehicles, and at least currently, disposal of dredged materials. However, *E. menziesii* remains highly vulnerable, primarily due to invasive species encroachment, recreational impacts, and sand mining. In addition, some populations are currently at risk from deer predation, not recognized at the time of listing.

Although census data are generally lacking for all but *Erysimum menziesii* ssp. *eurekaense*, the population of *E. m. ssp. menziesii* in Mendocino County appears to remain relatively large, and evidence suggests *E. m. ssp. eurekaense* may have increased somewhat since it was listed. However, *E. m. ssp. yadonii* and the Monterey distribution of *E. m. ssp. menziesii* remain at high risk. The Mendocino County population of *E. m. ssp. menziesii* remains vulnerable to rapid residential growth surrounding parts of MacKerricher State Park, the anticipated increase in recreational pressure on the park as a result of that growth, and invasive species encroachment. While significant progress has been made in habitat restoration benefiting all three subspecies, no mechanism has yet been implemented to ensure that monitoring and restoration are implemented on a routine basis in the future, nor has a permanent and dedicated source of funding been allocated for those purposes.

Particularly with respect to the California Department of Parks and Recreation-owned and managed sites in Mendocino and Monterey Counties, further understanding of how to best

accommodate the inevitable increase in recreational use while maintaining a stable population of *Erysimum menziesii* is needed. For both *E. m. ssp. menziesii* and *E. m. ssp. yadonii*, a formal monitoring program is urgently needed to determine trends and provide information on which to base management decisions regarding recreational use.

Based on the results of this 5-year review, we conclude that *Erysimum menziesii* continues to meet the Endangered Species Act definition of endangered. Overall, the risk to *E. m. ssp. eurekaense* appears to have decreased, while the risk to the other subspecies has stayed the same or increased. Therefore, no status change is recommended at this time.

III. RESULTS

A. Recommended Classification:

- Yes, downlist to Threatened
- Yes, uplist to Endangered
- Yes, delist
- No, no change is needed

B. New Recovery Priority Number 2c (no change)

IV. RECOMMENDATIONS FOR FUTURE ACTIONS

Specific actions to facilitate recovery of this species are listed below. Of these, the five actions considered to be of highest priority, and which should be implemented within the next 5 years include: 1) completion of population estimates for the Monterey and Mendocino County populations of *Erysimum menziesii*; 2) establishment of a uniform reporting protocol for agencies conducting population inventories and habitat restoration across the range; 3) increased Service support, in the form of funding and staff involvement, of habitat restoration and population enhancement efforts along the Marina Dunes on private and public lands; 4) completion of a genetics evaluation and taxonomic review of *E. menziesii* across its range to help resolve outstanding questions on the identity of several large populations; and 5) investigation of methods and reliable funding mechanisms for ensuring future invasive species monitoring and control programs at critical sites.

A. Partnership

Successful partnerships with the California Department of Parks and Recreation, Bureau of Land Management, Manila Community Services District, Cities of Eureka and Pacific Grove, Big Sur Land Trust, Monterey Peninsula Regional Parks District, and various private owners in whose hands the fate of *Erysimum menziesii* rests, are crucial to the successful recovery of this species. Therefore, continued collaboration between the Service and these parties is critical.

B. Acquisition and/or Protection of Habitat

Priorities for increased protection, by fee acquisition, conservation easement, or other legal protective mechanism, are as follows:

Erysimum menziesii ssp. *eurekaense*

- City of Eureka property, including Samoa airport (North Spit of Humboldt Bay; large amount of habitat and wallflower population).
- Texaco property (South Spit of Humboldt Bay; isolated and growing wallflower population).
- Elk River parcels (City of Eureka and California Department of Fish and Game property; large isolated population of wallflower).
- “Dog Ranch” parcel (formerly known as LP South; includes 50 acres of occupied or potential habitat).

Erysimum menziesii ssp. *menziesii*

In Mendocino County these properties include, in general, key private lands surrounding MacKerricher State Park which either support *E. m. ssp. menziesii* or contribute to preserving the integrity of the Ten Mile Dunes ecosystem, in decreasing order of priority, these lands are:

- Inland dune habitat immediately south of Ten Mile River.
- Inland dune and prairie habitat northeast of Cleone Grange.
- Dune habitat surrounding Virgin Creek and dunes habitat located east of Highway 101 south of Virgin Creek.
- Dune habitat near the inland extent of the dune sheet north of Ward Avenue.
- Dune habitat near the inland extent of the dune sheet north of Cleone Lake.

In Monterey County these properties include:

- Signal Hill Dunes (including Birdrock and Spyglass sites). Due to the past severe degradation of the Point Pinos and Spanish Bay dune systems, the Signal Hill (includes Birdrock/Spyglass Hill) dune exposure and the Asilomar dunes are considered critical to maintaining a viable population of *E. m. ssp. menziesii* on the Monterey Peninsula. Therefore, a comprehensive review of the Signal Hill dunes system is urgently needed to identify the critical protection and management needs necessary to ensure its viability in the future.
- Point Pinos. The Service should assist the California Department of Parks and Recreation and the City of Pacific Grove in facilitating transfer of the coastal dune portion of the former Point Pinos Coast Guard property to the California Department of Parks and Recreation. California Department of Parks and Recreation ownership of this habitat, restored and managed in conjunction with the Asilomar State Beach, would help ensure that the Point Pinos type locality for *E. menziesii* is recovered.

Erysimum menziesii ssp. *yadonii*

- RMC Cemex (former Lonestar Cement). This site and the currently unprotected sites for *E. m. ssp. menziesii* on the Monterey Peninsula are considered the highest priority for protection across the range of the species.
- Martin property (currently majority ownership held by Big Sur Land Trust).

C. Permanent Invasive Species Control and Funding

It is imperative that efforts to control invasive species continue across the range, and that restoration methods incorporate the most cost-effective means available. Manual removal, or where existing populations are not impacted, mechanical removal or burning followed with herbicide post-treatment, has shown to be particularly effective. The problem species could change as new technologies arise, but inevitably, encroachment by invasive species will continue to threaten these habitats in perpetuity. Therefore, habitat monitoring followed by removal of invasive species, when warranted, must be considered a permanent element in maintaining *Erysimum menziesii*.

Perhaps the most critical element in recovery is identification of ways to institutionalize or make permanent an invasive species monitoring and control program for critical populations. The public entities owning the majority of the distribution of the three subspecies (California Department of Parks and Recreation, Bureau of Land Management, City of Eureka, City of Pacific Grove, and the Service) should determine the amount of needed funds, and then pursue opportunities to secure permanent funding in the form of an endowment or trust fund, to ensure that periodic monitoring and habitat restoration are conducted in perpetuity.

D. Population Inventories, Monitoring and Reporting

With the exception of *Erysimum menziesii* ssp. *eurekaense*, data indicating population size at all locations for the species are either very old or completely lacking. Many sites are privately owned, and current population assessments will require securing access permission from the owners. Due to the limited populations and variety of threats for the Monterey County populations, that part of the distribution is in urgent need of a comprehensive inventory and census, extending from the mouth of the Salinas River south to Cypress Point.

All California Department of Parks and Recreation sites (MacKerricher State Park, Marina State Beach, Asilomar State Beach, Fort Ord Dunes State Park) have been subject to multiple dunes restoration projects. Periodic reassessment of population and occupied habitat at these sites is particularly important to detect trends, thus providing essential feedback on whether the restoration efforts are successful, and whether the current recreational management is compatible with conserving the species.

- It became apparent in preparing this status review that a more effective method for recording management actions and census data is needed. Much of the past extensive habitat restoration work and population surveys for *Erysimum menziesii*, particularly in Monterey County, has either not been described in report format, or was not easily retrievable for this review. In order for this office to conduct a more coordinated recovery effort, and be able to assess progress made toward recovery, we will prepare guidelines to be distributed to all affected landowners outlining a minimal, brief format for submittal of project reports to this office, documenting ongoing census work, habitat restoration, or other research related to *E. menziesii*.

- *Erysimum menziesii* ssp. *menziesii*
(Mendocino County) The majority of habitat occupied by *Erysimum menziesii* ssp. *menziesii* in MacKerricher State Park was first mapped and quantified in 2004, but no estimate of population has yet been made. A statistical-based estimate of that population should be completed as soon as possible, and then repeated at approximately 5 year intervals. Monitoring should emphasize detection of *E. m. ssp. menziesii* within habitat recently treated for European beachgrass.

(Monterey County) A current population estimate is needed at all sites.

- *Erysimum menziesii* ssp. *yadonii*
Current population counts are needed at all four occupied sites.
- *Erysimum menziesii* ssp. *concinnum*
It is also recommended that a rangewide inventory for *E. m. ssp. concinnum* be conducted to determine its current distribution and abundance (see genetics recommendation below).

E. Viability analysis, *Erysimum menziesii* ssp. *eurekaense*

Based on the extensive and comprehensive demographic data collected between 1991 and 2000 for *Erysimum menziesii* ssp. *eurekaense*, an exceptionally complete dataset exists detailing all aspects of demography that would allow for analysis of the role of rust in viability. The viability study is listed as one of the criteria needed for delisting.

F. Genetics Evaluation and Taxonomic Review

A genetics evaluation of *Erysimum menziesii* across its range, in conjunction with a taxonomic review, is needed to help resolve outstanding questions on the identity of several large populations of wallflower occurring on coastal dunes, as discussed in Section C.2. A genetics evaluation would also aid in selection of seed sources and the likelihood that restored populations will thrive (USFWS Ventura FWO 2005).

As part of the taxonomic review, a current inventory of *Erysimum menziesii* ssp. *concinnum* across its range should be conducted to determine its present status, provide suitable populations for genetic characterization within the overall species evaluation, and provide the context within which to assess the morphological, genetic, and thus taxonomic relationships among the group (see Section C.2.).

Propagation and outplanting efforts for *Erysimum menziesii* have either been ongoing, or are planned at several locations within the range. In accordance with the Service's policy regarding controlled propagation of listed species (65 FR 56916, September 20, 2000), and utilizing information derived from the above proposed genetic evaluation, a genetic management and outplanting plan should be developed as soon as possible.

G. *Erysimum menziesii* ssp. *yadonii* Reintroduction and Restoration Opportunities

Several opportunities may be available for reintroduction of *Erysimum menziesii* ssp. *yadonii*, and a State/Federal/private coordinated approach to habitat restoration affecting the majority of the Marina Dunes. These include:

- Salinas River NWR: Based on the reliable historical record of *E. m. ssp. yadonii* presence on the refuge, the Service should consider amending the refuge's Comprehensive Conservation Plan (CCP) to allow reintroduction of the species. The current Comprehensive Conservation Plan (USFWS 2002) outlines specific management objectives for enhancing the coastal dune habitat (CCP objective 1.4) and conserving populations of special status species (CCP objective 2.1).
- Martin property: Majority ownership of the Martin property, 117 acres located on the Marina Dunes, was recently acquired by the Big Sur Land Trust. This property reportedly supports *E. m. ssp. yadonii*, and thus may be a good candidate for restoration. The Service should consider assisting the Land Trust in funding and implementing appropriate restoration.
- RMC Cemex property: The Salinas River NWR is also well positioned to play a major role in the protection and conservation of the coastal dune system in Monterey Bay (CCP management objective 2.3). In that role, the refuge could assist in negotiating protection of *Erysimum menziesii* ssp. *yadonii* on the nearby RMC Cemex property. Perhaps the greatest opportunity is a coordinated approach to restoration of these dunes. For example, funding could be pursued (e.g., under section 6 of the Endangered Species Act) aimed at a multi-partnership (e.g., the Service, California Department of Parks and Recreation, Big Sur Land Trust; Monterey Peninsula Regional Parks District, RMC Cemex, and others), multi-species (*E. m. ssp. yadonii*, other listed plants, and Western snowy plover), coordinated effort to restore the Marina Dunes system and recover all of the listed species present in that ecosystem.

H. Mitigation of Deer Impacts, Monterey Peninsula

Damage by deer is currently considered one of the greatest threats to *Erysimum menziesii* ssp. *menziesii* on the Monterey Peninsula. Caging has successfully maintained reproductive output at some sites, but is labor intensive, and is considered a short-term solution at best. The following actions are recommended:

- Conduct a comprehensive assessment of the problem (site review, interview residents, etc.), and prioritize *Erysimum menziesii* ssp. *menziesii* sites based on the degree to which they may be successfully protected from deer and their importance to the species conservation.
- In coordination with the California Department of Fish and Game, the City of Pacific Grove, and others, review all available methods for discouraging deer predation. If feasible, develop a plan incorporating appropriate methods, where locally feasible, for reducing deer impacts on the plant populations.

I. Investigation of Erosional Impacts, Marina Dunes

In order to determine if sand removal is affecting the Marina Dunes system, as has been suggested, and whether beach retreat has or will soon impact *Erysimum menziesii* ssp. *yadonii* habitat, the following actions are recommended:

- Consult experts to determine if a historical aerial photo review and other types of assessments of beach erosion along the Marina Dunes have been conducted at a resolution necessary to determine if *E. m. ssp. yadonii* habitat has been or will be impacted in the future.
- If warranted, procure a new assessment of beach erosion along Marina Dunes, and contact the U.S. Geological Survey about remeasuring any historical beach profiles.
- Investigate whether old plot markers or other permanent markers are available to calibrate the erosion assessment, and determine whether a new system of permanent markers is warranted to enable future, focused assessment of erosion within *Erysimum menziesii* ssp. *yadonii* habitat.

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B. Personal Communications

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U.S. FISH AND WILDLIFE SERVICE
5-YEAR REVIEW of *Erysimum menziesii*

Current Classification Endangered
Recommendation resulting from the 5-Year Review

- Downlist to Threatened
- Uplist to Endangered
- Delist
- No change is needed

Appropriate Listing/Reclassification Priority Number NA

Review Conducted By David Imper, Ecologist

FIELD OFFICE APPROVAL:

Acting
Lead Field Supervisor, Fish and Wildlife Service

Approve *Kenny A. Brown* Date *7/5/08*

REGIONAL OFFICE APPROVAL:

Lead Regional Director, Fish and Wildlife Service

Acting
Approve *Robert Williams* Date *7/10/08*