

Layia carnosa
(Beach layia)
DRAFT
5-Year Review:
Summary and Evaluation



Layia carnosa: Humboldt Bay, California
Photograph utilized courtesy David Imper, Arcata FWO

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

November 2011

5-YEAR REVIEW
***Layia carnosa* (Beach layia)**

I. GENERAL INFORMATION

A. Methodology used to complete the review: This review was conducted by David Imper, Ecologist, with the Arcata Office of the U.S. Fish and Wildlife Service (USFWS), based on all information contained in files at that office and provided by the public and agencies in response to the Federal Notice.

B. Reviewers

Lead Region - Larry Rabin, Deputy Division Chief for Listing, Recovery, and Environmental Contaminants and Karen Jensen, Fish and Wildlife Biologist (916) 414-6464

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C. Background

1. FR Notice citation announcing initiation of this review:

On February 14, 2007, the USFWS announced initiation of the five-year review for *Layia carnosa* and asked for information from the public regarding the species' status (72 FR 7064). No information was received as a result of that announcement.

2. Listing history

Original Listing

FR notice: 57 FR 27848-27859

Date listed: June 22, 1992

Entity listed: Beach layia

Classification: Endangered

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

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

The recovery priority is 8, reflecting a moderate degree of threat, high recovery potential, and a taxonomic rank of full species.

5. 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?

No. The Endangered Species Act defines species as including any subspecies of fish or wildlife or plants, and any distinct population segment of any species of vertebrate wildlife. 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. 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. No evidence exists at this time to indicate Listing Factor C (disease or predation) is relevant.

Note: All of the downlisting criteria, and a portion of the delisting criteria included in the recovery plan (USFWS 1998) applied to the entire suite of dune plant species covered by the plan. As such, some interpretation of those criteria may be warranted to account for the specific life history or other circumstances of the species in question. The recovery criteria written specifically for *Layia carnosa* are referred to below as Specific Delisting Criteria.

Reclassification to threatened status will be evaluated when:

Downlisting Criterion 1 (Addresses Listing Factors A, D and E)

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

Though not clearly stated in the Recovery Plan, this criterion is intended to mean that a majority of each of the individual dune systems occupied by *Layia carnosa* across its range are secure, with some degree of long-term commitment by the landowners. For the purpose of this review, the term “occupied” is used to indicate habitat that, based on the most recent reliable inventory information, continues to contain *Layia carnosa*. There has been significant improvement in the security of habitat occupied by *Layia carnosa* since the recovery plan was prepared, as a result of land acquisition by Federal, State and local agencies, and non-governmental organizations (NGO), adoption of local coastal plans under the California Coastal Act, and implementation of management plans that address the needs of the species. Of the estimated 456 acres of near-shore dunes habitat currently occupied by *Layia carnosa*, approximately 91percent is owned by Federal and State governmental entities or other land owners with existing resource management direction precluding development within sensitive dunes habitat (Figure 1; Tables 1 and 2). The non-governmental land owners with existing resource management direction precluding development within sensitive dunes habitat are owned by the city of Eureka’s easement held by the Trust for Public Lands, the Manila Community Services District (CSD), and NGOs the Wildlands Conservancy and Friends of the Dunes (Tables 1 and 2). This occupied

habitat lies within the jurisdiction of the California Coastal Act, local coastal plans and zoning ordinances (Humboldt and Monterey Counties), and the California Environmental Quality Act (CEQA), all of which entail restrictions on most activities within sensitive dune habitat, or if development is allowed, compensatory mitigation (described in detail under Section C2a). Thus, 91 percent of the habitat occupied by *Layia carnosa* may be considered secure from direct development impacts, and the remainder will normally be afforded a high level of security.

There is wide variation in management commitment to maintain *Layia carnosa* and its habitat among landowners, ranging from no involvement intervention to proactive management, as described in detail under Section C2a. All of the Federal agencies and the California Department of Parks and Recreation (CDPR) are required under current policies to assist in recovery of *Layia carnosa* (approximately 52 percent of the occupied habitat), so long as it is Federally and State listed. After that, more generic and often discretionary direction related to conservation of biodiversity and the native dunes community will continue to benefit *Layia carnosa*, as described under Section C2a. Another 17 percent of occupied habitat is owned by California Department of Fish and Game (CDFG) and managed by the Bureau of Land Management (BLM), known as the South Spit Wildlife Management Area. The remaining 16 percent of the habitat currently occupied by *Layia carnosa* across its range is owned by NGOs (Wildlands Conservancy and Friends of the Dunes) or special district (Trust for Public Lands), or covered under a conservation easement (Manila CSD and, subject to management guidance that includes provisions for conservation of the sensitive dune habitat resources on their property (Table 2). However, with the exception of the Asilomar State Beach (SB), the funding for future habitat maintenance is discretionary. Asilomar SB has access to long-term funds specifically earmarked for conservation of the dunes on an annual basis, as part of the agreement with the onsite conference center.

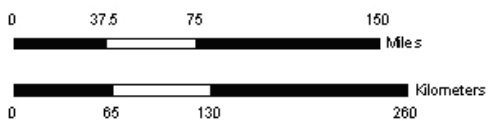
In summary, over 90 percent of habitat occupied by *Layia carnosa* is believed to meet the “secure” provision of this downlisting criterion, as a result of ownership by public entities or NGOs, coverage under policies or easement restrictions, or in the case of private ownership, being subject to planning restrictions and mitigation requirements that severely limit impacts within its habitat. Approximately 85 percent of its habitat is subject to management which emphasizes conservation of sensitive dune habitat, and about 52 percent is subject to management committed to assisting in the recovery of *Layia carnosa*. We believe that this criterion has been adequately met.



Figure 1. *Layia carnosa* (Beach Layia) Range Map
Prepared for the 2011 5-year Status Review



Produced in the Arcata Fish and Wildlife Office
Arcata, California
Map Date: 02.07.2011
File: Beach Layia_2011 rangeMap.mxd



UTM ZONE 10
NAD 83

Table 1. Historic and current sites occupied by *Layia carnosa*, from north to south. Table prepared for 2011 5-year review.

Dune System	Locality	County	Owner and CNDDB EO# ¹	Est'd occupied habitat (ac)	Est'd population (year est'd) or last year observed	Recent or ongoing invasive species removal	References ²
Freshwater Lagoon	Freshwater Lagoon Spit	Humboldt	Redwood National Park (EO30)	1 ³	587 (2010) ⁴		(Julian 2010)
Humboldt Bay	Mouth of Little River	Humboldt	CDPR (EO15)	Extirpated	1937	Yes	
Humboldt Bay	Mouth of Mad River	Humboldt	Private (EO14)	Extirpated	1967		
Humboldt Bay	North Spit to the mouth of the Mad River (Lanphere Dunes and Ma'le'i North units)	Humboldt	USFWS: HBNWR(EO11)	38	1.2 million(2010) ^{5,6}	Yes	(Pickart, pers.comm. 2010)
Humboldt Bay	North Spit to the mouth of the Mad River (Manila Dunes)	Humboldt	Manila CSD (EO17)	39	?	Yes	
Humboldt Bay	North Spit to the mouth of the Mad River	Humboldt	Friends of the Dunes (EO17)	12	?		
Humboldt Bay	North Spit to the mouth of the Mad River (Ma'le'i South and Samoa Dunes)	Humboldt	BLM (Samoa Peninsula Management Area [EO12])	20	?		
Humboldt Bay	North Spit to the mouth of the Mad River	Humboldt	City of Eureka (EO12)	16	?		
Humboldt Bay	North Spit to the mouth of the Mad River	Humboldt	Private (EO12)	31	?	Yes	
Humboldt Bay	South Spit	Humboldt	CDFG/BLM (EO27)	105	3.8 million*(2007) ^{6,7}	Yes	BLM 2006,2007
Humboldt Bay	Elk River Spit	Humboldt	City of Eureka (EO29)	1 ³	?		
Humboldt Bay	Mouth of Eel River	Humboldt	Wildlands Conservancy	>15	>3,000(2009) ⁷		Wildlands Conservancy 2009
Mouth of the Mattole River	Mouth of McNutt Gulch	Humboldt	Private (EO9)	1 ³	?Unknown		
Mouth of the Mattole River	Mouth of Mattole River	Humboldt	BLM (EO10)	27	3.3 million (2010) ⁹		BLM 2010a
Pt. Reyes	Kehoe Beach Dunes	Marin	Pt. Reyes NS (EO7)	Total Pt. Reyes NS 146 ⁹	>66,000 (2004) ¹⁰	Yes – portions of the Point Reyes dune system in general have been restored, or are slated for restoration	Point Reyes NS 2005
Pt. Reyes	Abbotts Lagoon	Marin	Pt. Reyes NS (EO8)	See above	See above		
Pt. Reyes	Abbotts Lagoon South	Marin	Pt. Reyes NS (EO19)	See above	See above		
Pt. Reyes	North Beach Parking	Marin	Pt. Reyes NS (EO22)	See above	See above		
Pt. Reyes	South Beach Access	Marin	Pt. Reyes NS (EO31)	See above	See above		
Pt. Reyes	South Beach Parking	Marin	Pt. Reyes NS (EO24)	See above	See above		
Pt. Reyes	Old Life Saving Stn	Marin	Pt. Reyes NS (EO25)	See above	See above		
San Francisco	Locality unknown	San Mateo-San Francisco	Unknown (EO6)	Extirpated	1904		
Monterey Peninsula	Pt. Pinos	Monterey	City of Pacific Grove (EO4)	Extirpated	1962	Yes	
Monterey Peninsula	Asilomar State Beach	Monterey	CDPR (EO5)	<0.1	190 (2009) ⁴	Yes	Johns 2009
Monterey Peninsula	Indian Village Dunes	Monterey	Private Del Monte Forest Foundation (EO2)	0.55	1783 (2009) ⁴	Yes	Johns 2009

Monterey Peninsula	Signal Hill Dunes	Monterey	Private (EO3)	<1 ³	?		
Vandenberg Air Force Base	Vandenberg Air Force Base	Santa Barbara	DOD (EO1)	2.6	4300 ⁴ (2011)	Yes	Lum, pers. comm. 2011
Vandenberg Air Force Base	Vandenberg Air Force Base	Santa Barbara	DOD (EO1)	See above	See above		

¹Landowner name is followed by the by the California Natural Diversity Database (CNDDDB 2011) element occurrence (EO#), if it is in the database.

²References in addition to CNDDDB 2011.

³Actual amount of occupied habitat not determined; conservative estimate made based on available suitable habitat and informal observations (see discussion of site population in Section IIC1).

⁴Complete census conducted.

⁵Humboldt Bay NWR population estimates for Lanphere Dunes Unit alone ranged 0.5 million – 2.7 million over period 1997-2010, based on (45) 0.5m x 100m linear plots representing 20 acres occupied habitat spread over approximately 1 mile of near-shore dunes.

⁶Combined population estimates for EO11 and a portion of EO27 (5 million) represent 95.5 acres of the total estimated 291 acres occupied habitat surrounding Humboldt Bay, and 456 acres range wide.

⁷South Spit Management Area 2007 population 95 percent C.I. = 2.2-5.4 million, based on (151) 45 s.f. plots allocated by vegetation type and polygon size, representing 75.5 acres of occupied habitat; does not include estimated 30 occupied acres within the Eel River Wildlife Area.

⁸Wildlands Conservancy Eel River Preserve not yet accurately inventoried or mapped; preliminary survey indicated >15 acres occupied habitat and >3,000 plants; actual population may be much larger.

⁹Mattole River population estimate based on (400) 4 s.f. plots randomly located along two fixed transects located in the northern and southern portions of the 27 acres occupied habitat (95percent C.I. 2.3-4.3 million).

¹⁰Point Reyes NS occupied habitat a compilation of polygons recorded 2001-2003; 2004 population estimate represents a relatively small portion of the total estimated occupied habitat.

Table 2. Summary breakdown of habitat occupied by *Layia carnosa* under different ownership and management direction across its range. Table prepared for 2011 5-year review.

Owner	Total Ownership		Subject to management direction aimed at <i>Layia carnosa</i> and/or sensitive dune habitat	
	Acres	%	Acres	%
<u>Federal</u>				
USFWS	38	8	38	8
BLM	47	10	47	10
Redwood NP	1	0	1	0
Pt. Reyes NS	146	32	146	32
DOD	3	1	3	1
Total Federal	235	52	235	52
<u>State</u>				
CDFG	105	23	75 ¹	17
CDPR	<1	0	<1	0
Total State	105	23	75	17
<u>Other</u>				
City (Eureka)	17	4	6 ²	1
Special District (Manila CSD)	39	9	39	9
Non-Governmental organizations	27 ²	6	27 ³	6
Private	33	7	1 ⁴	0
Total Other	116	25	73	16
Totals	456	100	383	85

¹South Spit Wildlife Management Area

²Easement held by Trust for Public Lands.

³Wildlands Conservancy and Friends of the Dunes.

⁴Easement held by Del Monte Forest Foundation.

Downlisting Criterion 2 (In part, addresses Listing Factors A, D and E)
Management measures are being implemented to address the threats of invasive species, pedestrians, and off-road vehicles at some sites.

The USFWS, BLM, Redwood National Park (NP), Point Reyes National Seashore (NS), and several other land managers in the northern portion of the range, and the CDPR, Department of Defense (DOD), and several other managers in the southern portion of the range have all instituted relevant management policies since the recovery plan was completed, or since the species was listed, described in detail in Section C2a. Those policies have reduced, and in many cases eliminated the threats posed by invasive species, pedestrians and off-road vehicles to *Layia carnosa*.

Sites which have had, or are currently undergoing invasive species removal projects are indicated in Table 1. In the northern portion of the range these sites include: Humboldt Bay National Wildlife Refuge (NWR) Lanphere Dunes Unit (former Nature Conservancy Lanphere-Christensen Dunes Preserve), and the Ma'le'l Dunes Cooperative Management Area (CMA), jointly managed by the USFWS and BLM (includes both Ma'le'l North and Ma'le'l South, a part of BLM's Samoa Peninsula Management Area; Table 1; A. Pickart, Humboldt Bay NWR, pers. comm. 2006, 2011b), the Manila dunes owned by the Manila CSD (K. Wear, private consultant, pers. comm. 2007a), the Samoa Dunes (a part of BLM's Samoa Peninsula Management Area) and South Spit Management Areas, owned or managed by BLM (A. Pickart, pers. comm. 2006; BLM 2007), and Point Reyes NS (Point Reyes NS 2006; L. Parsons, Point Reyes NS, pers. comm. 2011). In addition, the Humboldt Bay Harbor, Recreation and Conservation District (HBHRCD) also recently removed invasive species from two acres of potential *Layia carnosa* habitat on the North Spit of Humboldt Bay, in conjunction with a bay dredging project (USFWS Arcata FWO 2005), and the Wildlands Conservancy is planning to remove invasive species on their dune holdings at the mouth of the Eel River (D. Clendenen, Wildlands Conservancy, pers. comm. 2011). Sites on the Monterey Peninsula have undergone, or are undergoing restoration, including the type locality (extirpated) at Point Pinos (USFWS Ventura FWO 2005), the Asilomar State Beach (SB), which has conducted extensive dunes restoration over the past 20 years (L. Madison, Asilomar SB, pers. comm. 2007), and the Indian Village Dunes (Pebble Beach Company 1989).

With the exception of some privately held dunes habitat around Humboldt Bay at the mouth of McNutt Gulch, and a portion of the BLM and City of Eureka-owned dunes at Humboldt Bay (specifically set aside as an OHV park), off-road vehicles are not officially allowed in any habitat occupied by *Layia carnosa*. Illegal trespass by off-road vehicles has always, and will continue to occur occasionally in locations easily accessible to the public, such as the Wildlands Conservancy dunes at the mouth of the Eel River near Humboldt Bay (D. Clendenen, pers. comm. 2011).

Pedestrian and equestrian impacts do not appear to be a significant threat with the exception of the Signal Hill Dunes at Monterey Peninsula. This area is relatively small, severely fragmented, and degraded as a result of uncontrolled pedestrian and equestrian use (Imper 2007). Dispersed equestrian use has been allowed on the South Spit at Humboldt Bay since BLM began management of the area in 2002 (BLM 2002). The amount of habitat occupied by *Layia carnosa* more than doubled there between 2003 and 2006 (BLM 2003, 2006), suggesting that dispersed equestrian use, at least where large areas of occupied habitat are concerned, is compatible with large populations. In fact, in both cases the *Layia carnosa* population was mapped on the South Spit (2003 and 2006), many of the occupied polygons consisted of narrow strips along the edges of pedestrian and equestrian trails that penetrated otherwise unoccupied and unsuitable habitat. A positive relationship between *Layia carnosa* and moderately disturbed habitat adjacent to roads and trails (whether pedestrian or equestrian) in what otherwise is unoccupied habitat has been noted frequently throughout much of its range (Duebendorfer 1992; A. Pickart, pers. comm. 2011a; K. Wear, pers. comm. 2011; J. Wheeler, BLM, pers. comm. 2011; D. Clendenen, pers. comm. 2011).

As a result of the many management measures currently implemented across the range of *Layia carnosa* to address the threats of invasive species, pedestrians, and off-road vehicles, we believe that this criterion has been adequately met for the purpose of downlisting.

Downlisting Criterion 3 (In part, addresses Listing Factor E)

Monitoring reveals that management actions are successful in reducing threats of invasive non-native species.

Invasive species are the most significant factor leading to the stabilization, thus degradation of near-shore dunes across the range of *Layia carnosa* (Pickart and Sawyer 1998). Depending on the site, the principal invasive species include European beachgrass (*Ammophila arenaria*), bush lupine (*Lupinus arboreus*), iceplant (*Carpobrotus* spp.), and a variety of non-native annual grass species. Severe infestations are present at Vandenberg Air Force Base (AFB), Point Reyes NS, the majority of near-shore dunes surrounding Humboldt Bay, and Freshwater Lagoon. There are only three sites throughout the range where invasive species have either been completely removed, and are dealt with on a maintenance removal level at this time, or have not yet proven to be a serious threat; those include the Lanphere Dunes at Humboldt Bay, the mouth of the Mattole River, and Asilomar SB. The majority of landowners across the range have implemented control efforts for invasive species, as described above in Downlisting Criterion 2, and indicated in Table 1.

Routine monitoring of *Layia carnosa* populations is conducted by Redwood NP, USFWS, BLM, Point Reyes NS, Asilomar SB, and Vandenberg AFB. One example of *Layia carnosa*' response to invasive species control is the efforts made by the Manila CSD on the North Spit to the mouth of Mad River in Humboldt Bay, at a site where removal projects have been ongoing since 1992. The Manila CSD took over management in 1998, and currently owns

approximately 39 acres of occupied *Layia carnososa* habitat. Restoration there has been funded by various State and Federal grants over the years, including the Coastal Conservancy, CDPR, CDFG, National Fish and Wildlife Foundation, and the USFWS Partners Program. Restoration efforts since 1999 in one area of the property, primarily aimed at European beachgrass, has more than tripled the extent of *Layia carnososa*, from 1.1 to 3 acres (K. Wear, pers. comm. 2007a). Another example is the invasive species control efforts by BLM on the South Spit of Humboldt Bay, conducted since 2003, affecting 40-50 acres of near-shore dunes (J. Wheeler, pers. comm. 2011). *Layia carnososa* occupied habitat then doubled from 34 acres in 2003 to more than 75 acres in 2006 (BLM 2003, 2006). *Layia carnososa* was rediscovered in 1990 (L. Madison, pers. Comm. 2007) after restoration of dunes at Asilomar SB, that began in the 1980's. That population has ranged from 190 to 543 individuals since 1994 (Johns 2009). In the early 2000's an increase in *Layia carnososa* (Point Reyes 2006; J. Rodgers, pers. comm. 2007) occurred after dune restoration efforts at Point Reyes NS, although the magnitude of that increase was not quantified.

There is no question that management actions over the past 12 years may have reduced the threats from invasive species, at least in the short-term. We believe adequate success has been demonstrated to satisfy this downlisting criterion.

Downlisting Criterion 4 (In part, addresses Listing Factors A, 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.

Much of the intent of this criterion, in calling for establishment of additional populations, is to reduce the significance of localized impacts on individual populations, as well as to reduce the distance between populations, thereby increasing inter-population genetic communication. Since the criterion was written as a general goal for multiple species included in the recovery plan, clarification is needed on how it applies to *Layia carnososa*, and in particular, the intended meaning of the term "additional populations" as it applies to the species' distributional characteristics. Three of the 6 dune systems *Layia carnososa* occupies account for greater than 99 percent of the known total populations of the species. These include: Humboldt Bay, Pt. Reyes, and the Mouth of the Mattole River. It is reasonable to expect that the majority of efforts taken to meet Criterion #4 should be aimed at these dune systems, rather than at the edges of its range, where environmental conditions not easily manipulated could hinder or prevent the long-term establishment of new populations.

The distribution of *Layia carnososa* at the Mouth of the Mattole River extends across the majority of an isolated, very limited area of dunes. It is not feasible to establish a new population at this site. The nearby dunes at the Mouth of McNutt are privately owned, and the landowner has been unwillingly to provide access. The dunes at Humboldt Bay and Pt. Reyes occur in relatively continuous sheets (e.g., the dunes at Humboldt Bay extend continuously along nearly 19 miles of

coastline) within which *Layia carnosa* is scattered across a majority of the aerial extent of the dunesheets in many small isolated fragments of suitable habitat, surrounded by currently unsuitable habitat. The distribution of *Layia carnosa* in these dune systems is best viewed as either two, very large, single populations, or perhaps meta-populations (groups of spatially separated populations of the same species which interact at some level).

Given the limitations for establishment of truly isolated populations within the majority of the core distribution of *Layia carnosa*, we believe a reasonable interpretation of the intent of this criterion, as applied to the specific case of *Layia carnosa*, is the establishment of new occupied habitat where none previously was known. Such an interpretation removes the ambiguity, but has essentially the same overall results: i.e., creating a buffer from the threat of localized impacts; and reducing the distance between populations, thereby increasing inter-population genetic communication.

Examples of secured habitat considered “additional” in the context of this downlisting criterion (i.e., secured since the recovery plan was written) include:

- The South Spit Management Area was acquired by CDFG in about 2000, and BLM began restoration of the near-shore dunes there in 2002. Several phases of restoration have been conducted by BLM since then, affecting up to 50 acres, which contributed to a more than doubling of habitat, from 34 to 75 acres, occupied by *Layia carnosa* between 2003 and 2006 (BLM 2003, 2006). Due to the fact that *Layia carnosa* occurs in numerous widespread patches scattered over several miles of dunes, an accurate estimation of population size is labor intensive and costly. As a result, the sampling efforts made in 2003 and 2007, though substantial, failed to yield confidence intervals adequate to differentiate population sizes between the years (95 C.I. for 2003 = 2.5-8.6; for 2007 = 2.2-5.4 million) (BLM 2003, 2007). Nevertheless, as an annual species, *Layia carnosa* responds almost immediately to changes in its environment, and other things being equal, creation of new occupied habitat should have added proportionally to the population. There was no evidence that the habitat occupied in 2003 declined between 2003-2007, such that it would have offset the contribution made by the new habitat (Imper 2007; BLM 2003, 2007). Another reason why an obvious increase was not observed between 2003 and 2007 may have been due to a generally poor showing by *Layia carnosa* in 2007, seen in annual population trends recorded at Lanphere Dunes (A. Pickart, pers. comm. 2011a). In summary, based on the doubling of occupied habitat between 2003 and 2006, which did not appear to coincide with a significant decline in quality of previously occupied habitat, we believe it is reasonable to assume the population increased substantially, if not commensurately, when adjusted for normal variation mediated by climate.
- The former “Khoaghali” and “buggy club” parcels, including 200 acres of near-shore dunes and forest, was recently acquired by the USFWS and BLM, and is co-managed as the Mal’el Dunes Cooperative Management

Area. These parcels include a portion of the occupied habitat owned by BLM and USFWS on the North Spit of Humboldt Bay, reported in Table 1. Restoration began there in 2005 to remove invasive species, and initially resulted in an unusually high concentration of *Layia carnosa*, after which the population density fell to levels similar to other occupied habitat around Humboldt Bay. Those results were similar to what happened at Lanphere Dunes following restoration activities conducted in the 1980's (A. Pickart, pers. comm. 2011a, 2011c).

- Restoration efforts began in 1999 on lands owned and managed by the Manila CSD on the North Spit of Humboldt. Primarily removal of European beachgrass more than tripled the extent of *Layia carnosa*, from 1.1 to 3 acres in one area of the property (K. Wear, pers. comm. 2007a).

Management commitments by land managers across the range of *Layia carnosa* were described in Downlisting Criterion 1 above, and in more detail in Section C2a. In the cases cited above: habitat was secured since the recovery plan was completed; restoration was conducted with a commensurate response by *Layia carnosa*; and there is a long-term commitment to conservation of its habitat in the future. We believe that for the purpose of downlisting, this criterion has been adequately met.

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, D and E)
Full recovery will be achieved when the dune system it inhabits is: 1) secure; 2) 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. 3) The taxon needs 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. 4) The determination that delisting is possible must be based on at least 15 years of monitoring, to include wet and drought years. 5) 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.

Due to the complexity of this criterion, the various elements are discussed individually in the order identified above:

- 1) Over 90 percent of habitat occupied by *Layia carnosa* is judged to be secure, as described in Downlisting Criterion 1.
- 2) Significant progress has been made in removing or minimizing recreational threats (off-road vehicles, equestrian impacts), and reducing the threats from invasive species (primarily European beachgrass and iceplant) across the

range of *Layia carnosa*, as described in Downlisting Criterion 2 above, and there is documentation showing these efforts are successful, described in Downlisting Criterion 3 above. However, large areas of habitat in Humboldt County, at Point Reyes NS, and at Vandenberg AFB remain to be restored, and while the methods for habitat restoration are relatively well known (Duebendorfer 1992; Pickart and Sawyer 1998), the resources required to do so are substantial. Unfortunately the beneficial effects of invasive species removal are often highly transient, particularly when routine removal of sprouts is not implemented (A. Pickart, pers. comm. 2011a). Portions of restored habitat on the South Spit of Humboldt Bay, and undoubtedly elsewhere around Humboldt Bay, have been recolonized by invasive species in the absence of regular maintenance (J. Wheeler, pers. comm. 2011). Thus, while some land managers have demonstrated the ability to maintain its habitat (e.g., Asilomar SB, Lanphere Dunes), development of a strategy to ensure future maintenance remains a challenge for most landowners.

- 3) No efforts have yet been made to re-introduce *Layia carnosa* to historical sites. CDPR is undertaking restoration of near-shore dunes south of the mouth of the Little River in Humboldt County (near extirpated element occurrence #15, Table 1), and has indicated plans to reintroduce *Layia carnosa* there (M. Forsys, Environmental Scientist, CDPR, pers. comm. 2007).
- 4) In many cases, the population monitoring record for *Layia carnosa* extends beyond 15 years. Population baseline and trend data are available for several of the smaller populations (Freshwater Lagoon Spit since 2000 (Julian 2010), Asilomar SB since 1994 (L. Madison, pers. comm. 2007), Vandenberg AFB since 1995 (L. Lum, Department of Defense, pers. comm. 2007) and portions of the larger populations, including: small polygons within the Point Reyes NS population between 1988 and 2003 (Point Reyes NS 2005); the mouth of the Mattole River since 1994 (BLM 2010a); the South Spit of Humboldt Bay since 2003 (BLM 2003, 2007); various BLM locations on the North Spit of Humboldt Bay, in some cases since 1994 (BLM 2010b-e); and the Lanphere Dunes Unit of the Humboldt Bay NWR since 1989 (A. Pickart, pers. comm. 2011a).
- 5) While many aspects of the demography and population biology are relatively well understood for this species, gained both from the extensive field monitoring described above, and autecological research (Basor 2002; Sahara 2000), research is still needed to further define aspects of its ecology. For example, research is needed to better define the relationship between disturbance regime and the establishment and maintenance of *Layia carnosa* populations, and better define the environmental factors that serve to limit its distribution and reproductive success across its range. The latter research may be crucial to developing a strategy to counter the impacts of climate change and ocean-rise, once there is greater certainty about the changes that will eventually occur within its range.

We do not consider this general criterion for delisting to have been met.

Specific Delisting Criterion 1 (In part, addresses Listing Factors A, D and E)
*The Humboldt Bay dune system, on both the North and South Spits, has 1) substantially all of the European beachgrass removed from the foredune. Iceplant, yellow bush lupine, and pampas grass must be greatly reduced, degraded dunes restored, and vehicle management implemented (including fencing and patrolling where needed). 2) New colonies of *Layia carnosa* must be established and persist for at least 10 years, and monitoring for at least 15 years should demonstrate that populations are increasing in response to availability of habitat. 3) There must be written assurance of long-term support for continued management of the dunes and for biological monitoring.*

Due to the complexity of this criterion, the individual elements are discussed in the order identified above:

1. In the early 1990's, Duebendorfer (1992) estimated about 500 of the total 800 acres of near-shore dunes on the North and South Spits of Humboldt Bay (extending north to and including the Lanphere Dunes) were dominated by European beachgrass, iceplant and/or yellow bush lupine. Since that date, restoration efforts by the USFWS, BLM, Manila CSD and others combined have probably treated on the order of 200 acres (perhaps 40 percent). However, so long as major areas of habitat remain infested by one or more invasive species, in close proximity to previously restored habitat, maintenance of the restored habitat remains problematic. While iceplant, yellow bush lupine, and pampas grass have certainly been reduced, both these species and European beachgrass continue to dominate large areas. Off-road vehicles have been effectively excluded from virtually all the *Layia carnosa* habitat around the bay, through official closure by the landowner agency, and implementation of a local coastal plan and supporting ordinances restricting activities on private lands (Humboldt County 1995).
2. Technically, no new colonies of the *Layia carnosa* have been established around Humboldt Bay, although it has recolonized much restored habitat. Population monitoring has not generally focused on the restored areas to the degree necessary to document significant reestablishment, persistence, or long-term increase in populations. Reintroduction of *Layia carnosa* is planned for the Clam Beach Dunes, a historical site for the species approximately 10 miles north of Humboldt Bay (M. Forys, CDPR, pers. comm. 2007).
3. To the extent feasible at this time, and recognizing the financial limitations of landowners and managers, there is reasonable written assurance of long-term support for management of near-shore dunes contained in the various agency management plans and conservation easements that apply to the majority of dunes ownerships on the North and South Spits, described in Section C2a. With little exception, there generally is no written assurance that management specifically targeted to maintain *Layia carnosa* habitat long-term will continue once the species has been delisted.

We do not consider this specific criterion for delisting to have been met.

Specific Delisting Criterion 2 (In part, addresses Listing Factors A, D and E)
The extended population at Point Reyes National Seashore is expanded in response to the same measures described for the Humboldt dunes. The main exotic plant problems to be addressed are foredune European beachgrass and iceplant.

Progress has been made on this criterion, but much work remains to be done. Invasive species removal efforts were conducted at Point Reyes NS in 2000 and 2003, focused on European beachgrass and iceplant. Those efforts were described in the 2005 annual report (Point Reyes NS 2005), and included removal of beachgrass from 50 acres of coastal dunes both north and south of Abbotts Lagoon. In spring 2005, 18 *Layia carnosa* individuals were observed in the treated area. The urgency to remove invasive species (primarily iceplant) was ranked medium to high within at least 7 of the 14 population groups of *Layia carnosa* designated within Point Reyes NS at that time (Point Reyes NS 2005). The agency is planning to restore an additional 75 acres of dunes south of Abbotts Lagoon beginning in 2011. That habitat is dominated primarily by European beachgrass. No estimate was available of the extent of near-shore dunes habitat potentially restorable there, but based on aerial photography, habitat currently occupied by *Layia carnosa* (approximately 146 acres; Point Reyes NS 2010) appears to be only a small proportion of the potentially suitable dune habitat present along more than 9 miles of near-shore dunes.

While there has been progress toward meeting this criterion, we do not believe it has been met.

Specific Delisting Criterion 3 (In part, addresses Listing Factors A, D and E)
The occurrences south of San Francisco in the Monterey Bay and Vandenberg (a part of Guadalupe-Nipomo dune system) dune systems (Spyglass Hill [=Signal Hill Dunes]; Point Pinos; Pico Avenue, Pacific Grove [=Asilomar SB], Vandenberg AFB) have received foredune beachgrass control, iceplant management, are managed and enhanced to protect 5,000 individuals or more per site.

Some removal of iceplant has been completed adjacent to *Layia carnosa* habitat at Vandenberg AFB, and additional restoration within the habitat is planned (C. Rutherford, Botanist, USFWS, pers. comm. 2011). We are not aware of any restoration having been conducted at the Signal Hill Dunes site on the Monterey Peninsula. A restoration plan which includes removal of all iceplant from the Point Pinos site has been undertaken by the City of Pacific Grove, and restoration of the dunes at Asilomar SB is largely complete.

Between 1995, when *Layia carnosa* was re-discovered at Vandenberg AFB, until 2010, the entire known population did not exceed 500 (L. Lum, pers. comm. 2007). Several new colonies were found in both 2010 and 2011, bringing the total number of known plants to approximately 4,300 (L. Lum, pers. comm. 2011).

It is not clear why *Layia carnos* at Vandenberg AFB is so restricted. Part of the explanation may be the dunes there are generally more inland, higher, and appear more removed from dynamic coastal processes than habitat typically occupied by *Layia carnos* farther north in its range. Overall, the vegetation appears more stabilized, and may provide less optimal seedbed sites for the species. Alternatively, there may be aspects of the local climate or substrate that are not conducive to growth of *Layia carnos*. The history of the Monterey Peninsula population is also puzzling. Given the long history of disturbance of varying levels and types across virtually the entire Monterey Peninsula dunes (for example, pedestrian and wildlife traffic, roads, mining, hang-gliders, more recent invasive species removal efforts), and given the ability of *Layia carnos* to exploit at least a portion of most newly disturbed habitat around Humboldt Bay in close proximity to existing colonies, it is surprising that the species has not maintained a larger presence, albeit fragmented, in the dunes of the Monterey area. Even at Asilomar SB, where the species was rediscovered in 1990 following iceplant removal, the invasive species removal, and ongoing pedestrian or deer traffic should have created abundant habitat for germination and colonization by *Layia carnos*. Yet, the monitoring record there indicates the species is barely hanging on (264 mostly small, single-headed plants in 2007 [Madison 2007]; 190 plants in 2009 [Johns 2009]).

None of the population goals have been met for this criterion. While managing for such populations is desirable from the standpoint of maintaining genetic viability and preventing extirpation by stochastic events, there may be range limiting factors involved. For example, there may be suboptimal temperature or moisture regimes, or marginally suitable soils at the range extremes, which serve to limit its population vigor and reproductive capacity. The population monitoring records described above, and other preliminary evidence does tend to suggest that *Layia carnos* at Asilomar SB and Freshwater Lagoon Spit may have reduced reproductive vigor compared to the Humboldt Bay populations in particular.

Knowing whether there are range-limiting factors responsible for depressing the southernmost populations is critical to the recovery effort for *Layia carnos*, since the delisting criteria include relatively high population targets for the Monterey and Santa Barbara County populations. Critical resources may be expended attempting to manage features of its habitat which, in the end, are secondary to range-limiting factors in limiting the population. Whether or not these factors exist is speculative at this time. Research is needed to focus on the *Layia carnos* life history and possible population-limiting factors at the limits of its range, to determine if achievement of the stated recovery population goals is both feasible and practical.

This specific criterion for delisting clearly has not been met.

Adequacy of Criteria

Although the recovery criteria for this species are in some cases subject to interpretation, and could be written more specific to the individual species needs,

that is to be expected with a multi-species recovery plan. At this time, all downlisting and delisting criteria are considered adequate and appropriate with respect to recovery of this species, with the possible exception of Specific Delisting Criterion 3. We recommend research be conducted to determine whether the stated population size goals for populations located near the limits of the range for *Layia carnosa* are feasible and practical. The conservation strategy outlined by these criteria addresses all the currently known threats to *Layia carnosa*. Elements of the criteria include habitat protection and management secured by appropriate agreements (such as conservation easements, covenants) to address listing factors A (habitat loss or modification), D (inadequate regulatory mechanisms), and E (other natural or manmade factors).

C. Updated Information and Current Species Status

1. Biology and Habitat

Life History

Layia carnosa is a succulent annual herb belonging to the sunflower family (Asteraceae). The unbranched to highly branched plants range up to 6 inches tall and 16 inches across. Characteristics distinguishing *Layia carnosa* from similar species include its fleshy leaves, inconspicuous flower heads with short, 0.08 to 0.1 inch long white ray flowers and yellow disk flowers, and bristles around the top of the one-seeded achene, or dry fruit (USFWS 1998). The number of seed-heads on individual plants varies with plant size. Typically unbranched, short plants on dry, exposed sites will produce a single head, while highly branched plants in moist dune hollows may produce more than 100 heads.

As a winter annual, *Layia carnosa* germinates during the rainy season between fall and mid-winter, blooms in spring (April to June), and completes its life cycle before the dry season. Populations tend to be patchy and subject to large annual fluctuations in size and dynamic changes in local distribution associated with the shifts in dune blowouts, remobilization, and natural dune stabilization that occur in the coastal dune ecosystem. Colonies often occur where sparse vegetation traps wind-dispersed seeds, but causes minimal shading. Seeds are dispersed by wind mostly during late spring and summer months (USFWS 1998).

Distribution

No significant change in the distribution of *Layia carnosa* has occurred since the species was listed (Figure 1). The current distribution includes occurrences spread across six very isolated dune systems (Freshwater Lagoon, Humboldt Bay, mouth of the Mattole River, Point Reyes, Monterey Peninsula, Vandenberg [a part of the Guadalupe-Nipomo Dunes], over about 500 miles of shoreline in northern and central California. Beginning at Freshwater Lagoon Spit in northern Humboldt County, *Layia carnosa* occurs intermittently over 70 miles of shoreline as far south as the mouth of the Mattole River. From there, it jumps some 170 miles to Point Reyes NS (Marin County), and then another 120 miles to the Monterey Peninsula (Monterey County). From Monterey, a gap of about 150 miles separates it from the southernmost site at Vandenberg AFB, in Santa Barbara County. Five historical occurrences located in San Francisco, Monterey and

Humboldt counties are believed to have been extirpated (U.S. Department of the Interior 1998).

Habitat

Estimates of actual occupied habitat for *Layia carnosa* cited in this review are primarily based on detailed mapping of its distribution on the North Spit of Humboldt Bay in 1999 (USFWS - Humboldt Bay National Wildlife Refuge 1999); South Spit of Humboldt Bay in 2006 (BLM 2006); Point Reyes NS since 2001 (Point Reyes NS 2010); the King Range National Conservation Area (NCA) at the mouth of the Mattole River in 2004 (BLM 2005), combined with information contained in our files for smaller populations throughout the range (Imper 2011). Recognizing that “occupied habitat” technically includes habitat that contains a seedbank but no vegetative plant growth, for the purpose of this review the term is used to indicate habitat that, at the time of the last surveys, supported vegetative growth of the plant.

Layia carnosa is restricted to openings in coastal sand dunes ranging in elevation from 0 to over 100 feet, where it colonizes sparsely vegetated, semi-stabilized dunes and blowouts. The species often occurs in narrow bands of moderately disturbed habitat along the edges of trails and roads. Common associated species include: coast buckwheat (*Eriogonum latifolium*), beach pea (*Lathyrus littoralis*), beach sandwort (*Artemisia pycnocephala*), dune bluegrass (*Poa macrantha* and *P. douglasii*), dune goldenrod (*Solidago spathulata*), sand verbena (*Abronia latifolia*), and beach-bur (*Ambrosia chamissonis*) (U.S. Department of the Interior 1998). Humboldt Bay is considered to have the highest quality habitat for the species, in part due to the relative higher proportion of dune mat in the dunes there, and perhaps due to the higher rainfall (Pickart and Sawyer 1998).

Overall, an estimated 456 acres of near-shore dunes habitat is currently known to support *Layia carnosa* (Imper 2011; Tables 1 and 2). Humboldt County contains approximately 68 percent of the occupied habitat rangewide. Federal agencies own about 52 percent of the occupied habitat (235 acres), followed by State agencies at 23 percent, or 105 acres. Local governmental entities and NGOs own an estimated 83 acres, or 19 percent of the occupied habitat, and the remaining 7 percent (33 acres) is in private ownership. The estimated percentage ownership of occupied habitat by landowner (Table 2), in descending order is: Pt. Reyes NS = 32; CDFG = 23; BLM = 10; Manila CSD = 9; USFWS = 8; private = 7; NGOs = 6; City of Eureka = 4; and CDPR, DOD and Redwood NP all 1 percent or less (Imper 2011; Table 2).

Layia carnosa is often associated with other rare, threatened or endangered species. The Federally-listed species it shares habitat with include, by county: Humboldt County - Menzies wallflower (*Erysimum menziesii* ssp. *eurekaense*); Marin County - Tidestrom’s lupine (*Lupinus tidestromii*) and Sonoma spineflower (*Chorizanthe valida*); Monterey County – Monterey gilia (*Gilia tenuiflora* ssp. *arenaria*), Monterey spineflower (*C. pungens* var. *pungens*), Tidestrom’s lupine and Menzies wallflower (*E. m.* ssp. *menziesii*).

Population Size

Mostly informal estimates of populations made across the range prior to 1998 totaled some 300,000 plants (USFWS 1998). Based on our current population estimate (likely in excess of 10 million), the 1998 estimate may have been a gross underestimate.

Nevertheless, accurate estimation of population size is difficult and costly for diminutive, short-lived annual species such as *Layia carnosa*, which tends to occur in small patches scattered across large areas of habitat. Therefore, current statistically valid estimates are only available for a portion of the Humboldt County distribution, and some of the smaller populations located elsewhere.

At the same time, the current estimate of actual occupied habitat is somewhat lower than the estimate of 1,390 acres stated in the recovery plan (U.S. Department of the Interior 1998), which likely reflects a difference in the method used to estimate the area, and the resolution. The current estimate is largely based on relatively accurate GPS mapping of occupied polygons on the North and South Spits of Humboldt Bay, at Point Reyes NS and the mouth of the Mattole River conducted since 1999. Amount of occupied habitat may vary from year to year due to variation in reproductive success of this annual species, which could affect the totals reported here.

Individual populations or meta-populations are described below from north to south (Table 1). Ownership is indicated in Table 1.

Humboldt County

- **Freshwater Lagoon Spit** (Redwood NP): *Layia carnosa* was discovered in 2000 on Freshwater Lagoon Spit, located in northern Humboldt County approximately 50 miles south of the Oregon border. In 2000, a total of 2,612 plants were counted in 13 clusters spread over about 4 acres of near-shore dunes (Williams 2000). Since then the population, and individual patches have fluctuated substantially, with a peak of 11,110 plants recorded in 2003, and as few as 587 plants in 2010 (Williams 2005; S. Samuels, Redwood National and State parks, pers. comm. 2007a; Julian 2010). A total 7,909 plants were counted in 2007 (S. Samuels, pers. comm. 2007b). Data collected in 2007 were expanded to include the number of flowering heads per plant, as an index of plant vigor and reproductive potential. Approximately 12 percent of the population during the census (conducted May 2 and 3) was vegetative, while one to two percent produced more than 5 flower heads, and 60 to 70 percent produced only a single flower head (S. Samuels, pers. comm. 2007b). For the purpose of calculating total occupied habitat, the Freshwater Lagoon Spit population is conservatively estimated to occupy about one acre, recognizing that during good years, that estimate may be low.

The population fluctuations at Freshwater Lagoon Spit may have been influenced by a reduction in human traffic on the dunes as a result of park management since 2001 which, while initially favorable, may have stimulated dune stabilization by native dune species, primarily grasses (S. Samuels, pers. comm. 2007a). There is also anecdotal evidence that the population fluctuations, and perhaps the relatively large number of small, few-flowered plants may have been caused by late-spring storm events that deposited sand on top of the plants after they germinated (S. Samuels,

pers. comm. 2007b). Wet and cold spring weather was cited as a possible explanation for the low count in 2010 (Julian 2010).

- **Humboldt Bay - North Spit to the Mouth of the Mad River** (USFWS, BLM, Manila CSD, City of Eureka, Friends of the Dunes, private): The following assessment is based on the last comprehensive mapping effort for *Layia carnosa* on the North Spit, conducted in 1999 (USFWS Humboldt Bay NWR 1999). Occupied *Layia carnosa* habitat on what is referred to as the North Spit, extends for approximately 11.3 miles between the mouth of the Mad River and the entrance to Humboldt Bay, and between 0.1 mile and 0.5 miles inland from the foredune. The 1999 mapping effort yielded a total of 367 occupied polygons with a combined total area of about 157 acres of near-shore dunes.

The principal owners of occupied habitat on the North Spit are the USFWS and the Manila CSD. The Humboldt Bay NWR includes the Lanphere Dunes Unit (formerly owned by The Nature Conservancy) and the Ma-le'i Dunes Unit property, managed as part of the Ma-le'i Dunes Cooperative Management Area, which also includes dunes owned and managed by the BLM. Some 200 acres of near-shore dunes and dune forest (Khoaghali and buggy club parcels), located north of Manila, were recently acquired by BLM and the USFWS, and were included in the Ma-le'i Dunes CMA (USFWS Arcata FWO 2007). In addition, BLM owns the Samoa Dunes Recreation Area at the south end of the North Spit, a portion of which is managed for endangered species. All of BLM's holdings on the North Spit of Humboldt Bay are referred to as the Samoa Peninsula Management Area (Table 1). Overall, the BLM and USFWS own approximately 58 acres of occupied *Layia carnosa* habitat on the North Spit.

The USFWS and The Nature Conservancy have inventoried the *Layia carnosa* population within most of the Lanphere Dunes Unit since 1987 (A. Pickart pers. comm. 2010) which, based on the 1999 map effort, contained approximately 20 acres of actual occupied habitat. The population estimate for 2010 was 1.2 million plants (95 percent confidence interval [CI] = 1.1 to 1.3 million).

Approximately 39 acres of occupied habitat on the North Spit is owned by the Manila CSD, and another 12 acres is owned by the Friends of the Dunes, an organization dedicated to the conservation of dunes and natural resource education around Humboldt Bay (K. Wear, pers. comm. 2006, 2007a). The Friends of the Dunes have an irrevocable offer to dedicate title in fee recorded on their property, which transfers ownership to the State should the group cease to exist, or if any of the terms of the grant from the California Conservancy are violated (Friends of the Dunes Exhibit A undated). The City of Eureka owns about 16 acres of occupied *Layia carnosa* on the North Spit, located near the southern tip of the North Spit. About 6 acres of that total is located within the 84-acre piece under a conservation easement held by the Center for Natural Lands Management. The remainder of the City-owned occupied habitat is located within their industrial zoned property, or within the coastal portion that is managed by BLM for recreational vehicle riding. The remainder of habitat occupied by *Layia carnosa* on the North Spit, as of 1999 (about 33 acres) is privately owned.

No population estimates have been made on the Manila CSD, City-owned, or private properties.

- **Humboldt Bay - Elk River Spit** (City of Eureka): The Elk River Spit is a sand peninsula extending approximately 1.2 miles long by up to 0.1 mile wide, located on the east shore of Humboldt Bay. This population of *Layia carnosa* has not been formally inventoried, nor has the amount of occupied habitat. Although a relatively large amount of potentially suitable habitat is present, for the purpose of calculating total occupied habitat for *Layia carnosa*, the occupied habitat there is conservatively estimated to be one acre.
- **Humboldt Bay – South Spit and Mouth of the Eel River** (CDFG and NGO): Habitat supporting *Layia carnosa* on the South Spit of Humboldt Bay extends about 7.3 miles south from the entrance to the bay to the mouth of the Eel River, and up to 0.2 miles wide in some locations. CDFG recently acquired the majority of the South Spit, now designated as the South Spit Wildlife Management Area, under BLM management (USFWS Arcata FWO 2002).

The *Layia carnosa* population within the South Spit Management Area was estimated in 2003, and again in 2007 (BLM 2003, 2007). Total occupied habitat in 2003 was mapped at 34.3 acres, supporting an estimated 5.5 million plants (95 percent CI = 2.5 to 8.6 million). A total of 75 acres was mapped as occupied in 2007, for which the total population of *Layia carnosa* was estimated at 3.8 million (95 percent CI = 2.2 to 5.4 million).

Immediately south from the South Spit Management Area, an estimated 30 acres of near-shore dunes support *Layia carnosa* within the CDFG's Eel River Wildlife Area (WA). The size of that population has not been estimated, but nearly all of the available suitable habitat reportedly contained *Layia carnosa*, when it was inventoried in 1993 ((Botanica Northwest Associates 1993). At that time the species appeared more common in the north portion of the wildlife area. On the south side of the Eel River Wildlife Area, the Wildlands Conservancy (D. Clendenen, pers. comm. 2011) recently acquired approximately 100 acres of dunes as part of a larger acquisition just south of the mouth of the Eel River. Clendenen estimated perhaps 15 acres of the dunes there support *Layia carnosa*, although at relatively low density.

- **Mouth of the Mattole River** (BLM) and mouth of **McNutt Gulch** (private): The population of *Layia carnosa* at the mouth of the Mattole River was first recorded by Berg in 1987, when he reported greater than 1,000 plants occupying excellent quality dunes habitat (CDFG 2007). That site, part of the King Range NCA, is located 35 miles south of the entrance to Humboldt Bay. *Layia carnosa* occupies approximately 27 acres of near-shore dunes on the south side of the river mouth. BLM began population monitoring in 1994, using a frequency method that emphasizes detection of trends, but did not provide an estimate of population size. The method was modified in 2010 to record plant density. Four hundred stratified-random samples are collected along two permanent transects, split between the northern and southern portions of the occupied near-shore dunes (BLM 2010). Based on the average plant density recorded in March 2010 (3 per square foot), the

population of *Layia carnosa* at this site was on the order of 3.3 million plants. Similar frequency monitoring conducted at 4 locations on the North Spit of Humboldt Bay (for which number of plants was recorded in each frequency plot). Density ranged between 0.5 and 4 plants per square foot. Frequency data for the single transect monitored at Mattole Beach since 1994 (when vehicle traffic was removed from the habitat) indicates the population may have increased as much as 200 percent.

Layia carnosa was also documented occupying privately owned dunes near the mouth of McNutt Gulch, approximately 4.5 miles north of the mouth of the Mattole River, by Berg in 1987. At that time, Berg observed more than 500 plants occupying excellent quality dunes (CDFG 2007). Lozier (1988) noted two discrete population areas, separated by a mile or more of beach and dunes. No recent information was available on this population. For the purpose of calculating total habitat occupied by *Layia carnosa*, this site is conservatively estimated to encompass one acre, recognizing the actual total could be higher.

Marin County

- **Point Reyes National Seashore** (National Park Service): Moving south from the Mattole River, the next known occurrence of *Layia carnosa* is located in Marin County, 200 miles south of Humboldt Bay, in the dunes between Kehoe Beach Dunes and the Point Reyes lighthouse at Point Reyes NS (U.S. Department of the Interior 1998). This very large dune system contains approximately 146 acres of near-shore dunes occupied by *Layia carnosa*, based on mapping conducted since 2001 (Point Reyes NS 2010). Population estimates for *Layia carnosa* at Point Reyes NS began in the 1980's, but were largely conducted by volunteers and do not appear to have been controlled sufficiently to provide accurate trends. The population at Point Reyes NS occupies 14 areas of concentration, referred to as "populations" for convenience by the park, spread over 13 miles of coastline (Point Reyes NS 2005; 2006, 2010). Each population contains several or more isolated dune patches, making it difficult to conduct an accurate census. A sampling protocol was initiated in 2004, when 8 of the 14 populations were sampled, and the boundaries recorded with GPS. The total count for *Layia carnosa* that year exceeded 44,000, occupying just over 66,000 square meters of dunes (approximately 16 acres), which comprised only a portion of the habitat occupied by the 8 sampled populations. The total estimate for 2003, which included a complete census of the known distribution then, exceeded 66,000 plants.

San Francisco County

- **San Francisco**: An occurrence somewhere in the City of San Francisco was extirpated in about 1904 (CDFG 2011).

Monterey County

The contribution of the Monterey Peninsula populations to the distribution of *Layia carnosa* rangewide is relatively small. The combined total population in 2009 on the Monterey Peninsula, not counting the Signal Hill site, was 1,973 plants; total occupied habitat (not counting Signal Hill) was less than one acre. However, the significance of these populations to the recovery effort is comparatively great, since the delisting criteria mandate populations for these locations far larger than currently exist (USFWS 1998), as described under Specific Delisting Criterion 3.

- **Asilomar SB** (CDPR): *Layia carnosa* was rediscovered within Asilomar SB in 1990 (CDFG 2007). In 1994, 192 plants were documented, scattered in three relatively small areas of dunes near the north side of the park. That population peaked in 1996 at 543 plants, dropping to 264 plants 2007 (Madison 2007), and 190 plants in 2009 (Johns 2009). All of the plants occupied less than 0.1 acre in 2009 (Johns 2009).
- **Indian Village Dunes** (Pebble Beach Company): The Indian Village Dunes include an estimated 3 to 5 acres of recently restored dune habitat, of which about 0.55 acres support the largest population of *Layia carnosa* on the Monterey Peninsula, a total of 1,783 plants in 2009 (Johns 2009). No historical estimates are available. Although not verified, there is evidence that this population may have been planted (CDFG 2007). While owned by Pebble Beach Company, a conservation easement on the Indian Village Dunes is held by the Del Monte Forest Foundation, which emphasizes conservation of the natural resources on the property.
- **Signal Hill Dunes** (Pebble Beach Company): This population, located less than a mile south of the Indian Village Dunes, has not been inventoried recently but is highly fragmented and restricted to a small portion of approximately 25 acres of severely degraded dunes located above the Spyglass Hill Golf Course. The population was last mapped in 2001, when *Layia carnosa* occupied five semi-isolated small patches of dunemat. For the purpose of calculating total occupied habitat for *Layia carnosa*, the occupied habitat at this site is assumed to encompass less than one acre. The dunes are severely degraded by exotic species, pedestrian and equestrian traffic. The *Layia carnosa* population was characterized as “much more abundant on Signal Hill than the (Menzies’) wallflower, and would require considerably more effort to map thoroughly” (M. Zander, Zander Associates, pers. comm. 2007). However, only four Menzies’ wallflower plants were recently detected at those dunes, so it is not clear what “abundant” means in this case.

The Signal Hill Dunes is not currently protected, but it is part of a proposed conservation area to be established to mitigate for construction of an adjacent golf course project. Depending on the outcome of that project, these dunes may eventually be covered under a perpetual conservation easement.

- **Point Pinos (type locality)**(City of Pacific Grove): A fourth historical site for *Layia carnosa* on the peninsula (the type locality) occurred at the Point Pinos dunes, currently contained within the Pacific Grove Golf Course, owned by the City of Pacific Grove. No plants have been recorded at this site since 1919; several focused surveys at the site since 1987 have not detected *Layia carnosa* (CDFG 2007). The Point Pinos dunes are currently undergoing restoration and endangered species augmentation as part of a plan related to expansion of the golf course and transfer of the property from the US Coast Guard to the City of Pacific Grove. *Layia carnosa* is not currently a part of the restoration plan, but its reintroduction there would be an appropriate and feasible recovery action.

Santa Barbara County

- **Vandenberg AFB** (Department of Defense [DOD]): *Layia carnosa* was first documented on Vandenberg AFB in 1929, and then not again recorded until 1995, when 80 plants were observed within about 400 square feet of dune scrub habitat on the west side of Surf Road (CNDDDB 2007). Since 1995, the population has been highly dynamic. No plants have been observed at the 1995 rediscovery site since the first year. A second population, estimated between 200 and 500 plants, was discovered in 1998 near the edge of the coastal bluff directly west of the first site (L. Lum, pers. comm. 2007), but that population dropped to only 46 plants in 2006. Several new colonies were found in both 2010 and 2011, bringing the known total to some 4,300 plants concentrated in two areas of the base, occupying about 2.6 acres (L. Lum, pers. comm. 2011).

Summary of population size:

Overall total habitat occupied by *Layia carnosa*, based on data collected between 1999 and 2010, is estimated on the order of 456 acres, which may be conservative given the difficulty in detecting the plant and conducting thorough surveys. Statistical estimates of the *Layia carnosa* population occupying roughly 95 acres of the approximately 291 acres of occupied habitat around Humboldt Bay, conducted by the BLM and USFWS in 2007 and 2010, yielded a mean of 5.0 million plants (95 percent CI = 3.3 to 6.7 million)(BLM 2007; A. Pickart, pers. comm. 2010). The estimated population on approximately 27 acres of near-shore dunes at the mouth of the Mattole River in 2010 yielded another 3.3 million plants (95 percent C.I. = 2.3 to 4.3 million)(2010a). While the plant density estimates for Humboldt Bay and the mouth of the Mattole River may overestimate the average density range wide, a conservative current estimate of the total population occupying dunes just in Humboldt County is on the order of 10 million (Table 1).

Genetics

Recent research on evolutionary relationships within the tarweed group (Madiinae; Compositae) by Baldwin (2006) suggests *Layia carnosa* is genetically distinct within the eight chromosome group of *Layia*, in accordance with its high degree of morphological and ecological distinction, and that discontinuity occurred relatively recently through accelerated phenotypic divergence from *L. gaillardoides*-like ancestors. Baldwin indicates his data for *Layia carnosa* exhibit a high degree of genetic uniformity across its range, at least with respect to rDNA spacer sequences (B. Baldwin, UC Berkeley, pers. comm. 2007). His research to date included samples of *Layia carnosa* from Vandenberg AFB, Monterey Peninsula and Humboldt Bay. While his data and conclusions are preliminary, they do suggest there are no significant genetic differences across the range.

2. **Five Factor Analysis (threats, conservation measures and regulatory mechanisms).**
 - a. **Present or threatened destruction, modification or curtailment of its habitat or range:** With the possible exception of the effects of climate change, the degree to which this factor threatens *Layia carnosa* has been substantially reduced since it was listed.

Habitat security and future management

The threat of commercial or residential development has been eliminated throughout most of the current range since the species was listed, since the majority of occupied habitat either occurs on public lands, is covered under resource management plans with an emphasis on conservation of natural resources, or is covered under local coastal plans and zoning ordinances (Humboldt and Monterey Counties) that protects sensitive dune habitat (Tables 1 and 2; citations north to south: [Humboldt County]: RNP 2000; BLM 1995, 2002, 2004; USFWS 2002, 2009; Friends of the Dunes 2007; Humboldt County Planning Department 1995; K. Kovacs, pers. comm. 2007; K. Wear, pers. comm. 2006; [Marin County]: J. Rodgers, pers. comm. 2007; [Monterey County]: CDRP 2004a, 2004b; Pebble Beach Company 1989; Monterey County Planning and Building Inspection Department 2005; [Santa Barbara County]: ManTech SRS Technologies, Inc. 2010). For the same reason, the threat of off-road vehicles has reduced significantly, with the exception of some of the privately held habitat located in Humboldt County. The remaining occupied habitat most susceptible to human destruction or modification includes the dunes located near the mouth of McNutt Gulch, and the Signal Hill Dunes on the Monterey Peninsula. Although livestock trampling was indicated as a threat when *Layia carnosa* was listed, the only population known to be currently exposed to livestock is near the mouth of McNutt Gulch. No information is available on the size of that population, or degree of impacts by livestock. Livestock are in the process of being removed from occupied *Layia carnosa* habitat on the Wildlands Conservancy preserve near the mouth of the Eel River (D. Clendenen, pers. comm. 2011).

Not all of the technically secure habitat, from the standpoint of ownership or management direction, is managed to the benefit of *Layia carnosa*. The current and future commitment by the various owners of *Layia carnosa* habitat to its management across its range are described below.

Federal:

- **USFWS:** The Humboldt Bay NWR includes both the Lanphere Dunes Unit (former Lanphere-Christensen Dunes Preserve), and the Ma-le'l Dunes Unit (also known as Ma-le'l North) properties located on the North Spit of Humboldt Bay, which together contain about 38 acres of occupied habitat. The NWR is managed in accordance with a 15-year Comprehensive Conservation Plan (CCP)(USFWS Humboldt Bay NWR 2009), which incorporates restoration and management goals designed to benefit *Layia carnosa* and the other listed species present. Management direction for the National Wildlife Refuge System ultimately is contained in part 601 of the Fish and Wildlife Service Manual (USFWS 2006), which assigns highest management priority to fulfilling refuge purposes, which include compliance with laws such as the ESA and the Migratory Bird Treaty Act. Next highest priority for management of refuges is given to maintaining biological integrity, diversity and environmental health (USFWS 2001). That direction, although general, would theoretically provide for post-delisting maintenance of *Layia carnosa* as a component of the natural dunes community within the refuge. Inevitably however, once *Layia carnosa* is delisted, and after the 5-

year post-delisting monitoring period mandated under the ESA has passed, the management priority given to population monitoring and maintaining its habitat will receive less emphasis, particularly where conflicts in management (funding, staff availability) exist between fulfilling the refuge purposes (for example, compliance with ESA and Migratory Bird Treaty Act) and maintaining *Layia carnosa*. One way to ensure future conservation of the species and its habitat may be to include specific guidance within the CCP to maintain the species on the refuge.

- **BLM:** The BLM owns several properties that support *Layia carnosa*, including the Samoa Peninsula Management Area on the North Spit of Humboldt Bay (includes Manila Dunes Area of Critical Environmental Concern [ACEC]; Manila Dunes Research Natural Area [RNA], Ma-le’l Dunes South property; Samoa Dunes Recreation Area), and dunes located within the King Range NCA, at the mouth of the Mattole River. Together, these areas include about 47 acres of habitat currently occupied by *Layia carnosa*. The BLM also holds a conservation easement on dunes owned by the CDFG on the South Spit of Humboldt Bay. In 2005, the BLM adopted their King Range Management Plan (BLM 2004), which formalized future monitoring and protection of the *Layia carnosa* population while it remains listed under the ESA. Management direction for the Samoa Peninsula Management Area, and the South Spit Management Plan include provisions for future habitat restoration and protection of the *Layia carnosa* so long as it remains listed (BLM 1995; USFWS Arcata FWO 2002). After that it would depend on whether the species remains on their agency Sensitive Species List.

However, with respect to BLM commitment to future management, there are no regulations or policies that speak directly to conservation of this species after it is delisted by the Federal and State government (J. Willoughby, BLM, pers. comm. 2007). The only meaningful protection after delisting must be contained in the individual Resource Management Plans (RMP), and specific activity plans, such as are written for Areas of Critical Environmental Concern. These plans generally are written for a 10 to 15 year planning horizon. Therefore, in order for *Layia carnosa* to receive long-term protection on BLM lands after it is delisted, the relevant RMP or other site specific plans would need to be amended, and perhaps an agreement made to maintain the species on the agency sensitive species list, such that the future threats from invasive species, off-road vehicles, pedestrians and other activities are monitored and dealt with as needed to maintain viable populations.

- **Point Reyes NS:** The Point Reyes NS includes abundant near-shore dunes potentially suitable for *Layia carnosa*, and approximately 146 acres of currently occupied habitat (Point Reyes NS 2010). The enabling legislation for Point Reyes NS was somewhat unique within the Park Service in that it emphasized conservation of the undeveloped coastline over, and above, the provision of recreational opportunities (J. Rodgers, Point Reyes NS, pers. comm. 2007). The current draft General Management Plan and Environmental Impact Statement for Point Reyes NS includes general

direction to “stabilize and improve populations” of listed species, and original plans were to include new guidance in the form of a Resource Stewardship Strategy, to include a 300-acre dunes restoration program that would benefit a portion of the *Layia carnosa* habitat there (J. Rodgers, pers. comm. 2007). Financial constraints have reduced at least the near-term goal for the strategy to 75 acres of near-shore dunes, slated for invasive plant removal in 2011 (L. Parsons, Point Reyes NS, pers. comm. 2011).

- **Redwood NP:** The northernmost occurrence of *Layia carnosa* at Freshwater Lagoon Spit, in northern Humboldt County, is owned by Redwood NP. Their management follows a General Management Plan (GMP), completed in 2000, which covers a period of 20 years (L. Arguello, Redwood National and State Parks, pers. comm. 2007). They have no specific direction for management of Freshwater Lagoon Spit. Redwood NP has taken measures to reduce pedestrian, vehicle and unrestricted camping impacts on the native dunes, which likely has both benefited, and perhaps negatively affected *Layia carnosa*. No active restoration of its habitat has been conducted.

Since the population of *Layia carnosa* was discovered in 2000, park staff has monitored the population annually. As a Federally listed species, *Layia carnosa* is automatically included on the Redwood NP Sensitive Plant List, and therefore is taken into account in planning of all park projects. Currently, Redwood NP has no management direction to ensure the monitoring and responsive management necessary to maintain *Layia carnosa* once this species is delisted both at the Federal and State level. Specific management direction could be added to the GMP when it is renewed in another 13 years (L. Arguello, pers. comm. 2007).

- **Department of Defense –Vandenberg AFB:** The southernmost distribution of *Layia carnosa* is at Vandenberg AFB in Santa Barbara County. Management and restoration goals affecting *Layia carnosa* are generally described in the Integrated Natural Resources Management Plan (INRMP) for the facility. The INRMP for Vandenberg AFB was recently updated (Mantech SRS Technologies, Inc. 2010), and is pending signature (R. Farris, USFWS Ventura FWO, pers. comm. 2011). The INRMP indicates the intent of the facility to “implement an effective, long-term management program for protection and conservation of special status plants”, as well as describes management considerations and protections relevant to *Layia carnosa*, and lists the local and State environmental laws with which the AFB must comply. The INRMP element outlining control of invasive species gives high priority to restoration of listed species habitat. While the INRMP does not specify, or mandate a plan to restore *Layia carnosa* habitat, it does provide for security of its habitat. The facility has no current obligation or policy direction to proactively manage for *Layia carnosa*, or maintain its habitat once the species is delisted.

State:

- **CDFG:** The extensive dunes on the South Spit of Humboldt Bay, which extends south to the mouth of the Eel River, are owned by CDFG. Approximately the northern 70 percent of those dunes is managed by the BLM under a conservation easement. The southern portion is contained within CDFG's Eel River Wildlife Area (WA), managed under the general provisions for state wildlife areas contained in Title 14 of the California Administrative Code. In general, the Eel River WA is open to the public, with restricted vehicle use and consumptive and non-consumptive uses such as hunting, and other special activities subject to the approval of the Regional Manager. Off-road vehicle use is restricted to the ocean wave slope and a single dune access road, which is posted. In general, management guidance for state wildlife areas contains the flexibility to respond to changing resource needs. No enhancement projects or habitat manipulation have been conducted or are planned for *Layia carnosa*. Since the Eel River WA was acquired primarily for its wetlands, any future habitat restoration projects would likely emphasize the wetlands, or take a holistic habitat approach which, while potentially benefiting *Layia carnosa*, probably would not emphasize specific needs for the species (K. Kovacs, CDFG, pers. comm. 2007).
- **CDPR:** The CDPR owns and manages only one site supporting *Layia carnosa*, at Asilomar SB on the Monterey Peninsula. As a result of extensive restoration over the past 20 years, that park contains exceptionally high quality near-shore dunes habitat, which support a relatively small population of *Layia carnosa* (Madison 2007). Management of Asilomar SB is guided at the highest level by the Department Operations Manual, or DOM (CDPR 2004a), and more specifically, the Asilomar SB General Plan (CDPR 2004b). The DOM generally advances a holistic approach to natural resource management, and "does not attempt to solely preserve individual species except threatened or endangered species in special situations." Ultimately, the DOM allows for waiver or modification of department policy on a case by case basis by the Director. Due to limitations of park management policy (variability in staffing levels, staff interest and management priorities), there is no guarantee that appropriate management will continue long-term for *Layia carnosa*. There appears to be no specific agency direction which would ensure future conservation of *Layia carnosa* after it is delisted (L. Madison, pers. comm. 2007).

Asilomar SB is relatively unique within California State Parks in that a portion of the proceeds from the on-site conference center goes to habitat maintenance in the park, and has successfully funded an aggressive dunes restoration effort. Although allocation of funding remains somewhat discretionary (L. Madison, pers. comm. 2007), this funding mechanism is as close as any across the range of *Layia carnosa* to meeting the stated recovery goal for an endowment enabling long-term habitat maintenance.

Local Government, Special Districts, NGOs and Private:

- **Manila CSD:** The Manila CSD owns a large portion of the near-shore dunes on the North Spit of Humboldt Bay. The Services District developed a long-term management plan calling for restoration and maintenance of its native dunes and endangered species, as well as recreation and beach access (K. Wear, pers. comm. 2006). The dune restoration has not been completed, and the management plan does not include any financial provision to fund long-term management; funding is currently dependent on the CSD receiving grants (A. Pickart, pers. comm. 2007)
- **City of Eureka:** The city owns a significant amount of near-shore dunes around Humboldt Bay, including an estimated 16 acres of habitat occupied by *Layia carnosa* in the southern portion of the North Spit (USFWS Humboldt Bay NWR 1999).

The City also owns the Elk River Spit on the east shore of the bay, which has not been inventoried, but likely supports one or more acres of dunes occupied by *Layia carnosa*. The City has no specific direction for management of its lands with respect to listed species. With the exception of about 84 acres of their land on the North Spit zoned as Natural Resource (NR), their land is zoned for coastal dependent industry, and is currently utilized for a variety of recreational activities, including off-road vehicle use, a dragstrip, a bed and breakfast, and an airport, as well as past dumping of dredge spoils and sand mining (L. Shikany, City of Eureka, pers. comm. 2007). The 84 acres of dune habitat zoned NR is covered under an easement held by the Center for Natural Lands Management. The easement provides general direction for future conservation of the natural resources. A local non-profit organization (Friends of the Dunes) periodically conducts invasive species removal projects on about 25 percent of the property (K. Wear, pers. comm. 2007b). However, a restoration plan developed for this property in the 1990's has not been implemented and the overall habitat condition continues to decline for *Layia carnosa* (A. Pickart, pers. comm. 2007)

The Elk River Spit is also zoned NR, although the City is exempt from the Humboldt County Zoning ordinance. However, the City is subject to the local coastal plan, which would likely require consideration of mitigative measures for any projects there, or on the North Spit, that impact near-shore dunes habitat. Such projects would also likely trigger review under CEQA.

- **Friends of the Dunes (Non-Profit NGO):** The Friends of the Dunes, an organization dedicated to the conservation of the dunes ecosystem around Humboldt Bay, recently acquired a significant near-shore dune holding on the North Spit of Humboldt Bay, with the assistance of the California Coastal Conservancy. As part of that agreement, there is an irrevocable offer to dedicate fee title on the property to the state, if the terms of the state grant are violated (Friends of the Dunes website; Exhibit A, undated). Those terms preclude most kinds of development, and stipulate the primary management

shall be for public access, open space, habitat conservation and outdoor recreation.

- **Pebble Beach Company:** The Pebble Beach Company owns two of the three extant sites for *Layia carnosa* on the Monterey peninsula:

Indian Village Dunes: Other than Asilomar SB, this is perhaps the best intact dune habitat on the Monterey Peninsula. This habitat currently supports the largest population of *Layia carnosa* on the peninsula. Although owned by Pebble Beach Company, the Del Monte Forest Foundation holds a conservation easement (Pebble Beach Company 1989), formalized in 1999. The easement restricts most kinds of development on the property. While not expressly mandating conservation of the dunes habitat, the easement contains a provision for “management, maintenance and improvement activities for the conservation, protection and enhancement of the natural habitat.”

Signal Hill Dunes: These dunes are included in a proposed Del Monte Forest Preservation and Development Plan, advanced by Pebble Beach Company (Zander Associates 2001). As part of that proposed plan, in return for approval of a golf course located on Signal Hill, a conservation easement would be dedicated by the Pebble Beach Company covering the Signal Hill Dunes Conservation Area, which would mandate the future monitoring and restoration necessary to maintain the dunes and resident endangered species in perpetuity (Monterey County 2005). Whether or not this project and the conservation easement provision move forward, the concept of perpetual monitoring and responsive management proposed for this site appears to provide an excellent template for application to other critical populations of *Layia carnosa*, and other listed species.

- **Other Private Owners:** With the exception of a portion of habitat owned by the City of Eureka, virtually all property supporting *Layia carnosa* on the North Spit of Humboldt Bay is zoned NR in the Humboldt County General Plan. The local coastal program (Humboldt County 1995) and County zoning ordinance afford considerable protection to *Layia carnosa* and its habitat which, among other restrictions prohibits vehicles above the wave slope except in the Samoa Dunes Recreation Area. The County planning documents also recommend management to restore degraded dunes, including removal of invasive, non-native plant species, fencing of rare plant habitat and limiting public access.

Modification of habitat through over stabilization

Many populations of *Layia carnosa* across its range continue to be impacted by uncontrolled pedestrian or equestrian traffic. However, evidence suggests that, for many sites where natural dune processes may be lacking, at least some recreation-related mortality may be a necessary consequence of the need for adequate disturbance to preclude over stabilization of the habitat. Acute levels of foot traffic clearly directly eliminate *Layia carnosa* from the center of traveled pathways, but at the same time, monitoring data and anecdotal evidence described

under Downlisting Criterion 2, has consistently documented a strong preference by *Layia carnosa* for moderately disturbed habitat located along roads and trails (whether pedestrian or equestrian) in what otherwise would be unoccupied habitat

Modification or destruction of its habitat as a result of climate change

The most recent literature on climate change includes predictions of hydrological changes, higher temperatures, and expansion of drought areas, resulting in a northward and/or upward elevation shift in range for many species (IPCC 2007). 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. There is also little or no data indicating the sensitivity of *Layia carnosa* to changes in environmental factors such as air temperature and soil moisture.

However, it is expected that sea level may rise at least 16 inches along the California coast by 2050, with a 50-inch rise predicted by 2100 (Heberger *et al.* 2009). Beyond the direct influence of ocean-rise in potentially inundating the lower range of *Layia carnosa* habitat, even small changes in water level may cause significant changes in wave energy and the potential for shoreline damage from wave forces (California Coastal Commission 2001). We know that storm surges have over-run portions of the South Spit, and the southern portion of the North Spit in relatively recent times (A. Pickart, pers. comm. 2011b).

Another coastal process that has the potential to affect *Layia carnosa* habitat, at least at Humboldt Bay, is vertical land deformation. Recent investigation suggests that deformation is occurring both during and between seismic events, and appears to vary in its direction (i.e., subsidence or uplift) and magnitude across the bay region (Walters 2011). Enhanced dune erosion may already be occurring in portions of the Humboldt Bay dune system, evidenced by the recent development of two unusually large, moving dune blowouts that show no sign of stabilizing, as well as a general loss of dune habitat on the North Spit (A. Pickart, pers. comm. 2011b). Factors other than ocean-rise or subsidence may be involved, including the cessation of off-source disposal of bay dredge spoils (A. Pickart, pers. comm. 2011b).

Detailed topographic data are not available for the range of *Layia carnosa*, other than a portion of the Humboldt Bay distribution. A 5 by 5 meter grid digital elevation model (DEM) developed in 2005 covers the majority of the North and South Spits (California State University at Monterey Bay 2005). *Layia carnosa* habitat polygons mapped in 1999 and 2007 (USFWS Humboldt Bay NWR 1999; BLM 2007), representing 160 of the estimated 280 acres of occupied habitat around Humboldt Bay, were overlaid on the DEM to determine the elevational distribution of the species (Figures 2 and 3). The northern portion of the Mal'el Dunes Cooperative Management Area, and the Lanphere Dunes Unit of the Humboldt Bay NWR were not covered by the DEM, which together support an estimated 50 acres of occupied habitat. In general, the elevation of occupied habitat rises moving north on the North Spit, indicating that habitat there would generally fall in the higher elevation ranges shown in Figure 2. The elevation of dune habitat within 100 feet of the *Layia carnosa* polygons was also extracted

from the DEM, to provide an indication of the availability of dune habitat within close proximity for *Layia carnosa* to expand into higher elevations, should its habitat become unsuitable as a result of ocean-rise, storm surge, or generally increased sand erosion (Figure 4).

The distribution of *Layia carnosa* extends from roughly 9 feet to over 40 feet elevation (NAVD88 datum) on the North Spit, and from 9 feet to a maximum of 30 feet on the South Spit of Humboldt Bay (Figure 2). While the elevation at which dune habitat would be relatively unaffected by ocean-rise is not known, and certainly would vary across the distribution, for the purpose of this assessment it seems reasonable to expect occupied habitat between 10 and 13 feet elevation will largely disappear; habitat from 13 to as high as perhaps 20 feet could be negatively impacted, and habitat above 20 feet elevation will likely remain intact. Major blowouts or development of parabola dunes could migrate inland, beyond the immediate effects of water level rise, and eliminate additional habitat at higher elevations. To some extent, the negative impact of increased sand mobility will be offset by new moderately-disturbed habitat along the margins of the unstable sections, which likely would support early successional dune colonizers like *Layia carnosa*. Based on the data used to create Figure 3, greater than 88 percent of the habitat occupied by *Layia carnosa* on the North and South Spits of Humboldt Bay combined, is located above 13 foot elevation; 76 percent is above 15 foot elevation, and 51 percent is above 20 foot elevation. Those percentages would likely go up if data for the northern portion of the Mal'el dunes and the Lanphere Dunes were included. The elevational distribution of dune habitat within 100 feet of *Layia carnosa* derived from the DEM (Figure 4) suggests there is an abundance of habitat available for *Layia carnosa* to move up in elevation, of course subject to conditions otherwise being suitable for the species (e.g., free of invasive species).

As far as other near-shore dunes habitat around Humboldt Bay, the majority is estimated to be represented by Figure 2, with one exception. An estimated 15 acres of occupied dunes on the south side of the Eel River occur at relatively low elevations, and likely is the most threatened habitat for the species within the Humboldt Bay region.

For other *Layia carnosa* sites in California, the surface elevation was roughly estimated from USGS topographic maps and information provided by the land manager. High resolution LIDAR should be available soon for the entire California coast, as part of the California Shoreline Mapping Project (California Ocean Protection Council 2011). In the meantime, based on the USGS maps, the occupied habitat at Freshwater Lagoon and the northern portion of the mouth of the Mattole River dunes (Humboldt County) probably occurs at 20 foot elevation or below. The southern portion of the Mattole River habitat is higher, between 20 and 30 foot elevation. All but 2 of the *Layia carnosa* polygons mapped at Point Reyes NS occur on or above the 40 foot contour. The relatively small *Layia carnosa* populations on the Monterey Peninsula, and at Vandenberg AFB also appear to be at relatively high elevation, perhaps ranging from 30 to over 100 feet in elevation.

Figure 3. Ground elevation of *Layia carnosa* occupied habitat on the North and South Spits of Humboldt Bay, Humboldt County, California
Figure created for the 2011 5-year review

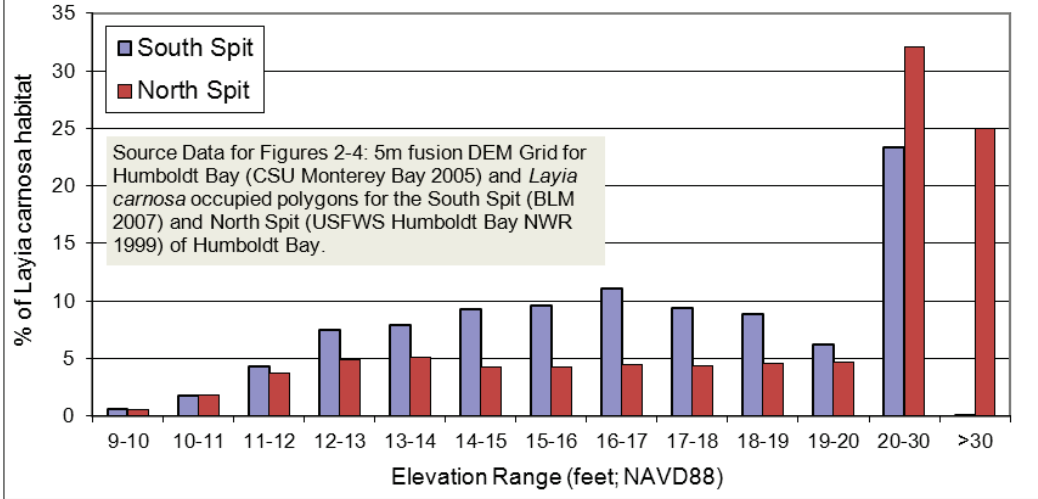


Figure 4. Relationship of *Layia carnosa* occupied habitat to ground elevation on the North and South Spits of Humboldt Bay, Humboldt County, California
Figure created for the 2011 5-year review

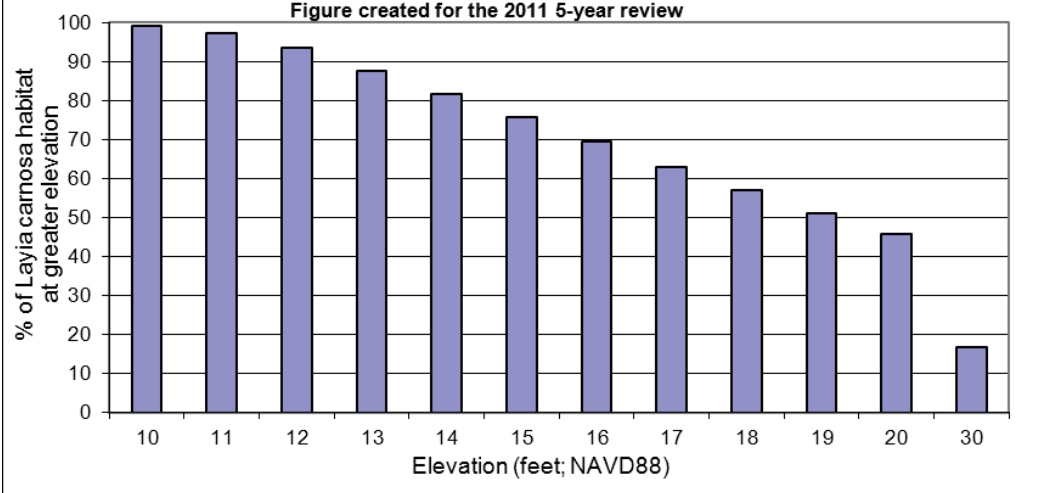
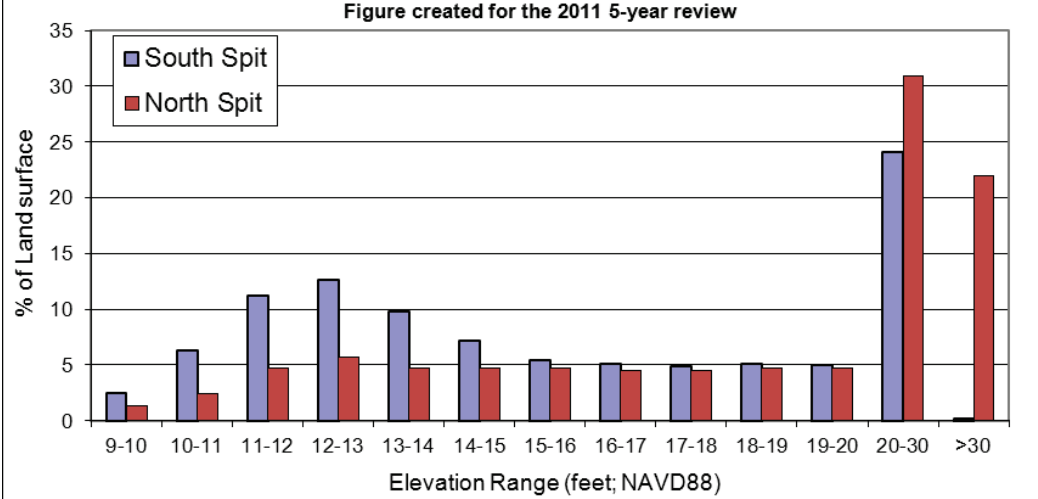


Figure 5. Ground elevation of land surface within 100 feet of *Layia carnosa* occupied habitat on the North and South Spits of Humboldt Bay, Humboldt County, California
Figure created for the 2011 5-year review



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

There were no threats to *Layia carnosa* related to overutilization identified at the time of listing, and we know of no current threats of this nature. However, unrestricted collecting for scientific or horticultural purposes or excessive visits by individuals interested in seeing rare plants could result from increased publicity, and seriously impact these plants.

c. Disease or predation:

There were no threats to *Layia carnosa* related to disease or predation identified at the time of listing, and we know of no current threats of this nature.

d. Inadequacy of existing regulatory mechanisms:

There has been no change in state or federal regulations protecting this species since the plant was listed. *Layia carnosa* was listed as Endangered by the State of California in 1990, and receives limited protections under the Native Plant Protection Act and California Endangered Species Acts (USFWS 1992). While those and other statutes (CEQA, California Coastal Act, Federal Coastal Zone Management Act) all provide limited protections for *Layia carnosa* on private and public property, many of its current threats are either unregulated, or of a kind not affected by land use regulations (invasive species encroachment, pedestrian impacts). Thus regulatory restrictions, even when applicable, are currently inadequate to conserve this species.

On State and local government-owned lands, which together with Federal lands includes a majority of the distribution, as well as on privately owned lands, most projects entailing significant impacts to resources will be covered under CEQA, which normally would require mitigation to reduce impacts to less than significant. However, protection of listed species under both acts is at the discretion of the lead agency.

**e. Other natural or manmade factors affecting its continued existence:
Competition with Invasive Species**

Layia carnosa was listed, in part, due to the past introduction and invasion of its habitat by a variety of invasive, non-native plant species. These species threaten virtually the entire distribution of *Layia carnosa*, through direct competition for space, stabilization of the dunes, and in some cases, enrichment of the soils which then stimulates invasion by other aggressive species. In Humboldt County the primary threats are invasive annual grasses, European beachgrass, yellow bush lupine, iceplant, and jubata grass (*Cortaderia jubata*). Iceplant, annual grasses, and in some cases European beachgrass, are the primary threats farther south in its range. Evidence suggests these taxa will continue to invade *Layia carnosa* habitat, necessitating routine and long-term management action. European beachgrass, yellow bush lupine, and iceplant generally have been mapped within the various dune systems occupied by *Layia carnosa*, and there has been much effort to remove and control these species; however, much habitat remains to be restored, and a permanent strategy for maintaining this habitat is yet to be developed. In addition, little attention has been given to mapping or restoration of

habitat invaded by annual grasses, with the exception of the USFWS lands at Humboldt Bay.

Examples of past management to address the threat of non-native species to *Layia carnososa* include the following:

Invasive species removal projects are ongoing at the Humboldt Bay NWR Lanphere Dunes Unit (former Nature Conservancy Lanphere-Christensen Dunes Preserve), the Ma-le'l Dunes CMA, jointly managed by the USFWS and BLM, the Manila Dunes owned by Manila CSD, the Samoa Dunes Endangered Plant Area (BLM), the South Spit Management Area, and occasionally on a portion of the City of Eureka 80-acre dunes mitigation area (A. Pickart, pers. comm. 2006; K. Wear, pers. comm. 2007b). In addition, a project to remove invasive species from two acres of potential *Layia carnososa* habitat on the North Spit was recently implemented by the HBHRCD, in conjunction with dredging of the bay (USFWS Arcata FWO 2005).

In Monterey County, extensive dunes restoration has been conducted over the past 20 years (L. Madison, pers. comm. 2007). An estimated 100 acres have been treated at the Asilomar SB (which led to the rediscovery of *Layia carnososa*), and restoration was conducted at the Indian Village Dunes during the 1990's, as part of requirements for the Spanish Bay 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. Although *Layia carnososa* was not included in the current restoration plan, its reintroduction remains a feasible option for this site. 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).

In summary, the USFWS, BLM, Manila CSD, Point Reyes NS, and CDPR have made substantial efforts to implement research and management aimed at controlling invasive species and restoring *Layia carnososa* habitat. These efforts, particularly the monitoring, need to be both continued and expanded. While the threat posed by invasive species has been addressed to some extent, at least temporarily, no mechanism has been implemented which ensures continued funding and implementation of an invasive species control program, or the monitoring necessary to effectively implement such a program.

Small population size

The listing decision (USFWS 1992) also identified the isolation of small populations as a potential factor affecting its continued existence. Annual species such as *Layia carnososa* are vulnerable to random fluctuations (stochasticity) and variation in annual weather patterns or other environmental factors (USFWS 1998). All of the Monterey and Santa Barbara County populations, and the

Freshwater Lagoon Spit site in Humboldt County, due to their relatively small size and area of occupied habitat, continue to be vulnerable to stochastic extinction.

Climate Change

Global climate change may constitute a new threat for *Layia carnosa*. 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. Beyond the potential for changes in temperature and moisture regimes, perhaps of greatest concern is the potential for progressive ocean level rise, which would affect at least a portion of *Layia carnosa* habitat (as discussed in Factor A).

D. Synthesis.

Based on threats identified when the species was listed, the threat of destruction, modification or curtailment of the range of *Layia carnosa* has been significantly reduced since the species was listed. About 91 percent of the currently occupied habitat is owned by Federal, State, and local agencies, special districts, or NGOs, or covered under conservation easements, with at least some management direction aimed at conserving the dunes habitat. The majority of the remainder of occupied habitat is subject, at least in theory, to restrictions mandated by County local coastal programs, the California Coastal Act, and CEQA. The majority of the largest landowners, including the USFWS, BLM, Pt. Reyes NS, Manila CSD, Friends of the Dunes, Wildlands Conservancy, as well as DOD and CDPR, are pursuing restoration activities at some level to reduce the threat of invasive species. However, while significant progress has been made in invasive species removal, very large areas remain infested, and 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 that purpose. As a result, *Layia carnosa* remains vulnerable to the persistent encroachment by invasive species, and over-stabilization of its near-shore dunes habitat. A means is needed to ensure the future monitoring and responsive management necessary to maintain *Layia carnosa*.

In addition, a new threat has been identified, in the form of ocean-rise resulting from climate change. A minor, but significant portion of the populations of *Layia carnosa* at Humboldt Bay and the Mattole River, and the Freshwater Lagoon population may be vulnerable to destruction from frequent inundation and increased erosion resulting from ocean-rise. An analysis of the majority of the Humboldt Bay population of *Layia carnosa* suggests that at least 50 percent, and perhaps as high as 93 percent of that population may occur at elevations high enough to escape the direct impacts from increased erosion and storm surges. As an early successional species able to readily colonize moderately disturbed habitat once invasive species are removed, *Layia carnosa* will undoubtedly be able to exploit a portion of the newly disturbed habitat resulting from ocean-rise.

The population monitoring data indicate the current rangewide population of *Layia carnosa* is substantially larger than suggested at the time of listing, by an order of magnitude. Since the population data available at the time of listing (USFWS 1992) do not appear to have been based on detailed quantitative data, there is no evidence to indicate the suggested increase is due to an actual expansion of the population. The Humboldt Bay population clearly is the largest across the range, likely exceeding 10 million individuals. The population at the mouth of the Mattole, estimated in the millions, occupies about 27 acres, and at least for the present, is relatively free of invasive species. The Point Reyes population has not been accurately censused, but appears to number in the 10's of thousands or higher. That population is surrounded by extensive near-shore dunes, a portion of which will be soon restored. The Vandenberg AFB and Freshwater Lagoon Spit populations, at the extreme ends of the range, and all populations within Monterey County remain at relatively higher risk than the Humboldt Bay, Mattole River and Point Reyes populations. It is not clear whether those populations are being limited by environmental factors unrelated to invasive species encroachment or processes leading to over-stabilization of its habitat. While the current population estimates suggest the taxon is not at as great a risk as originally thought, caution must be taken in interpreting the population data. As an annual species, *Layia carnosa* responds almost immediately to changes in its environment, and therefore, degradation of its habitat by invasive species can cause almost immediate declines. At the same time, a great efforts and resources have been expended to secure its habitat, and reverse the loss of habitat to invasive species since this species was listed.

We believe that *Layia carnosa* continues to be at some risk of extinction due to the chronic threat of habitat loss from invasive species, and the potential for ocean-rise to eliminate some of its habitat within the foreseeable future. In particular, the populations in Monterey and Santa Barbara Counties, and the northernmost population in Humboldt County remain at high risk of extirpation due in part, to their small size. Portions of the distributions at Humboldt Bay and the mouth of the Mattole River appear at risk of destabilization, perhaps relatively soon, as a result of increased erosion due to ocean-rise. However, several factors argue for a reduced degree of regulatory concern:

- 1) Over 90 percent of habitat occupied by *Layia carnosa* is owned by a public entity subject to policies precluding development impacts, or is subject to development restrictions and mitigation requirements mandated by the California Coastal Act, local coastal plans, zoning ordinances, or CEQA;
- 2) Approximately 91 percent of its habitat is subject to management which emphasizes conservation of sensitive dune habitat, and about 52 percent is subject to management committed to assisting in the recovery of *Layia carnosa*, There is no reason to believe the existing commitment will change as a result of the downlisting of this species;
- 3) Restoration of near-shore dunes and invasive species removal projects are ongoing, planned, or have been completed, by the majority of the largest landowners, including: USFWS, BLM, Point Reyes NS, CDPR, Manila CSD and Friends of the Dunes;
- 4) Large populations of *Layia carnosa* are present at Humboldt Bay, the mouth of the Mattole River and at Point Reyes NS. Based on population estimates made since 2007 for 95 acres of near-shore dunes at Humboldt Bay, added to the estimate for 27 acres at the Mouth of the Mattole River, an estimated 8.3 million plants occupy 122 acres, or 27 percent of the total 454 acres presumed to currently be occupied across its range. Based on those data, the average total annual population across its range is expected to exceed 10 million, even during low population years.
- 5) Recent DNA analysis, considered preliminary, found no differences among populations of

Layia carnosa sampled at Vandenberg AFB, Monterey Peninsula, and Humboldt Bay;

- 6) *Layia carnosa* appears well-adapted (though not yet adequately documented) to moderate levels of pedestrian, equestrian and vehicle disturbance;
- 7) Although a portion of the core populations at Humboldt Bay and the Mattole River appear at risk due to ocean-rise, the majority of the occupied habitat appears to exist above the zone of likely impact. There is good reason to expect some degree of ocean-rise will occur by the year 2050 that will impact *Layia carnosa* habitat. As a result, a monitoring program should be implemented and management actions should be taken to minimize the threat. However, there is large uncertainty on the degree of ocean rise, and it may be some time before the actual degree of the threat is known. Should monitoring detect significant, rising impacts from ocean-rise in the future, the decision may be made at that time to restore its status to endangered;
- 8) *Layia carnosa* is frequently associated with other dune plant species currently listed as Endangered, and subject to similar threats, which should ensure that ongoing restoration and non-native species control efforts continue in a portion of its habitat.

Therefore, we find sufficient evidence exists to recommend *Layia carnosa* be downlisted to threatened status. Research has been initiated to determine the feasibility of achieving the stated recovery goals for the Monterey and Santa Barbara County populations. Depending on those results, the current criteria for delisting should be reassessed. In conjunction with downlisting, efforts should be made to locate additional populations in the southern portion of the range, and restoration efforts should be initiated at Vandenberg AFB, as described in Section IV of this review.

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 8 (no change)

C. If applicable, indicate the Listing and Reclassification Priority Number (FWS only):

Reclassification (from Threatened to Endangered) Priority Number: _____

Reclassification (from Endangered to Threatened) Priority Number: _____

Delisting (Removal from list regardless of current classification) Priority Number: _____

IV. RECOMMENDATIONS FOR FUTURE ACTIONS

Partnerships

Continued collaboration with Redwood NP, CDP, BLM, Manila CSD, City of Eureka, Point Reyes NS, Vandenberg AFB, and perhaps private landowners is essential to the successful recovery of this species.

Reintroduction

The type locality population for *Layia carnosa* at the Point Pinos dunes has not been detected since 1919 (CDFG 2007). The Point Pinos dunes are currently undergoing restoration and endangered species augmentation as part of a plan related to expansion of the golf course and transfer of the property from the US Coast Guard to the City of Pacific Grove. Unfortunately *Layia carnosa* was not included in the restoration plan. An attempt should be made to reintroduce *Layia carnosa* to Point Pinos from seed collected at nearby Asilomar SB or Indian Dunes. Whether or not the recovery goal for that population can be met is unknown. However, the attempt to establish a vigorous population there is called for under one of the delisting criteria, and could reestablish a historically significant population. In addition, the planned reintroduction of *Layia carnosa* to restored habitat near the historical occurrence at the mouth of Little River should be pursued (Forys 2006).

Additional Population Inventories, Monitoring and Reporting

Population and Occupied Habitat Inventories:

Habitat owned by the USFWS, BLM, City of Eureka, Manila CSD, Point Reyes NS, CDP, and Pebble Beach Company (Indian Village Dunes) have been the focus of one or more dunes restoration projects. Periodic reassessment of these populations and occupied habitat at these sites, employing consistent methodology, is critical to establish trends, provide feedback on the restoration efforts, and determine whether the current recreational management is compatible with conservation of the species.

Baseline population and habitat inventories are needed for the City of Eureka Elk River Spit, the privately held dunes near the mouth of McNutt Gulch, and the Signal Hill site owned by Pebble Beach Company on the Monterey Peninsula. Where populations are too large to census, a uniform methodology similar to that utilized by the USFWS and BLM at Humboldt Bay should be adopted.

Disturbance Monitoring:

Habitat disturbance is known to be a necessary element in the ecology of *Layia carnosa*; however, too much or too little disturbance is detrimental. Therefore, in order to effectively tailor recreational management to the needs of *Layia carnosa*, quantitative data are needed indicating its response to specific recreational use. Research is needed to measure the rate of establishment and mortality of *Layia carnosa* in response to varying types and levels of disturbance.

Acquisition and/or Protection of Habitat

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

- Signal Hill Dunes, on the Monterey Peninsula
- City of Eureka dunes habitat located on the North Spit, and Elk River Spits of Humboldt Bay.
- Private owned dunes habitat on the North Spit of Humboldt Bay, and north of the mouth of the Mattole River.

The monitoring and restoration conservation easement proposed by Pebble Beach Company as part of the Spyglass Hill Golf Course project could serve as a template for future agreements needed to ensure future conservation of critical dunes habitat for this species. Such agreements would in many cases contribute to recovery of multiple listed species, including the Monterey spineflower (*Chorizanthe pungens* var. *pungens*, sand gilia (*Gilia tenuiflora* ssp. *arenaria*), Tidestrom's lupine (*Lupinus tidestromii*) and Menzies' wallflower (*Erysimum menziesii* ssp. *menziesii*) on the Monterey Peninsula; Tidestrom's lupine at Point Reyes NS; and Menzies wallflower (*E. m. Eurekaense*) in the Humboldt Bay portion of the range.

Permanent Habitat Maintenance, Invasive Species Control, and Funding

Due to the vulnerability of its habitat to stabilization by invasive species, and as a result, the highly transient nature of its habitat, the requirement to ensure future maintenance of *Layia carnosa* habitat is paramount to the recovery effort. 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 will not be impacted, mechanical removal or burning followed with herbicide post-treatment has shown to be particularly effective. The problem species could change overtime, but inevitably, encroachment by invasive species and resulting over-stabilization of its habitat will continue to threaten *Layia carnosa* in perpetuity. Therefore, habitat monitoring followed by removal of invasive species, when warranted, must be considered a permanent element in maintaining *Layia carnosa*, even after the delisting.

Efforts should be made to determine which of the following three options for ensuring long-term protection best applies to individual sites and ownership:

- 1) endowment of conservation easements specifically written to include the necessary monitoring and habitat maintenance needed to conserve the species;
- 2) incorporation of language within the management guidance documents for each of the agencies that own property supporting significant populations of *Layia carnosa*, which emphasizes invasive species monitoring and control efforts in perpetuity, and at least some level of *Layia carnosa* population monitoring, even after it is delisted;
- 3) implementation of conservation agreements which combine the necessary elements of the above two options in ensuring future maintenance of *Layia carnosa* habitat after it is delisted.

Permanent Funding: With respect to the privately held habitat, the level of funding necessary to adequately monitor *Layia carnosa* populations and habitat, and implement maintenance actions prior to onset of population decline needs to be determined. Opportunities should then be pursued to secure permanent funding in the form of an endowment or trust fund, which ensures that the responsive management is conducted in perpetuity.

Monitoring Program Designed to Measure the Impacts of Ocean-rise

The California Shoreline Mapping Project, implemented in 2010, will provide high resolution LIDAR photography enabling development of accurate DEM's (California Ocean Protection Council 2011). Those data should be analyzed in conjunction with occupied habitat maps and periodic population monitoring data for sites across the range, particularly the Humboldt Bay, Mattole River, and Point Reyes populations, to help evaluate future trends in population and habitat as they correlate with elevation.

Habitat Restoration Goals to Counter the Impacts of Ocean-rise

Future dunes habitat restoration projects across the range, but most importantly at Humboldt Bay, the mouth of the Mattole River, and at Point Reyes should utilize elevation data available from the DEM for those areas, and begin focusing restoration efforts in areas at sufficient elevation, and if possible, located geographically so as to insulate *Layia carnosa* as much as possible from the effects of ocean-rise.

Due to the questions concerning the viability of the Santa Barbara and Monterey County populations of *Layia carnosa*, the following tasks are highly recommended in association with downlisting the species to Threatened.

Research on Range Limiting Factors

Delisting Criterion #3 for *Layia carnosa* includes a specific population target for all of the populations located in the south portion of the range; i.e., “*The occurrences south of San Francisco in the Monterey Bay and Vandenberg dune systems (Spyglass Hill; Point Pinos; Pico Avenue; Pacific Grove, Vandenberg AFB) have received foredune beachgrass control, iceplant management, and are managed and enhanced to protect 5,000 individuals or more per site.*” While managing for such large populations is desirable for many reasons, there may be range-limiting factors involved (for example, temperature or moisture regimes, sand mineralogy) that are not easily manipulated, and which serve to limit reproductive success at the limits of its range. The monitoring records for sites at Vandenberg AFB, Monterey Peninsula, and Freshwater Lagoon Spit suggest there may be factors limiting those populations not related to proper disturbance regime or invasive species encroachment.

Research designed to answer the above questions is scheduled to proceed in fall 2011 (USFWS Arcata FWO 2008). The study should include a comparison of climate and soil factors, and other factors that may affect reproductive success in populations of *Layia carnosa*, both at the limits of its range, and within the center of its range (for example, Humboldt Bay). As soon as those results are available, the feasibility and practicality of meeting the existing delisting recovery criteria for the species should be evaluated, and recommendations made regarding adequacy of the existing recovery criteria.

Population Inventories – Southern Portion of the Range

Focused inventories for *Layia carnosa* should be conducted at all the significant dune systems located along the coast between the Monterey Peninsula and Vandenberg AFB, which constitutes a 150 mile long gap in the known distribution for the species.

Management Efforts at Vandenberg AFB

Initial efforts have been made to restore near-shore dunes habitat at Vandenberg AFB, and expand the relatively small population of *Layia carnosa*. The results of the *Layia carnosa* life history study, scheduled to be initiated in fall 2011, hopefully should indicate whether range-limiting factors, or simply the absence of an appropriate disturbance regime is preventing this population from expanding. Due to the fact it is the southernmost site for the species, and in accordance with the recovery plan, seed from this site should be deposited at an approved seedbank as soon as adequate seed are available.

V. REFERENCES

A. Literature

Baldwin, B. G. 2006. Contrasting patterns and processes of evolutionary change in the tarweed-silversword lineage: Revisiting Clausen, Keck, and Heisey's findings. *Ann. Missouri Bot. Gard.* 93:66-96.

Basor, B. 2002. Emergence, survival and fecundity of the endangered annual *Layia carnosa* (Asteraceae). Unpublished report submitted to Humboldt State University and U.S. Fish and Wildlife Service, Arcata, California.

Botanica Northwest Associates. 1993. Sensitive Plant Survey of Sand Dunes in the Eel River Wildlife Area. Unpublished document submitted to California Department of Fish and Game, Eureka, California.

Bureau of Land Management. 1995. Environmental Assessment and Land Use Decision Amendment for the Samoa Peninsula Management Area, Arcata Resource Area. Arcata Field Office, Arcata, California

Bureau of Land Management. 2002. Biological assessment for Arcata Field Office Bureau of Land Management Interim Management Plan for Lands on the South Spit of Humboldt Bay Managed Under Conservation Easement by the Bureau of Land Management. Bureau of Land Management, Arcata, California.

Bureau of Land Management. 2003. Beach *Layia* (*Layia carnosa*) field data and GIS shapefile indicating occupied habitat on the South Spit of Humboldt Bay. Arcata Field Office, Arcata, California.

Bureau of Land Management. 2004. King Range National Conservation Area Draft Resource Management Plan and Draft Environmental Impact Statement. Arcata Field Office, Arcata, California

Bureau of Land Management. 2005. Biological Assessment for the King Range National Conservation Area, U.S. Bureau of Land Management 2005 Resource Management Plan and Record of Decision. Arcata Field Office, Arcata, California

- Bureau of Land Management. 2006. Beach Layia (*Layia carnososa*) GIS shapefile indicating occupied habitat on the South Spit of Humboldt Bay, based on 2006 mapping effort. Arcata Field Office, Arcata, California.
- Bureau of Land Management. 2007. Beach layia (*Layia carnososa*) sample plot data for population estimation on the South Spit of Humboldt Bay. Unpublished data. Arcata Field Office, Arcata, California.
- Bureau of Land Management. 2010a. Mattole Beach Dunes Study Spring 2010: Report of beach layia (*Layia carnososa*) frequency monitoring. Arcata Field Office, Arcata, California.
- Bureau of Land Management. 2010b. Samoa Dunes Endangered Plant protection Area Study Spring 2010: Report of beach layia (*Layia carnososa*) frequency monitoring. Arcata Field Office, Arcata, California.
- Bureau of Land Management. 2010c. Samoa Open Riding Area Study Spring 2010: Report of beach layia (*Layia carnososa*) frequency monitoring. Arcata Field Office, Arcata, California.
- Bureau of Land Management. 2010d. Manila Research Natural Area Study Spring 2010: Report of beach layia (*Layia carnososa*) frequency monitoring. Arcata Field Office, Arcata, California.
- Bureau of Land Management. 2010e. Eureka Dunes Monitoring Summary Spring 2010: Report of beach layia (*Layia carnososa*) frequency monitoring. Arcata Field Office, Arcata, California.
- California Coastal Commission 2001. Overview of sea level rise and some implications for coastal California. Report prepared by the California Coastal Commission staff, not formally approved by the Commission.
- California Department of Fish and Game. 2011. Element occurrence reports for *Layia carnososa*. California Natural Diversity Database (CNDDDB), California Department of Fish and Game, Sacramento.
- California Department of Parks and Recreation. 2004a. Department Operations Manual Section 3: Natural Resources. California Resources Agency, Sacramento.
- California Department of Parks and Recreation. 2004b. Asilomar State Beach and Conference Grounds: Preliminary General Plan and Environmental Impact Report. California Resources Agency, Sacramento.
- California Ocean Protection Council 2011. The California Shoreline Mapping Project. <http://www.opc.ca.gov/2010/11/the-california-shoreline-mapping-project/>.

- California State University at Monterey Bay, Seafloor Mapping Lab 2005. 5 meter fusion digital elevation model grid for Humboldt Bay. Topographic/bathymetric grid (shapefile) derived from Earthdata LIDAR and other sources. CSU Monterey Bay, Monterey, California.
- Cayan, D., M. Dettinger, I. Stewart, and N. Knowles. 2005. Recent changes towards earlier springs: early signs of climate warming in western North America? U.S. Geological Survey, Scripps Institution of Oceanography, La Jolla, California.
- Duebendorfer, T. 1992. Vegetation classification, rare plant analysis, impacts, restoration, and habitat management strategies. Technical report completed for the Humboldt County Beach and Dunes Management Plan, Humboldt County Planning Department, Eureka, California.
- Field, C.B., G.C. Daily, F.W. Davis, S. Gaines, P.A. Matson, J. Melack, and N.L. Miller. 1999. Confronting climate change in California. Ecological impacts on the Golden State. A report of the Union of Concerned Scientists, Cambridge, Massachusetts, and the Ecological Society of America, Washington, DC.
- Friends of the Dunes. 2007. Website <http://friendsofthedunes.org/>.
- Heberger, M., H. Cooley, P. Herra, P. Gleick, and E. Moore. 2009. The impacts of sea-level rise on the California coast. California Climate Change Center, Sacramento.
- Humboldt County. 1995. General Plan, Vol. II: Humboldt Area Plan of the Humboldt County Local Coastal Program; original certification 1982; last adopted June 1994. Eureka, California.
- Imper, D.K. 2007. U.S. Fish and Wildlife Service, Arcata Fish and Wildlife Office, Arcata, California. Field notes and observations made during the period April 23-27, 2007 in Monterey County.
- Imper, D.K. 2011. U.S. Fish and Wildlife Service, Arcata Fish and Wildlife Office, Arcata, California. Computations and unpublished data related to *Layia carnosa* occupied habitat.
- [IPCC] Intergovernmental Panel on Climate Change. 2007. Climate change 2007: the physical science basis. Summary for policymakers. Contribution of Working Group I to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change, IPCC Secretariat, World Meteorological Organization and United Nations Environment Programme, Geneva, Switzerland.
- Johns, M.E. 2009. Assessment of endangered beach layia (*Layia carnosa*) on the Monterey Peninsula. Capstone Project Report submitted to California State University, Monterey Bay, May 16, 2009.

- Julian, L. 2010. Redwood National and State Parks Rare and Endangered Plant Species Status Report 2010. Unpublished report on file, Redwood National Park, Orick, California.
- Madison, L. 2007. Monitoring data 1994-2007 for *Layia carnosus*, Asilomar State Beach. California Department of Parks and Recreation, Monterey, California.
- ManTech SRS Technologies, Inc. 2010. Integrated Natural Resources Management Plan elements for management of coastal resources, invasive species, and threatened and endangered species, Vandenberg Air Force Base, California. Lompoc, California.
- Monterey County Planning and Building Inspection Department 2005. Final Environmental Impact Report on the Pebble Beach Company Del Monte Forest Preservation and Development Plan. Monterey, California.
- Pickart, A.J., and J. Sawyer. 1998. Ecology and restoration of northern California coastal dunes. California Native Plant Society, Sacramento.
- Point Reyes National Seashore. 2005. Beach Layia (*Layia carnosus*) Annual Report 2000-2005, USFWS Permit TE018180-2. Unpublished report on file, Point Reyes National Seashore, Point Reyes, California.
- Point Reyes National Seashore. 2006. Beach Layia (*Layia carnosus*) Annual Report 2006, USFWS Permit TE018180-2. Unpublished report on file, Point Reyes National Seashore, Point Reyes, California.
- Point Reyes National Seashore. 2010. Beach Layia (*Layia carnosus*) GIS shapefile indicating occupied habitat, based on 2001 and later mapping efforts, Point Reyes National Seashore, Point Reyes, California.
- Redwood National and State Parks. 2000. General Management Plan/General Plan, Redwood National and State Parks, Humboldt and Del Norte Counties, California. Orick, California.
- Sahara, A. 2000. Pollination of *Layia Carnosa* at the Lanphere Dunes, Humboldt Bay National Wildlife Refuge. Unpublished report submitted to Humboldt State University, Arcata, California.
- U.S. Fish and Wildlife Service. 1992. Endangered and threatened wildlife and plants; Six plants and Myrtle's silverspot butterfly from coastal dunes in Northern and Central California determined to be endangered. Federal Register 57(120):27848-27859.
- U.S. Fish and Wildlife Service. 1998. Seven Coastal Plants and the Myrtle's Silverspot Butterfly Recovery Plan, Portland, Oregon. 141 pp.

- U.S. Fish and Wildlife Service. 2001. National Wildlife Refuge System, Policy for Maintaining Biological Integrity, Diversity and Environmental Health. Insert Part 601 FW 3, 04/19/01, FWM 366 (4 sheets).
- U.S. Fish and Wildlife Service. 2006. The Fish and Wildlife Service Manual, Part 601 National Wildlife Refuge System: Refuge Management. Division of Policy and Directives Management, U.S. Department of Interior, Washington D.C.
- U.S. Fish and Wildlife Service, Arcata Fish and Wildlife Office. 2002. Formal Section 7 consultation on the interim management plan for lands managed by the Bureau of Land Management on the South Spit of Humboldt Bay, California. File No. 1-14-2002-1196.
- U.S. Fish and Wildlife Service, Arcata Fish and Wildlife Office. 2005. Informal and formal Section 7 consultation, Eureka waterfront and Woodley Island Marina maintenance dredging project, Humboldt County, California. File No. 1-14-2005-2456.
- U.S. Fish and Wildlife Service, Arcata Fish and Wildlife Office. 2007. Informal and formal Section 7 consultation, Ma-le'l Dunes Cooperative Management Area Access Plan, Humboldt County, California. File No. 1-14-2007-3112.
- U.S. Fish and Wildlife Service, Arcata Fish and Wildlife Office. 2008. Requisition Number 8133180275: Design, coordinate and assist in beach layia population surveys. Contract award to Joey Dorell-CanepaSan Juan Batista, California, dated August 8, 2008.
- U.S. Fish and Wildlife Service (USFWS), Humboldt Bay NWR. 1999. Beach Layia (*Layia carnosa*) GIS shapefile indicating occupied habitat on the North Spit of Humboldt Bay, based on 1999 mapping effort. Humboldt Bay National Wildlife Refuge, Eureka, California.
- U.S. Fish and Wildlife Service, Humboldt Bay NWR. 2009. Comprehensive Conservation Plan and Final Environmental Assessment. Humboldt Bay National Wildlife Refuge, Eureka, California.
- U.S. Fish and Wildlife Service, Ventura Fish and Wildlife Office. 2005. Biological opinion for transfer of surplus property from Federal to City ownership at Light Station Point Pinos, City of Pacific Grove, Monterey County, California; document 1-8-04-F-35.
- Walters, Heidi. 2011. Behind the levee: Come flood, quake or high seas, Jacobs Avenue business owners plan to stay put. January 27, 2011 issue of The North Coast Journal, Eureka, California.
- Wildlands Conservancy. 2009. GPS locations for *Layia carnosa* from observations on March 18, 2009, at the Wildlands Conservancy's preserve on the Eel River Dunes. Unpublished report. The Wildlands Conservancy, Oak Glen, California.

Williams, A. 2000. Redwood National and State Park Rare Plant Survey Report FY00. Unpublished report on file, Redwood National Park, Orick, California.

Williams, A. 2005. Redwood National and State Park Rare Plant Survey Report 2005. Unpublished report on file, Redwood National Park, Orick, California.

Zander Associates 2001. Biological resources of the Del Monte Forest: Coastal Dunes: Del Monte Forest Preservation and Development Plan. Unpublished document prepared for Pebble Beach Company, Pebble Beach, California.

B. Personal Communications

Arguello, Leonel. 2007. Senior Environmental Scientist, Redwood National and State Parks, Orick, California. Phone conversation with David Imper, U.S. Fish and Wildlife Service, Arcata, California, on June 11, 2007.

Baldwin, Bruce G. 2007. Professor and Curator, University of California at Berkeley, California. Email communication to David Imper, U.S. Fish and Wildlife Service, Arcata, California, dated February 9, 2007.

Clendenen, D. 2011. Project Manager, The Wildlands Conservancy, Oak Glen, California. Conservation with David Imper at U.S. Fish and Wildlife Service, Arcata, California, on February 3, 2011.

Farris, R. 2011. Botanist, Ventura Field Office, U.S. Fish and Wildlife Service, Ventura, California. Phone conversation with David Imper, U.S. Fish and Wildlife Service, Arcata, California, on February 11, 2011

Forys, Michelle. 2007. Environmental Scientist, California Department of Parks and Recreation, Eureka, California. Email communication to David Imper, U.S. Fish and Wildlife Service, Arcata, California, dated May 16, 2007.

Kovacs, Karen. 2007. Senior Scientist, California Department of Fish and Game, Eureka, California. Phone conversation with David Imper, U.S. Fish and Wildlife Service, Arcata, California, on June 14, 2007.

Lum, Luanne. 2007. Botanist, 30 CES/CEVNN Vandenberg Air Force Base, California. Electronic communication to David Imper, U.S. Fish and Wildlife Service, Arcata, California, dated April 18, 2007.

Lum, Luanne. 2011. Botanist, 30 CES/CEVNN Vandenberg Air Force Base, California. Phone conversation with David Imper, U.S. Fish and Wildlife Service, Arcata, California, on August 31, 2011.

Madison, Lorrie. 2007. Environmental Scientist, Asilomar State Beach, California Department of Parks and Recreation, Monterey, California. Conversation with David Imper, U.S. Fish and Wildlife Service, Arcata, California, on April 26, 2007.

- Parsons, Lorraine. 2011. Environmental Scientist, Point Reyes NS, Point Reyes, California. Phone conversation with David Imper, U.S. Fish and Wildlife Service, Arcata, California, on January 31, 2011.
- Pickart, Andrea. 2006. Ecologist, U.S. Fish and Wildlife Service, Humboldt Bay National Wildlife Refuge, Arcata, California. Conversation with David Imper, U.S. Fish and Wildlife Service, Arcata, California, on October 12, 2006.
- Pickart, Andrea. 2007. Ecologist, U.S. Fish and Wildlife Service, Humboldt Bay National Wildlife Refuge, Arcata, California. Email to David Imper, U.S. Fish and Wildlife Service, Arcata, California, on July 11, 2007.
- Pickart, Andrea. 2010. Ecologist, U.S. Fish and Wildlife Service, Humboldt Bay National Wildlife Refuge, Arcata, California. Email to Joey Dorell-Canepa, Monterey, California, on November 5, 2010.
- Pickart, Andrea. 2011a. Ecologist, U.S. Fish and Wildlife Service, Humboldt Bay National Wildlife Refuge, Arcata, California. Email to David Imper, U.S. Fish and Wildlife Service, Arcata, California, dated January 31, 2011.
- Pickart, Andrea. 2011b. Ecologist, U.S. Fish and Wildlife Service, Humboldt Bay National Wildlife Refuge, Arcata, California. Phone conversation with David Imper, U.S. Fish and Wildlife Service, Arcata, California, on February 4, 2011.
- Pickart, Andrea. 2011c. Ecologist, U.S. Fish and Wildlife Service, Humboldt Bay National Wildlife Refuge, Arcata, California. Phone conversation with David Imper, U.S. Fish and Wildlife Service, Arcata, California, on November 17, 2011.
- Rodgers, Jane. 2007. Ecologist, Point Reyes National Seashore, Point Reyes, California. Conversation with David Imper, U.S. Fish and Wildlife Service, Arcata, California, on June 11, 2007
- Rutherford, Connie. 2011. Botanist, U.S. Fish and Wildlife Service, Ventura Field Office, Ventura, California. Phone conversation with David Imper, U.S. Fish and Wildlife Service, Arcata, California, on February 4, 2011.
- Samuels, Stassia. 2007a. Plant Ecologist, Redwood National Park, Orick, California. Email to David Imper, U.S. Fish and Wildlife Service, Arcata, California, dated March 22, 2007
- Samuels, Stassia. 2007b. Plant Ecologist, Redwood National Park, Orick, California. Email to David Imper, U.S. Fish and Wildlife Service, Arcata, California, dated May 14, 2007.
- Shikany, Lisa. 2007. Planner, City of Eureka Community Development Services, Eureka, California. Conversation with David Imper, U.S. Fish and Wildlife Service, Arcata, California, on June 19, 2007.

- Wear, Kyle. 2006. Environmental Consultant, Manila Community Services District, Manila, California. Email to David Imper, U.S. Fish and Wildlife Service, Arcata, California, dated October 24, 2006
- Wear, Kyle. 2007a. Environmental Consultant, Manila Community Services District, Manila, California. Email communication to David Imper, U.S. Fish and Wildlife Service, Arcata, California, dated May 15, 2007.
- Wear, Kyle. 2007b. Environmental Consultant, Manila Community Services District, Manila, California. Phone conversation with David Imper, U.S. Fish and Wildlife Service, Arcata, California, on June 20, 2007.
- Wear, Kyle. 2011. Environmental Consultant, Manila Community Services District, Manila, California. Email communication to David Imper, U.S. Fish and Wildlife Service, Arcata, California, dated January 28, 2011.
- Wheeler, Jennifer. 2011. Botanist, Bureau of Land Management, Arcata California Office. Phone conversation with David Imper, U.S. Fish and Wildlife Service, Arcata, California, on February 10, 2011.
- Willoughby, John. 2007. Botanist, Bureau of Land Management, State Office, Sacramento, California. Email communication to David Imper, U.S. Fish and Wildlife Service, Arcata, California, dated May 31, 2007.
- Zander, Michael. 2007. Biological Consultant, Zander Associates (Pebble Beach Company Consultant). Email communication to David Imper, U.S. Fish and Wildlife Service, Arcata, California, dated May 16, 2007.

U.S. FISH AND WILDLIFE SERVICE
5-YEAR REVIEW of *Layia carnosa*

Current Classification Endangered

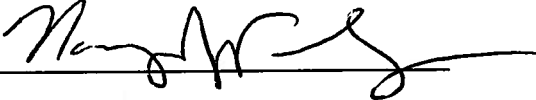
Recommendation resulting from the 5-Year Review

- 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:
Lead Field Supervisor, Fish and Wildlife Service

Approve 

Date 12-8-11

Cooperating Field Supervisor, Fish and Wildlife Service

Concur Do Not Concur

Signature  , VFWO

Date 1/10/12

Cooperating Field Supervisor, Fish and Wildlife Service

Concur Do Not Concur

Signature 

Date 1/18/12

REGIONAL OFFICE APPROVAL:
Lead Assistant Regional Director, Ecological Services, Fish and Wildlife Service

Approve 

Date 1/27/12