

Chorizanthe howellii
(Howell's spineflower)

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



Chorizanthe howellii: MacKerricher State Park, California
Photograph utilized courtesy Peter Warner, Fort Bragg, California

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

December 2011

5-YEAR REVIEW

***Chorizanthe howellii* (Howell's spineflower)**

I. GENERAL INFORMATION

Purpose of 5-Year Reviews:

The U.S. Fish and Wildlife Service (Service) is required by section 4(c)(2) of the Endangered Species Act to conduct a status review of each listed species at least once every 5 years. The purpose of a 5-year review is to evaluate whether or not the species' status has changed since it was listed (or since the most recent 5-year review). Based on the 5-year review, we recommend whether the species should be removed from the list of endangered and threatened species, be changed in status from endangered to threatened, or be changed in status from threatened to endangered. Our original listing of a species as endangered or threatened is based on the existence of threats attributable to one or more of the five threat factors described in section 4(a)(1) of the Endangered Species Act, and we must consider these same five factors in any subsequent consideration of reclassification or delisting of a species. In the 5-year review, we consider the best available scientific and commercial data on the species, and focus on new information available since the species was listed or last reviewed. If we recommend a change in listing status based on the results of the 5-year review, we must propose to do so through a separate rule-making process defined in the Endangered Species Act that includes public review and comment.

Species Overview:

Chorizanthe howellii is an herbaceous annual member of the buckwheat family (Polygonaceae), endemic to 7 miles of coastal dunes extending from the City of Fort Bragg north to the Ten Mile River, Mendocino County, California (Figure 1). The majority of the distribution occurs within MacKerricher State Park (MSP). *C. howellii* may grow to 4 inches tall and 20 inches across, with heads of tiny flowers ranging up to 0.2 inch long. Among other features, *C. howellii* is distinguished by its straight awns protruding from the outer floral ring (involucre). *C. howellii* blooms between May and July.

Seed dispersal by *C. howellii* is facilitated by the floral spines, which attach to passing animals. The species prefers vegetation gaps or sparsely-vegetated areas relatively free from other competing species. *C. howellii* is capable of rapid exploitation of habitat, such as following removal of invasive species like iceplant (*Carpobrotus edulis*). However, much of its habitat has been eliminated by invasive species, including iceplant and European beachgrass (*Ammophila arenaria*). Recreational activities within MSP, while sometimes detrimental to the species, can often benefit the species by maintaining open, semi-disturbed habitat adjacent to trails and high activity areas.



Figure 1. *Chorizanthe howellii*
(Howell's spineflower) Range Map
Prepared for the 2011 5-Year Status Review



Produced by the Arcata Fish and Wildlife Office
Arcata, California
Map Date: 10/06/2011
File: Howell's Spineflower_2011 Range Map.mxd

0 55 110 220
Miles

0 87.5 175 350
Kilometers

UTM 20 NE 10
NAD83

Methodology Used to Complete the Review:

This review was conducted by the Arcata Fish and Wildlife Office (AFWO) following the Region 8 guidance issued in March 2008. We used information from the *C. howellii* recovery plan (Service 1998), information contained in our files, relevant information provided by other agencies and experts, and the California Natural Diversity Database (California Department of Fish and Game [CDFG] 2011a) in this review. The recovery plan, data in our files, and unpublished monitoring and research reports were our primary sources of information used to update the species' status and threats. This 5-year review contains updated information on the species' biology and threats, and an assessment of information compared to that known at the time of listing or since the last 5-year review. We focused on current threats to the species that are attributable to the Endangered Species Act's five listing factors. The review synthesizes all this information to evaluate the listing status of the species and provide an indication of its progress towards recovery. Finally, based on this synthesis and the threats identified in the five-factor analysis, we recommend a prioritized list of conservation actions to be completed or initiated within the next 5 years.

Contact Information:

Lead Regional Office: Larry Rabin, Deputy Division Chief for Listing, Recovery, and Habitat Conservation Planning; and Karen Jensen, Fish and Wildlife Biologist; Region 8, (916)414-6464.

Lead Field Office: David Imper, Ecologist, AFWO, (707)822-7201.

Federal Register (FR) Notice Citation Announcing Initiation of This Review:

A notice announcing initiation of the 5-year review of this taxon and the opening of a 60-day period to receive information from the public was published in the Federal Register on May 25, 2011 (76 Federal Register 101). No comments were received in response to the notice.

Listing history:

Species (Service 1992)

FR Notice: Federal Register 50(17):27848-27859

Date of Final Listing Rule: June 22, 1992

Entity Listed: Howell's spineflower

Classification: Endangered

Associated Rulemakings: None

Review History: The initial 5-year status review was approved on September 24, 2007.

Species' Recovery Priority Number at Start of 5-Year Review:

The recovery priority number for *C. howellii* is 8 according to the Service's 2011 Recovery Data Call for the AFWO, based on a 1-18 ranking system where 1 is the highest-ranked recovery priority and 18 is the lowest (Endangered and Threatened Species Listing and Recovery Priority Guidelines, 48 FR 43098, September 21, 1983). This number indicates that the taxon is a full species, facing a moderate degree of threat, and has high potential for recovery.

Recovery Plan or Outline:

Name of Plan or Outline: Recovery Plan for Seven Coastal Plants and the Myrtle's Silverspot Butterfly

Date Issued: September 29, 1998

II. REVIEW ANALYSIS

Application of the 1996 Distinct Population Segment (DPS) policy:

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

Information on the Species and its Status:

Distribution and Abundance

C. howellii is restricted to the Ten Mile Dunes along the coast of Mendocino County, California. Although there were two historical locations on the west side of Fort Bragg, until recently the verified distribution of *C. howellii* extended from the Ten Mile River south approximately 5.4 miles to Virgin Creek, north of the City of Fort Bragg, and as much as 0.5 mile inland from the Pacific Ocean (Figure 1). A new population was discovered in 2009, likely one of the historical Fort Bragg sites, approximately 1.5 miles south of Virgin Creek, in conjunction with surveys for a new coastal trail project (California Department of Transportation 2011). A total of 375 plants were discovered within an area less than 0.01 acre on California Department of Parks and Recreation (CDPR) property, approximately 200 feet north of Elm Street in the City of Fort Bragg.

Overall, greater than 95 percent of the distribution is expected to lie within MSP. The remainder of the distribution is in private ownership (CDFG 2011a; Service 1998), spread across multiple parcels at the eastern extent of the dune sheets, both north and south of Ward Avenue. Much of that habitat is severely impacted by invasive species, or otherwise marginally occupied by *C. howellii*, likely a result of fragmentation by development, proximity to invasive species strongholds, and isolation from dune-forming processes (e.g., wind). For example, the majority of the 12-acre Wynn-Lane property, located at the southern reach of a dune sheet just north and east of Ward Avenue, consists of degraded to relatively pristine near-shore dunes habitat. In

2010, that property contained only 225 *C. howellii* individuals (WRA Consulting 2010). Another 0.9 acre property located immediately east of Ward Avenue contained 0.2 acre of degraded dunemat, and just 4 individuals of *C. howellii* (Wetland Research Associates 2004).

A survey of MSP in 2001 mapped some 277 habitat polygons occupied by the species ranging as large as 0.73 acre, and encompassing some 7.8 acres (Maslach 2001). No statistically valid estimate of the population was attempted. Based on a relatively small sample, the total population that year may have exceeded 3 million (Maslach 2002a). The portion of the population located within the Inglenook Fen-Ten Mile Dunes (IF-TD) Natural Preserve, a 1,285-acre preserve at the north end of MSP, was mapped and sampled in 2011 (Maslach 2011). That effort documented a total of 186 polygons encompassing about 8.6 acres. The 2011 results represented a 190 percent increase from that mapped just within the preserve in 2001 (3 acres). The number of *C. howellii* individuals exceeding 7 millimeters in diameter within the IF-TD Natural Preserve in 2011 was estimated at 1.04 million plants (95% confidence interval 0.88 – 1.20 million) (B. Maslach, CDPR, pers. comm. 2011a). Extrapolating the 2011 mean plant density to the occupied habitat mapped outside the IF-TD Natural Preserve in 2001 yields an overall estimate of about 1.7 million plants. If occupied habitat outside the preserve is assumed to have increased equivalent to the increase observed within the preserve between 2001 and 2011, the estimate rises to about 3 million plants.

While a population exceeding one million plants seems relatively large, we have no information with which to put the population size in a meaningful context. As an annual species, *C. howellii* completes its entire life cycle within a year, and therefore responds almost immediately to changes in its environment. A persistent seedbank in the soil can mitigate this dependence to some extent, but we have no information indicating whether *C. howellii* forms such a seedbank. Although evidence indicates *C. howellii* is capable of rapid exploitation of habitat, such as following removal of iceplant, very large declines in density of plants have also been observed following encroachment by invasive species or changes in recreational use, even within one season (Imper 2005).

Habitat Relationships

C. howellii occurs in several vegetation alliances associated with semi-stabilized near-shore dunes and backdunes. It also occurs in disturbed areas of coastal prairie, on relatively fertile, finer-textured soils associated with some of the coastal bluffs in the south portion of MSP (Imper 2005; Pickart and Barbour 2007; Sawyer *et al.* 2009). Its habitat is generally characterized as early successional. Disturbance in the form of wind exposure and sand deposition, or limited foot traffic appears necessary to prevent encroachment by other species, both native and non-native, which may cause a steep decline in *C. howellii* (Imper 2005). For example, much of the occupied habitat occurs on the edges of pedestrian or horse trails. However, some of the largest stands are located within semi-stabilized dune swales, which appear to receive little foot traffic.

C. howellii in general does not tolerate a high level of competition for seedling establishment. In some cases, *C. howellii* rapidly colonizes areas in which iceplant has died or been pulled, if the remaining mulch is not too deep (Imper 2005; Warner 2006). In 2005, this observation led to a study funded under an Endangered Species Act (ESA) section 6 grant, to investigate the

conditions under which a routine program of iceplant removal might be designed to contribute to sustained management for *C. howellii* (CDPR 2004a).

Twenty-five 50-square meter macroplots, each containing more than 50 percent iceplant cover and located within *C. howellii* habitat, were cleared of all iceplant manually in January 2005 (Warner 2006). *C. howellii* cover was initially zero percent. By June 2006, *C. howellii* cover averaged 3 percent, and the number of plants had increased by 1,300 percent. Unfortunately the study plots have not been resampled since June 2006. Continuation of that study would enable an assessment of the long-term benefit to *C. howellii* and sustainability of the treatments.

Given the expected continued encroachment of invasive species into *C. howellii* habitat, and the observed positive response of the species to some kinds of human disturbance (P. Warner, CDPR, pers. comm. 2006), complete absence of human-related disturbance in *C. howellii* habitat may lead to a decline in the species. Thus, the location of the majority of the rangewide distribution of *C. howellii* within MSP, offers a potential opportunity for permanent conservation and management of the species. Ultimately, the recovery of *C. howellii* depends on compatible management of recreational activities, and a permanent control program for invasive species within MSP.

Species-specific Research and/or Grant-supported Activities

A partial list of activities focused on *C. howellii* since the species was listed, along with funding source, includes:

Inventory:

- *C. howellii* mapping and population estimate, MacKerricher State Park, 2010-2011. Funded by AFWO, Arcata, California.

Research and restoration:

- Nutrient requirements of four dune species from Mackerricher State Park, 1991. Contract #4-823-9003 funded by California Department of Parks and Recreation (Zoger and Barbour 1991).
- Coastal dune habitat restoration for sensitive species recovery: MacKerricher State Park and Inglenook Fen – Ten Mile Dunes Preserve, Mendocino County, California, 1997. R. Pasquinelli, Project Manager. Funded by Environmental Enhancement Mitigation Grant Program, California Department of Transportation, Sacramento (Pasquinelli 1997).
- Dune restoration for Menzies wallflower, Howell's spineflower, and western snowy plover, Mackerricher State Park, 2000-2002. Funded by Federal section 6 Grant, Service (Maslach 2002b).
- Geomorphical study of the ten Mile Dunes in relation to the old logging road, Inglenook Fen – Ten Mile Dunes Natural Preserve, California, 2004. Funded by California Department of Parks and Recreation (Wollenberg and Maslach 2004).
- Development of a Restoration Strategy for *C. howellii* at MacKerricher State Park; P. Warner, Project Manager. 2004-2006. Funded by Federal section 6 grant, Service (Warner 2006).
- European beachgrass herbicide treatment (total 135 acres) and prescribed burn (total 60 acres). 2006-2011. Funded by CDPR maintenance, natural heritage stewardship and bond-funded programs.

Five Factor Analysis:

The following analysis describes and evaluates the threats attributable to one or more of the five listing factors outlined in section 4(a)(1) of the ESA. Little information is available regarding threats to the species where it occurs on private land. Therefore, the discussion below largely focuses on MSP, which contains more than 95 percent of the distribution of *C. howellii*.

FACTOR A: Present or Threatened Destruction, Modification or Curtailment of Habitat or Range

Pedestrian, Equestrian, and Off-road Vehicle Use

At the time of its listing, principle threats for destruction or modification of habitat for *C. howellii* were considered to be pedestrian, equestrian, and off-road vehicle use. The degree to which these factors currently threaten *C. howellii* has been substantially reduced since the species was listed, as described below.

At the time the recovery plan was completed, CDPR was considering replacing eroded sections of the old haul road (currently a pedestrian trail) adjacent to Cleone Lake, and in the north portion of MSP. Replacing those eroded sections would have directly eliminated some colonies of *C. howellii*, and could have interfered with sand movement and contributed to accelerated stabilization of habitat landward of the road, both detrimental to *C. howellii* (CDPR 1998; EDAW 2000). The current proposal would remove most of the pavement and underlying foundation material associated with the haul road within the IF-TD Natural Preserve, and replace it with a more primitive pedestrian trail (R. Pasquinelli, CDPR, pers. comm. 2011a). This proposal would be less detrimental to *C. howellii*, and may provide some benefit, by restoration of natural processes, and through implementation of the mitigation measures (e.g., habitat restoration).

Equestrian and pedestrian trails within MSP continue to affect a significant portion of the occupied habitat, mostly in the area south of the IF-TD Natural Preserve. Equestrian use of MSP is managed by a concessionaire, currently permitted on a monthly basis. MSP ultimately plans to implement a more comprehensive, permanent plan consistent with the resource opportunities and constraints within the park (R. Pasquinelli, pers. comm. 2006, 2011a). No formal monitoring is currently conducted on the impacts of equestrian use on *C. howellii* (R. Pasquinelli, pers. comm. 2011a). Residential development around the park combined with completion of a pedestrian bridge between Fort Bragg and MSP likely will increase recreational pressure on the park. However, completion of a proposed coastal trail within Fort Bragg may counter some of that potential increase (R. Pasquinelli, pers. comm. 2006, 2011a).

Both equestrian and recreational trails facilitate public access to the dunes, and increase the risk of trampling in the more remote populations of *C. howellii*. Moderate to heavy pedestrian and horse traffic preclude establishment of *C. howellii* within the well-used center of pathways. In addition, the trails facilitate invasion by invasive species, such as iceplant, burclover (*Medicago polymorpha*) and European beachgrass, identified in the recovery plan as primary threats to *C.*

howellii; as well as ripgut brome (*Bromus diandrus*), which often invades following removal of iceplant (R. Pasquinelli pers. comm. 2006). At the same time, anecdotal evidence and preliminary monitoring data (Maslach 2002a) indicate that moderate foot traffic helps maintain and likely creates new *C. howellii* habitat along the edges of the trails. The result, in terms of the overall impact on *C. howellii* distribution and its abundance within MSP, has not been determined. Monitoring aimed at better defining the relationship between pedestrian disturbance and *C. howellii* habitat suitability was initiated in 2002, but has not been evaluated since then. Additional studies that assess the compatibility between various levels of recreational use and *C. howellii*, and enable extrapolation of those results in planning new or expanded recreational activities should be explored.

Destruction or Modification of *C. howellii* Habitat as a Result of Climate Change

A new recognized threat to *C. howellii* is climate change and associated ocean-rise. 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 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 *C. howellii* to changes in environmental factors such as air temperature and soil moisture.

It is predicted that the mean sea level elevation may rise 16 inches along the California coast by 2050, and a 50-inch rise by 2100 (Heberger *et al.* 2009). The precise elevational distribution of *C. howellii* is currently not known. However, the 7.5 minute USGS topographic maps suggest the majority of *C. howellii* within MSP occurs from just below 20 feet to above 40 feet elevation (NGVD29). Predicting the elevations at which dune habitat would be affected by ocean-rise is complex. Taking in to account the predicted 16-inch rise and its direct effect on factors that likely influence the lower limit of *C. howellii* (e.g., seasonal runup patterns and salt spray toxicity), it seems reasonable to expect that occupied habitat below 15 feet elevation may potentially be lost or impacted; however, without site specific elevation information, it is difficult to quantify. *C. howellii* habitat as high as 20 feet elevation may be negatively impacted, while habitat above 20 feet elevation would likely remain largely intact. Ultimately, the majority of the *C. howellii* population is not expected to be directly affected by ocean-rise.

Beyond the direct influence of ocean-rise in potentially inundating the lower range of *C. howellii* 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). There is abundant evidence that storm-generated waves have washed over the haul road in the past, extending in some areas over 600 feet inland (Wollenberg and Maslach 2007). Ocean rise, coupled with the fact that in portions of MSP the waveslope is eroding inland, indicate that overwash occurrences may be more frequent and extend further inland (Wollenberg and Maslach 2004). The result will be increased potential for erosion and blowouts, resulting in loss or degradation of an unknown amount of *C. howellii* habitat. At the same time, the negative impact of increased sand mobility will to some extent be offset by new moderately-disturbed habitat along the margins of the unstable sections, which may support early successional dune colonizers like *C. howellii*.

FACTOR B: Overutilization for Commercial, Recreational, Scientific, or Educational Purposes

Overutilization has not been, and currently is not known to be a threat for *C. howellii*.

FACTOR C: Disease or Predation

We know of no current threats to *C. howellii* from disease or predation.

FACTOR D: Inadequacy of Existing Regulatory Mechanisms

There has been no change in the imminence of this threat factor since the last 5-year review. The California Environmental Quality Act (CEQA) (chapter 2, section 21050 *et seq.* of the California Public Resources Code) and the California Coastal Act are perhaps the two most important laws protecting the species. Many activities on both public and private property, such as building construction, sand mining, or road construction are subject to review under CEQA. In addition, because virtually all of the distribution of *C. howellii* falls within the Coastal Zone, most projects in *C. howellii* habitat are subject to the California Coastal Act, which is administered locally by the Mendocino Local Coastal Program (LCP). Both acts require an assessment of impacts on sensitive resources. While CEQA may allow significant impacts, subject to mitigation, the Coastal Act generally prohibits significant impacts to sensitive resources. However, a number of activities on private property that could affect *C. howellii* are not subject to a permit at the local, state, or federal level, or are difficult to enforce, such as small-scale vegetation removal or creation of trails through sensitive habitat.

C. howellii was listed as Threatened by the State of California in January 1987. As such, it also receives limited protections under the California Native Plant Protection Act and California Endangered Species Act (Service 1992; CDFG 2011b). The primary protections under federal law are afforded by the Endangered Species Act of 1973 (Act), as amended.

Overall, the most significant current threats to *C. howellii* are either unregulated, or of a kind not affected by land use regulations (e.g., invasive species encroachment, pedestrian impacts, climate change). Thus regulatory restrictions, even when applicable, are currently inadequate to conserve this species.

FACTOR E: Other Natural or Manmade Factors Affecting Its Continued Existence

Invasive, Non-native Plants

C. howellii 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 *C. howellii*, 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. Within *C. howellii* habitat, European beachgrass, iceplant, burclover, ripgut brome and other annual grasses are principle threats (R. Pasquinelli, pers. comm. 2006). The majority of these species have not

been, nor are they currently, mapped within MSP on a routine basis, so there is little documentation of encroachment rates; however, evidence suggests these taxa will continue to invade *C. howellii* habitat, necessitating routine and permanent management action. MSP has implemented several projects aimed at controlling European beachgrass and iceplant. Efforts to remove European beachgrass began in 1997 (CDPR 1997), and was supported by private donations, and funding under ESA section 6 grants to the states (CDPR 2002). As of 2011, European beachgrass has been treated on over 150 acres in the north portion of MSP (B. Maslach, pers. comm. 2011a). Once removed, treated habitat requires periodic retreatment to eliminate sprouting and new recruits.

Efforts to control iceplant began with an extensive removal project located near Cleone Lake, in the center of MSP (CDPR 1996). In 2005, another project funded under a Section 6 ESA grant was implemented to determine the historical rate of iceplant encroachment within MSP, and determine the response by *Chorizanthe howellii* to controlled removal of the iceplant under different conditions (Warner 2006). Recent field mapping and inspection of historical aerial photographs indicated that iceplant established a foothold within MSP sometime prior to 1978, and expanded an average of 300 percent between 1986 and 2005 (Warner 2006). Some areas of MSP exhibited as much as a 1,000 percent increase during that period. The preliminary results from iceplant removal suggest that *C. howellii* responds both predictably, and favorably, at least in the short term, to iceplant removal under certain conditions (Warner 2006), but past removal efforts have indicated the positive response may be short-lived (B. Maslach, pers. comm. 2006).

In a small-scale iceplant removal study conducted in 2001, Maslach observed very rapid initial expansion by *C. howellii* when seeded into habitat in which iceplant had been removed. However, within a year or two the abundance of *C. howellii* declined substantially. It is apparent that longer term monitoring data are needed in order to establish meaningful trends in this species. The ultimate objective of the section 6 iceplant removal study initiated in 2006 is to determine whether a sustained program of removal could play an integral role in recovery of *C. howellii* in MSP (CDPR 2004a).

In summary, MSP has made substantial efforts to implement research and management aimed at controlling invasive species and restoring *C. howellii* habitat, and learning more about the ecology and habitat requirements of *C. howellii*. These efforts, particularly the monitoring, should be 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.

Climate Change

Global climate change may constitute a new threat for *C. howellii*. 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-rise, which will almost certainly affect a portion of *C. howellii* habitat (discussed in Factor A).

III. RECOVERY CRITERIA

The recovery plan for *C. howellii* was approved September 29, 1998. Recovery plans provide guidance to the Service, states, and other partners and interested parties on ways to minimize threats to listed species, and on criteria that may be used to determine when recovery goals are achieved. There are many paths to accomplishing the recovery of a species; and recovery may be achieved without fully meeting all recovery plan criteria. For example, one or more criteria may have been exceeded while other criteria may not have been accomplished. In that instance, we may determine that, over all, the threats have been minimized sufficiently, and the species is robust enough, to be downlisted or delisted. In other cases, new recovery approaches and/or opportunities unknown at the time the recovery plan was finalized may be more appropriate ways to achieve recovery. Likewise, new information may change the extent that criteria need to be met for recognizing recovery of the species. Overall, recovery is a dynamic process requiring adaptive management. Assessing a species' degree of recovery is likewise an adaptive process that may, or may not, fully follow the guidance provided in a recovery plan.

We focus our evaluation of species status in this 5-year review on progress that has been made toward recovery since the species was listed by eliminating or reducing the threats discussed in the five-factor analysis. In that context, progress towards fulfilling recovery criteria serves to indicate the extent to which threat factors have been reduced or eliminated.

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.

The long-term protection status of habitat occupied by *C. howellii* has improved since the last 5-year status review, both within or outside MSP. More than 95 percent of the species' distribution remains within MSP (Imper 2005), owned and managed by the CDPR. The General Plan adopted for MSP in 1995 (CDPR 1995) designated roughly the northern 1,285 acres of the park as the IF-TD Natural Preserve. A map of the species distribution developed in 2001 indicated that area contained approximately 40 percent of the habitat occupied by *C. howellii* within MSP (Maslach 2001). An inventory conducted in 2011 recorded a 190 percent increase in occupied habitat within the IF-TD Natural Preserve since 2001, suggesting either the overall distribution within MSP has increased dramatically, or more likely, the proportion of the species occurring within the IF-TD Natural Preserve has increased. Under CDPR policy (CDPR 2004b), management of Natural Preserves emphasizes conservation of sensitive species more than other lands designated as State Park, which applies to the remainder of MSP. The draft Natural Resource Management Plan for the IF-TD Natural Preserve (Warner *et al.* 2007) specifically emphasizes protection and enhancement of *C. howellii* populations, with the ultimate goal being species recovery and delisting.

With respect to habitat outside MSP, a small population of *C. howellii* was relocated in 2009 within the City of Fort Bragg, in conjunction with surveys for a new coastal trail project (California Department of Transportation 2011). The CDPR had acquired the property, known as the Glass Beach Headlands, in 2002. As part of the Fort Bragg Restoration and Coastal Trail Project funded by the California Coastal Conservancy, uncontrolled trail use will be consolidated into a maintained trail network, eroding coastal bluffs will be rehabilitated, and invasive species will be removed from approximately 5 acres of degraded dunes. The restoration will provide an excellent opportunity for expansion of the *C. howellii* population there, estimated in 2009 to be 375 plants.

There has been no change with respect to long-term funding for conservation efforts. Invasive species removal efforts and the monitoring needed to effectively manage *C. howellii* remains subject to future CDPR budget and staffing resources. However, as written, the provision of financial security in perpetuity is not mandated by this criterion. As a result, pending final adoption of the IF-TD Natural Preserve management plan, progress made to date in habitat security and commitment has met the intent of this criterion, for the purpose of downlisting.

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 CDPR has implemented various projects aimed at controlling the highly invasive European beachgrass. The species was first mapped in MSP in 1997, and the map has been updated as removal efforts continue for that species (B. Maslach, pers. comm. 2006). As of 2004, beachgrass had been removed from approximately 16 acres of dune habitat in the north end of MSP (R. Pasquinelli, pers. comm. 2006). Since then, more than 135 acres has been treated using fire, herbicide and manual removal (B. Maslach, pers. comm. 2011c).

The extent of another highly invasive species, iceplant, within MSP was first mapped in 2005 (Warner 2006). Efforts to control this species began with a removal project located near Cleone Lake, in the center of MSP (CDPR 1996). In 2005, another project funded under a section 6 ESA grant was implemented to determine the historical rate of iceplant encroachment within MSP and the response by *C. howellii* to controlled removal of the iceplant under different conditions (Warner 2006). That study has indicated that, at least in the short-term, *C. howellii* responded quite favorably to removal of iceplant. *C. howellii* presence in 25 macro-treatment plots increased 200 percent, and in three of the macro-plots, increased from less than 1 percent to more than 25 percent cover within 18 months following iceplant removal (Warner 2006). The number of *C. howellii* in representative portions of the treated plots went from a total of 54 to 758 in that period, and were too numerous to count in many of the macro-plots.

Various non-native species, such as sheeps sorrel (*Rumex acetosella*), ripgut brome and quaking grass (*Briza* spp.) also responded favorably to the removal. Continued monitoring over a longer period is needed to determine the dynamics of re-occupancy following iceplant removal, whether this type of restoration provides any lasting recovery for *C. howellii*, and whether continued measures to control certain invasive species is warranted. Warner (2006) also recommended expanding the study to investigate the efficacy of other iceplant treatment methods, such as

mechanical and chemical control, due to the high cost for manual labor. Unfortunately, the study plot data have not been collected since June 2006.

Recreational activities that historically impacted *C. howellii* habitat primarily included off-road vehicle, pedestrian, and equestrian uses. No off-road vehicle use is currently allowed in MSP, and we know of no off-road vehicle use on the private parcels supporting this species. At the time the recovery plan was completed, CDPR was proposing to restore the old haul road in the north portion of MSP, which would have directly eliminated some colonies of *C. howellii*, potentially interfered with sand movement, and contributed to accelerated stabilization of habitat landward of the road (CDPR 1998; EDAW 2000). The current proposal involves removing a majority of the haul road within the IF-TD Natural Preserve, and replacing it with a more informal pedestrian trail that generally follows the old route. Preliminary estimates indicate as much as 12 percent of the *C. howellii* within the preserve may be directly impacted by the road removal project (B. Maslach, pers. comm. 2011b). Tentative mitigation efforts will include retention of the underlying base material in key segments that currently appear to benefit *C. howellii*; establishment of new occupied habitat elsewhere in the natural preserve, and restoration of habitat that is declining due to invasive species or stabilization (R. Pasquinelli pers. comm. 2011a). The overall results of the project are expected to be beneficial to the species, both from restoration of natural processes to this portion of the dunes, and implementation of the mitigation measures.

In 1996, MSP implemented a project to redirect recreational use away from *Chorizanthe howellii* habitat in the vicinity of Cleone Lake, combined with extensive removal of invasive plants and reseeded effort with *C. howellii* (CDPR 1996). In 2002, MSP implemented monitoring designed to assess the relative impacts of trails, and varying levels in intensity of use, on the abundance of *C. howellii*. The relationship may differ depending on the particular soils and vegetation in which the species occurs across its distribution within MSP. The information may then be used to design future trails, or modify the existing trail network in order to benefit *C. howellii*. That monitoring has not been conducted since 2002.

Downlisting Criterion 2 has been partially met. Although management actions have been taken to address invasive species removal, further effort is needed to clarify the relationship between pedestrian use and *C. howellii*. Pending the resumption of disturbance monitoring begun in 2002, or implementation of similar research, with the intent to better inform future trail management for the benefit of *C. howellii* within the park, this criterion will be considered to have been 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.

Efforts made to control invasive species, primarily within the IF-TD Natural preserve, were described in Downlisting Criterion 2 above. More than 150 acres infested with European beachgrass have been treated over the last 14 years. Surveys conducted in 2011 indicated habitat occupied by *C. howellii* within the preserve nearly tripled between 2001 and 2011. *C. howellii*

also responded quite favorably to removal of iceplant, described in Criterion 2 (Warner 2006). For the purpose of downlisting, this criterion is considered to have been met.

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.

The commitment by MSP to manage for *C. howellii*, and the progress made in removal of invasive species, followed by documented expansion of *C. howellii*, were described in the downlisting criteria above. However, the monitoring record is relatively short with respect to documentation of sustained benefits to *C. howellii* resulting from the invasive species removal efforts. Therefore, while the intent of this downlisting criterion has generally been met, further evidence is needed to demonstrate “long-term establishment” of the species. Subject to the availability of that evidence by the time of the next 5-year status review, this criterion will be considered to have been 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 secure, with experience to demonstrate that exotic (invasive) plants and other threats (recreational use, off-road vehicles, etc.) are controlled and managers have demonstrated their ability to keep the threats under control. The 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. The determination that delisting is possible must be based on at least 15 years of monitoring, to include wet and drought years. Aspects of demography and population biology must be understood to be assured that populations are likely to persist. The species can be considered for delisting when sites are secure from habitat modification (development), occupied habitat is stable or improving, and free of weed invasion.

Note: the recovery narrative specifically identifies two occurrences on private property (“A” Springer-Sheppard and Ward Avenue) that must be protected.

Progress has been made in securing habitat, removing or minimizing recreational threats (off-road vehicles, equestrian impacts), and restoring *C. howellii* habitat (primarily removal of European beachgrass), as described under the downlisting criteria above. Monitoring has documented expansion of occupied habitat as a result of invasive species removal. However, the history of monitoring is somewhat less than 15 years, and does not yet demonstrate the ability of *C. howellii* to persist in the restored habitat. Most of the restored habitat to date is located within the IF-TD Natural Preserve, covered under a (draft) management plan that emphasizes recovery of *C. howellii* (see Downlisting Criterion 1 above).

Various properties surrounding MSP, including those mentioned specifically in this criterion, either support *C. howellii*, or are important to sustaining the ecological integrity of the dune ecosystem represented within MSP. For example, the 64-acre Hunt property located near the north end of the Ten Mile Dunes, much of which is sand dunes, is currently being added to the park (R. Pasquinelli, pers. comm. 2011b).

No other acquisitions have been completed since the last 5-year status review, including either the “A” Springer-Shepard property, or any of the habitat along Ward Avenue, specifically mentioned as part of this delisting criterion. It is not clear where the Shepard property is located, since it does not show up on current ownership records. The Springer property, located in the Inglenook Creek watershed at the east boundary of the dunes, contains very little dunes habitat. That property does not currently warrant expenditure of resources for the purpose of recovery of *C. howellii*. However, several parcels located along the north side of Ward Avenue continue to warrant protection.

Regulatory protection may help secure habitat for *C. howellii*. For example, development restrictions and mitigation requirements levied by the California Coastal Commission under the Coastal Act will protect a majority, if not all, of the sensitive habitat located on a 12-acre parcel, which supports *C. howellii*, proposed for development (California Coastal Commission 2011).

This criterion has only been partially met. Remaining tasks include expanded, and sustained, control of invasive species; further population monitoring; documentation of the impacts of recreational disturbance on the species; reintroduction efforts; and efforts related to protection of the specifically identified privately-held habitat.

Specific Delisting Criterion (In part, addresses Listing Factors A, D and E)

Restoration of habitat at MacKerricher State Park and the vicinity (Ten Mile Dunes), including eradication of European beachgrass and expansion of populations into restored habitat, has been accomplished. Monitoring and history studies should, by then, demonstrate that the area occupied by the plant is increasing and that populations are not being lost to recreational activity.

Removal of invasive species, including European beachgrass, and restoration of habitat within MSP is ongoing, but complete eradication of beachgrass is an especially ambitious and expensive goal. The extensive restoration efforts and monitoring described in the above criteria represent significant progress in achieving this criterion. This criterion has been partially met.

IV. SYNTHESIS

The limited available data indicate the population of *C. howellii* in 2002 was substantially larger than suggested at the time of listing, by an order of magnitude (Maslach 2001, 2002a). Since the population information available at the time of listing (Service 1992) does not appear to have been based on quantitative data, there is no evidence to indicate the 2002 population estimate was due to an actual expansion of the population, or simply was a more accurate estimation. While the more recent population estimate suggests the taxon is not at as great a risk as

originally thought, other factors indicate the threat remains significant.

As an annual species, *C. howellii* responds almost immediately to changes in its environment. Encroachment by invasive plants into habitat occupied by *C. howellii*, if unchecked, generally eliminates its habitat. At the same time, while recreational use at MSP is in many cases beneficial to *C. howellii*, it also has the potential to severely degrade or eliminate its habitat. Recreational use is expected to increase as the surrounding residential population grows and access to MSP is improved. Considerable efforts have been made to reverse the loss of habitat to invasive species, and progress has been made toward understanding the impacts of recreational use on the species. However, further information is needed to better understand how to accommodate the current and expected increase in recreational use while maintaining a stable population of *C. howellii*, and the most efficient method for restoration of *C. howellii* habitat. In addition, given that the threat from invasive species is likely to remain, future monitoring and responsive management will be necessary to maintain *C. howellii*.

Climate change and associated ocean-rise undoubtedly pose a risk for the species. The degree of change in temperature and moisture regimes, and resulting impacts on *C. howellii* are unknown. At least a portion of the population is vulnerable to destruction from frequent inundation and/or increased erosion resulting from ocean-rise. Accurate elevation data are lacking, but available data suggest that a substantial portion of the population exists at elevations high enough to escape the direct impacts from ocean-rise. Increased frequency and magnitude of storm surges cause lead to dune blowouts and destabilization of its habitat further inland. However, as an early and aggressive colonizer in some situations, the species should be able to exploit a portion of the newly disturbed habitat resulting from the destabilization effects of ocean-rise.

C. howellii continues to be at risk of extinction due to the threat of habitat loss from invasive plants and recreational use. Therefore, we recommend that *C. howellii* remain endangered and no status change is recommended at this time.

V. RESULTS

Recommended Listing Action:

- Downlist to Threatened
- Uplist to Endangered
- Delist (indicate reason for delisting according to 50 CFR 424.11):
 - Extinction*
 - Recovery*
 - Original data for classification in error*
- No Change

New Recovery Priority Number and Brief Rationale: No change.

VI. RECOMMENDATIONS FOR ACTIONS OVER THE NEXT 5 YEARS

The following recommendations are listed in order of their priority, from highest to lowest:

- A. Facilitate Progress toward Downlisting:** The 2007 5-year review identified 4 tasks that, if completed as of the date of this 5-year review, would potentially qualify the species for downlisting. Those tasks and the degree to which they were accomplished are as follows:

***Task 1:** Using GPS, remap the distribution of *C. howellii*-occupied polygons within MSP in 2008, and again in 2012. Using that map, derive a statistically valid estimate of population during both years. In particular, the inventory should emphasize habitat restored over the past decade.*

Task 1 Status: Partially completed.

The distribution *C. howellii* within the IF-TD Natural Preserve, which contained 38 percent of its occupied habitat mapped in 2001, was remapped in 2011. The resulting polygons were then used to develop a statistically valid estimate of the total population in the preserve. The protocol used this year appears suitable for standardized use in the future.

The distribution throughout the park should be repeated at periodic intervals (e.g., 5 years). In order to detect overall changes in the *C. howellii* distribution, and provide feedback on the compatibility of recreational management with maintaining *C. howellii*. Monitoring should emphasize detection of *C. howellii* within habitat in which European beachgrass, iceplant, or other invasive species were removed during the intervening periods.

***Task 2:** Continue the monitoring begun as part of the section 6 iceplant/spineflower study implemented in 2003, to better characterize the relationship between iceplant removal and recolonization by *C. howellii*. Plots should be monitored at no less than two year intervals, beginning spring 2008.*

Task 2 Status: No progress.

Monitoring of plots as part of the ongoing ESA section 6 funded study of iceplant removal should continue past the 3-year completion date for the section 6 project, in order to assess the long-term response of *C. howellii* to iceplant removal. That study should help identify which invasive species (e.g., riggut brome) are most effective at competing with *C. howellii* following iceplant removal efforts, and suggest further research on ways to discourage those species from competing with *C. howellii*. Since the study has indicated that manual removal of iceplant may be cost-prohibitive, further research is also needed on alternative methods, such as herbicides, for its removal.

***Task 3:** Fully implement the disturbance-related *C. howellii* population monitoring initiated in 2003, and monitor those plots at not less than 2 year intervals.*

Task 3 Status: No progress.

Habitat disturbance is known to be a necessary element in the ecology of *C. howellii*; however, too much or too little disturbance is detrimental. Therefore, in order to effectively tailor recreational use to the needs of *C. howellii*, quantitative data are needed linking specific recreational use to response by *C. howellii*. The disturbance monitoring study that began in 2002, was designed to measure the rate of establishment and mortality of *C. howellii* along several pedestrian and equestrian trails. Monitoring should continue, to determine the relationship between *C. howellii* and pedestrian/equestrian use along these trail segments. If possible, the study should be expanded to include quantitative measurement of actual pedestrian/equestrian use, so that the impacts can be correlated directly with the response by *C. howellii*.

Task 4: Incorporate language in the forthcoming management plan developed for the Inglebrook Fen-Ten Mile Dunes Natural Preserve, which specifically commits to future conservation of C. howellii within that area.

Task 4 Status: Completed.

The current draft management plan for the preserve calls for protection and enhancement of *C. howellii* aimed at recovering the species (Warner *et al.* 2007).

Progress on the above tasks has not been adequate to warrant downlisting, as described above in Section III. To facilitate achievement of the downlisting criteria for *C. howellii* during the next 5-year review in 2016, the Service and CDPR should consider the adoption of a memorandum of understanding outlining a schedule for completion of the above tasks.

- B. Partnerships:** Successful partnership with CDPR, the agency that owns the majority of the land where *C. howellii* and its habitat occur, is crucial to successful implementation of the recovery plan and conserving the species. Therefore, continued collaboration between the Service and CDPR is important.
- C. Monitoring Program to Measure the Impacts of Ocean-rise and Targeted Restoration:** The California Shoreline Mapping Project, implemented in 2010, will provide high resolution LIDAR photography enabling development of an accurate digital elevation model (California Ocean Protection Council 2011). Those data should become available in 2012. At that time an analysis of *C. howellii* occupied habitat should be conducted to help evaluate future trends in population and habitat based on habitat elevation. Because *C. howellii* may be vulnerable to significant impacts from ocean-rise, future habitat restoration efforts should begin to focus on areas that are at elevations sufficient to avoid the majority of impacts.
- D. Invasive Species Removal:** Efforts should continue with respect to removal of iceplant and European beachgrass, and exploring ways to implement a permanent invasive species monitoring and response program. Such a program could potentially be included within the Weed Inventory Monitoring System (WIMS) program initiated by CDPR.
- E. Acquisition and/or Protection of Habitat:** The CDPR and the Service should continue

to pursue opportunities for acquisition or protection of important habitat adjacent to the park, which either supports *C. howellii*, or contributes to the integrity of the Ten Mile Dunes ecosystem. In decreasing order of priority, these important lands include:

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

F. Permanent Funding: The CDPR and/or the Service should determine the amount of needed funds, and then pursue opportunities to secure permanent funding in the form of an endowment or trust fund, which ensures that periodic monitoring and habitat restoration are conducted in perpetuity. Such funding would not then be subject to future CDPR staffing and budgetary limitations.

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

Chorizanthe howellii (Howell's spineflower)

Current Classification: Endangered

Recommendation Resulting from the 5-Year Review:

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

Review Conducted By: David Imper, Ecologist

FIELD OFFICE APPROVAL:

Lead Field Supervisor, U.S. Fish and Wildlife Service

Approve  Date 12-6-11