

# Recovery Plan for the Golden Paintbrush (*Castilleja levisecta*)

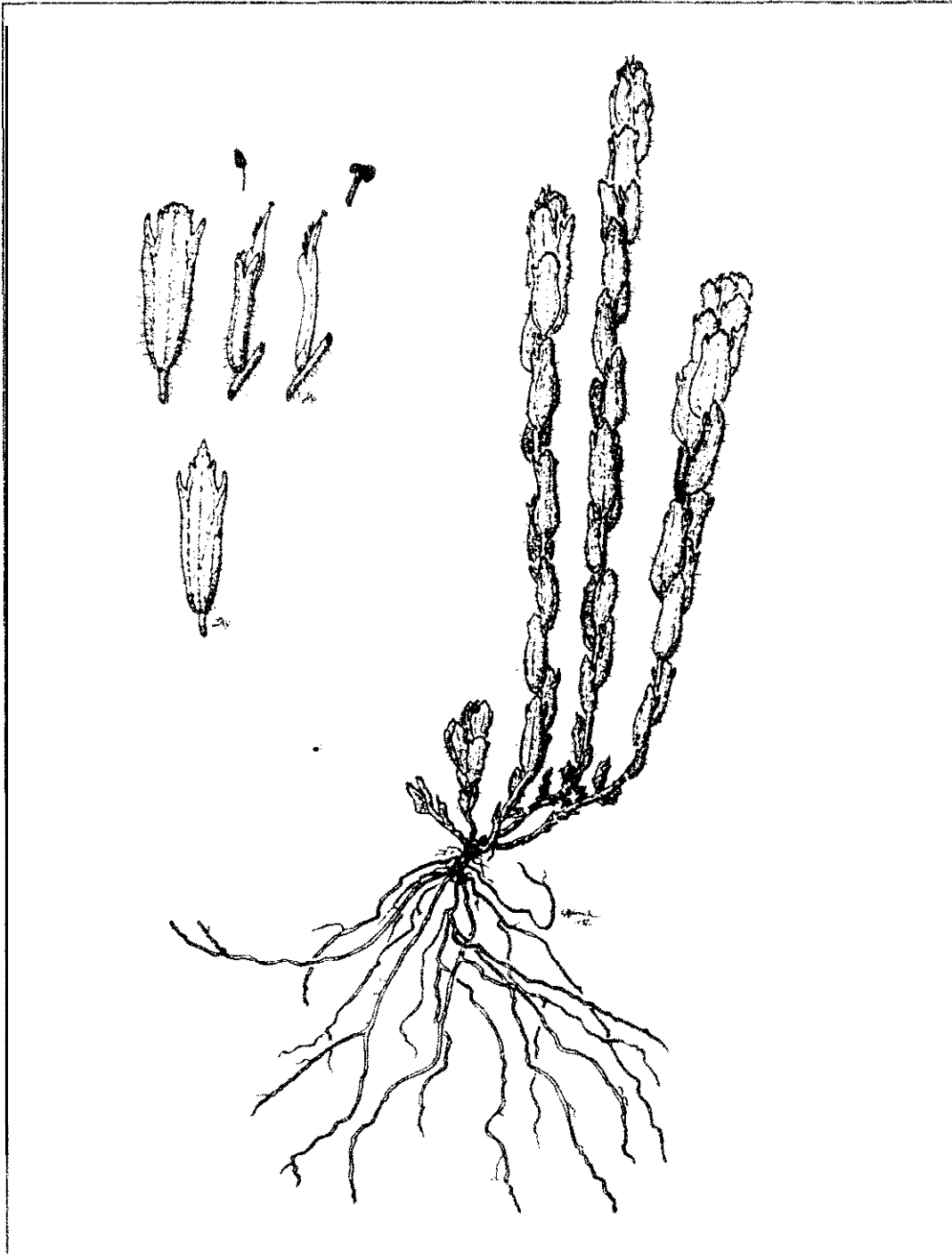



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**RECOVERY PLAN**  
for the  
**Golden Paintbrush**  
(*Castilleja levisecta*)

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

Approved:   
**ACTING** Regional Director, Region 1, U.S. Fish and Wildlife Service

Date: AUG 23 2000

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## EXECUTIVE SUMMARY

**Current Status:** Golden paintbrush (*Castilleja levisecta*), listed as threatened (62 FR 31740), is extant in Washington and British Columbia and was historically known from Oregon. There are 11 known populations, 9 in Washington and 2 in British Columbia. A majority of the populations are small both in terms of number of individuals and in total area occupied. Of the 11 populations, 5 are located on public lands (Federal and State owned) and 6 are on private property.

**Habitat Requirements and Limiting Factors:** *Castilleja levisecta* inhabits generally flat grasslands within the Puget Sound Lowlands (including the southern tip of Vancouver Island, British Columbia). Some sites have mounded topography, and others are on steep, grassy coastal bluffs. The coastal bluffs have a west or southwest aspect. Small to large thickets of low deciduous shrubs are commonly present.

Much of the historically suitable habitat for *Castilleja levisecta* was converted and/or developed for commercial, residential, and agricultural use. Remaining habitat is being degraded by encroaching native and non-native species that compete with *Castilleja levisecta* and create shade, which this species does not tolerate. Fire suppression over the last century has enabled Douglas-fir (*Pseudotsuga menziesii*) and non-native woody shrubs to colonize the grasslands, producing an environment unsuitable for the species' viability.

Because *Castilleja levisecta* has become restricted to a small number of existing sites, which are small in terms of number of individuals as well as total area occupied, it has become vulnerable to random events, whether due to humans or the environment.

**Recovery Priority:** This plant's recovery priority is 2 on a scale of 1 to 18, reflecting a high degree of threat, a high potential for recovery, and that this plant's taxonomic rank is a full species, which has a higher priority than a subspecies.

**Recovery Objective:** This recovery plan's overall objective is to recover *Castilleja levisecta* to the point where delisting is warranted. The recovery plan's

conservation measures for *Castilleja levisecta* and its habitat are designed to ensure that at least 20 self-sustaining populations will exist, distributed throughout its extant and historic range.

**Recovery Criteria:**

Delisting will be considered when the following conditions have been met:

1. There are at least 20 stable populations distributed throughout the historic range of the species. To be deemed stable, a population must maintain a 5-year running average population size of at least 1,000 individuals.
2. At least 15 of these populations are located on protected sites. In order for a site to be deemed protected, it must be either owned and/or managed by a government agency or private conservation organization that identifies maintenance of the species as the primary management objective for the site, or the site must be protected by a permanent conservation easement or covenant that commits present and future landowners to the conservation of the species.
3. Genetic material, in the form of seeds adequately representing the geographic distribution or genetic diversity within the species, is stored in a facility approved by the Center for Plant Conservation.
4. Post-delisting monitoring of the condition of the species and the status of all individual populations is ready to begin.
5. Post-delisting procedures for the ecological management of habitats for all populations have been initiated.

**Actions Needed:**

1. Develop and implement management plans for Federal and State managed sites harboring *Castilleja levisecta*.
2. Attain formal protection for as many private sites as possible.



3. Conduct the research that is necessary to successfully (1) manage existing populations and (2) establish new populations. Critical aspects of the biology of *Castilleja levisecta* need to be defined, including an evaluation of the genetic diversity within the species, testing of seed viability, and identification of propagation methods.
4. Develop and implement monitoring protocols for all populations to assess trends.
5. Identify and search potential habitat for *Castilleja levisecta* using standardized rare plant search methods developed by the Fish and Wildlife Service or other resource agencies.
6. Develop and implement a reintroduction plan.
7. Disseminate information about the species to appropriate audiences, including landowners.
8. Periodically review the status of the species and assess the effectiveness of the management plans and other recovery tasks. A technical working group should be established to carry out the reviews.
9. Collect seed adequately representing the genetic diversity within the species or its geographic range, and store it in a facility approved by the Center for Plant Conservation.

**Estimated Costs for Recovery:** We anticipate that it may cost approximately \$825,000 to recover this species.

**Estimated Date of Recovery:** Delisting may be considered by 2018 if all the recovery criteria have been met.

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## I. INTRODUCTION

### A. Listing History

We, the U.S. Fish and Wildlife Service, began work on listing the golden paintbrush (*Castilleja levisecta*) as an endangered or threatened species in 1990 when we announced that sufficient information was available to proceed with listing this plant in a *Federal Register* notice of review published February 21, 1990 (55 FR 6184). This announcement was based on new data collected by the Washington Natural Heritage Program. After this announcement, we published a proposal to list *Castilleja levisecta* as a threatened species on May 10, 1994 (59 FR 24106), and a final rule listing it as threatened on June 11, 1997 (62 FR 31740).

### B. Description

*Castilleja levisecta* is a perennial herb in the figwort or snapdragon family (Scrophulariaceae). An illustration is provided in Figure 1. *Castilleja levisecta* often has from 5 to 15 unbranched stems. The stems may be erect or spreading, in the latter case giving the appearance of being several plants, especially when in tall grass. Plants are up to 30 centimeters (12 inches) tall and are covered with soft, somewhat sticky hairs. The lower leaves are broader, with one to three pairs of short lateral lobes near the terminal third. The showy bracts are about the same width as the upper leaves, softly hairy and sticky, and are golden yellow. The bracts effectively hide the flowers.

### C. Distribution and Collection History

*Castilleja levisecta* was first collected by Macoun in 1875, in Victoria, British Columbia. The specimen was labeled *C. parviflora*, but later annotated by Greenman (1898), who published a description of *C. levisecta* in that year. Piper (1906) designated a collection by Howell in 1880 from Mill Plain (Clark County, Washington) as the type specimen (the specimen upon which the scientific name is based) (K. Chambers, pers. comm., cited in Sheehan and Sprague 1984). A

Figure 1: Illustration of *Castilleja levisecta* Greenman.

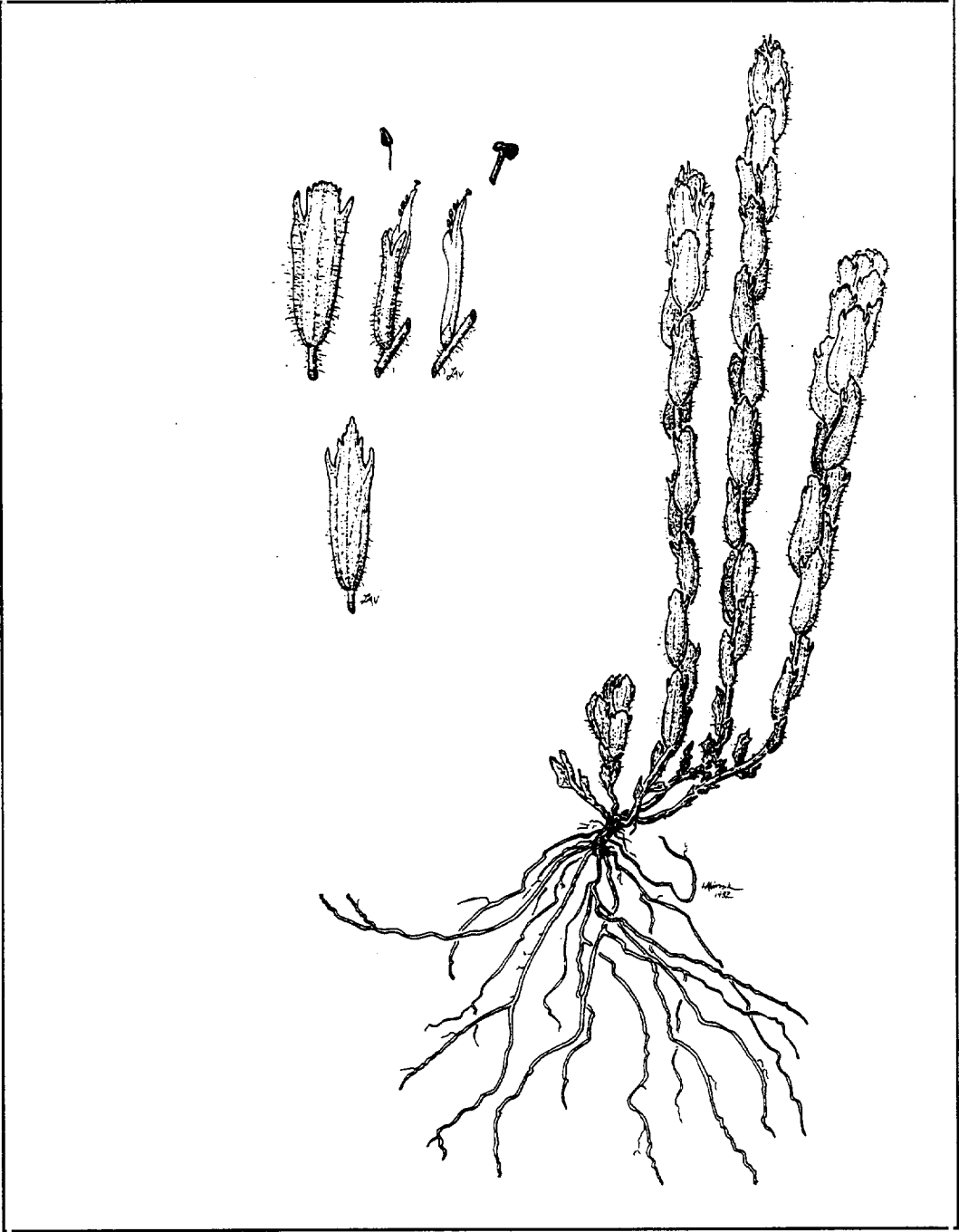


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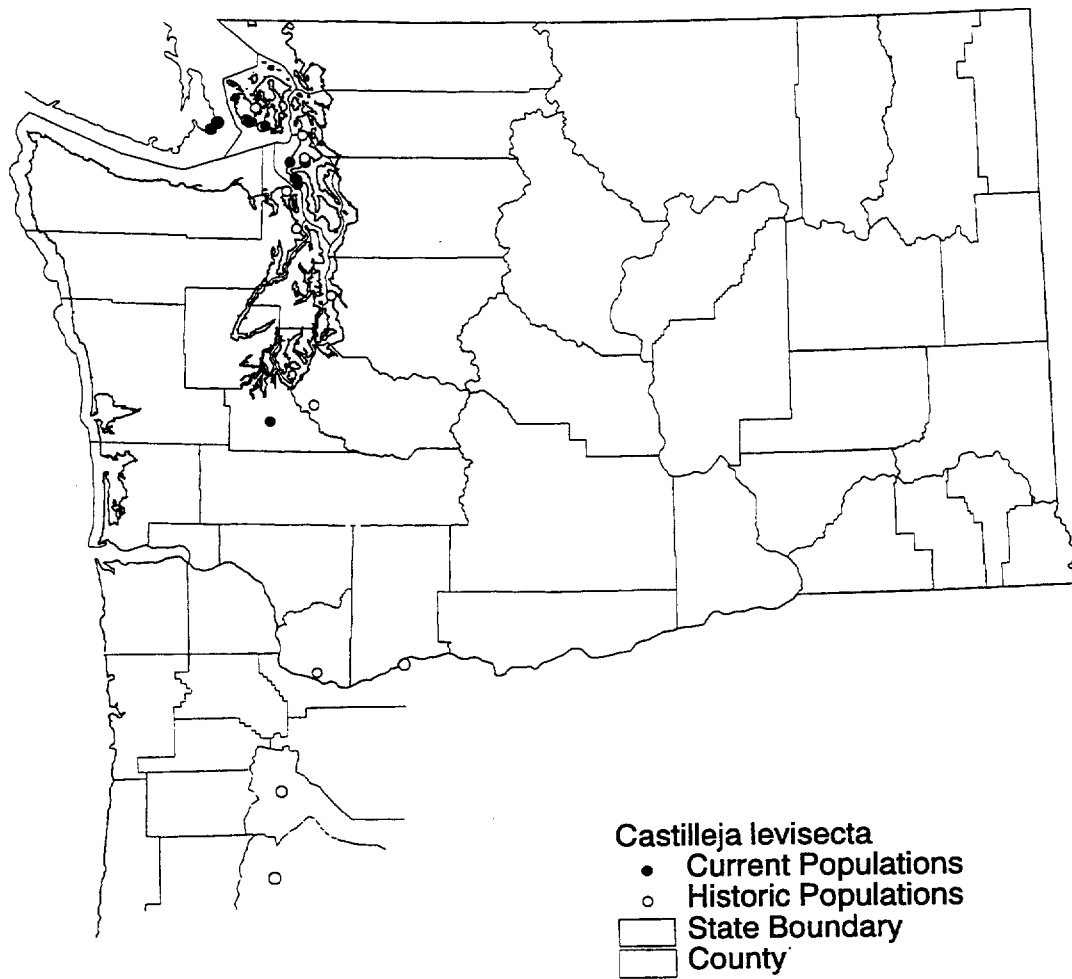
specimen at Harvard is cited as the type specimen in the Harvard type specimen database (ID number 56156, Checked November 19, 1998).

Historically, *Castilleja levisecta* has been reported from more than 30 sites in the Puget Trough of Washington and British Columbia, and as far south as the Willamette Valley of Oregon (Hitchcock *et al.*, 1959, Sheehan and Sprague 1984, Gamon 1995). In 1984, we funded the Washington Natural Heritage Program (Washington Department of Natural Resources) to assess the species' status throughout its range. The assessment found that the plant had been extirpated from more than 20 historic sites (Sheehan and Sprague 1984, Gamon 1995) (this information was previously presented in the final rule [62 FR 31740]). Many populations were extirpated because their habitats were converted for agricultural, residential, and commercial development. For example, the area around the type locality at Mill Plain, Clark County, Washington, was converted to pasture and orchards sometime after the plant was first collected in 1880. Housing developments currently occupy the site (Sheehan and Sprague 1984, Gamon 1995). In Oregon, *Castilleja levisecta* historically occurred in the grasslands and prairies of the Willamette Valley; the species has been extirpated from all of these sites as the habitat has disappeared.

*Castilleja levisecta* is now known from 11 extant populations (see Figure 2 and Table 1), of which 9 are in Washington: 1 south of Olympia in Thurston County, 5 on Whidbey Island in Island County, and 1 each on San Juan Island, Long Island, and Lopez Island in San Juan County.

Two extant populations of *Castilleja levisecta* occur in British Columbia, Canada, on small islands near Victoria. Historically, *C. levisecta* was documented from nine sites on southeastern Vancouver Island, and on two adjacent islands. All but the two populations found on islands are extirpated or are of unknown status, but likely have been extirpated (British Columbia Conservation Data Center 1993, Ryan and Douglas 1994).

**Figure 2: Rangewide distribution of *Castilleja levisecta*.**



**Table 1. Summary of Extant Sites for *Castilleja levisecta*.**

Site Name	County (if in Wash.) / B.C.	Size of Population (year)	Area*	10-Year Trend
Rocky Prairie Natural Area Preserve	Thurston	2,942 (1996)	ca. 30 acres	stable
Bocker Environ. Reserve	Island	367 (1998)	ca. 1 acre	declining
Fort Casey State Park	Island	179 (1998)	< 1 acre	declining
West Beach	Island	479 (1998)	< 1 acre	stable
Forbes Point	Island		< 1 acre	declining
Ebey's Landing	Island	4000+ (1993) (estimated)	ca. 1 acre	stable
False Bay	San Juan		< 1 acre	portions declining
Davis Point	San Juan	0 (1998) 4 (1996)	< 1 acre	declining; maybe extirpated
Long Island	San Juan	22 (1998)	< 1 acre	unknown
Trial Island	Brit. Columbia	2,560 (1994)	ca. 1 acre	stable
Alpha Islet	Brit. Columbia	ca 1,000 (1994)	< 1 acre	unknown

\* One acre is equal to 0.40 hectare

#### **D. Habitat**

*Castilleja levisecta* occurs in the Puget Trough Physiographic Province of Washington (as mapped by Franklin and Dyrness 1973) and lower Vancouver Island at elevations from sea level to about 100 meters (330 feet) above sea level. It also historically occurred in the Willamette Valley Physiographic Province of Oregon, but has not been observed in Oregon for more than 50 years.

*Castilleja levisecta* occurs on generally flat grasslands, including some that are characterized by mounded topography, and on steep coastal bluffs that are grass-dominated. The coastal bluffs have a west or southwest aspect. Low deciduous shrubs are commonly present as small to large thickets. In the absence of fire,

some of the sites have been colonized by trees, primarily Douglas-fir (*Pseudotsuga menziesii*), and shrubs including wild rose (*Rosa nutkana*), and, more commonly, Scots broom (*Cytisus scoparius*), an aggressive non-native shrub.

The mainland population in Washington occurs in a gravelly, glacial outwash prairie. Other populations occur on clayey soils derived from either glacial drift or glacio-lacustrine sediments (in the northern end of the species' historic range). All of the extant populations are on soils derived from glacial origins. Historic populations also occurred on near-bedrock soils (Lighthouse Point), as well as clayey alluvial soils (in the southern end of its historic range).

A vegetation map by Küchler (1966) shows the range of *Castilleja levisecta* associated with western red cedar – western hemlock – Douglas-fir forest in the northern part of its range and as a mosaic of the above type and Oregon oakwoods in the southern part of its range. A map by Bailey (1976) shows the range as Type 2410 Willamette – Puget Forest Province. Franklin and Dyrness (1973) map the range as the Puget Sound area of the Western Hemlock (*Tsuga heterophylla*) Zone and Interior Valleys of Western Oregon – Willamette Valley. The Puget Sound area of the Western Hemlock Zone differs from the rest of the Western Hemlock Zone by a number of features, among them the presence of prairies. Grasslands once covered much of the Willamette Valley, where forest communities were dominated by Douglas-fir (*Pseudotsuga menziesii*) or Oregon white oak (*Quercus garryana*). Grasslands have also declined in the Puget Trough, where currently there are less than 10 percent of the original grassland communities remaining (Crawford and Hall 1997).

#### **E. Life History/Ecology**

*Castilleja levisecta* is a short-lived perennial herb. Individual plants generally do not survive longer than 5 to 6 years. Observations of individual tagged plants that were followed over time show that up to 20 percent of the plants in 1 population were lost to mortality on an annual basis (Peter Dunwiddie, pers comm. 1999). Biologists think this species reproduces exclusively by seed; vegetative spread has never been observed or reported. Evans *et al.* (1984) reported the following phenological information for the species from Rocky Prairie Natural Area



Preserve (NAP). Plants emerge in early March. By mid-April, the plant is in bud, flowering generally begins the last week in April and continues until early June. Fruits mature from June to mid-July, by mid-July, the plants are in senescence. Capsules persist on the plants well into August. Based on historical collections and observations by the authors, flowering seems to occur about the same time throughout the species' range.

The genus *Castilleja*, like many others in the figwort family, is parasitic. Roots of paintbrushes are capable of forming parasitic connections to roots of other plants. These specialized connections are called haustoria. Heckard (1962) showed that although *Castilleja* plants could be grown in the greenhouse without host plants, they thrived better with hosts. *Castilleja levisecta* has also been shown to have the ability to germinate and develop in a greenhouse setting with and without a host plant (Wentworth 1994). Wentworth (1994) observed haustorial connections with the roots of a variety of host plants, although she also observed that *C. levisecta* will develop haustoria on its own roots when grown without a host. Paintbrush plants are probably not host-specific (Mills and Kummerow 1988). It has been clearly shown that *C. levisecta* grows well independently of a host plant and that they do not necessarily require a host to survive. This evidence leads the authors to consider this species of *Castilleja* as a facultative root parasite.

The breeding system of *Castilleja levisecta* has not been thoroughly documented. Evans *et al.* (1984) reported that a species of bumblebee, *Bombus californicus*, was observed visiting *C. levisecta*. Pollen could be observed on the bee's head as it exited the inflorescence. Jane Wentworth (pers. comm. 1995) also observed that *Bombus* sp. were the most frequent visitors to *C. levisecta* inflorescences. In a pollinator exclusion experiment, Wentworth (1994) found that fruits can be produced in the absence of pollinator visitation, but fruit set was almost five times greater in unbagged inflorescences compared to inflorescences bagged to prevent visitation to the flowers by pollinators.

Evans *et al.* (1984) raised the possibility that the Rocky Prairie site may have too few bumblebees to pollinate the entire population. The bumblebee population

could have declined as a result of successional<sup>1</sup> changes, disturbances to the bumblebees' habitat, or factors other than habitat changes, such as pesticide application or drift.

Evans *et al.* (1984) reported 75 percent seed set for all inflorescences. The percentage was calculated for each inflorescence as the ratio of flowers with seed capsules to the total number of flowers. Wentworth (pers. comm. 1995) calculated the mean number of seeds per capsule to be 165.

Germination studies on seeds collected from Rocky Prairie in Thurston County, Washington, were conducted at the Berry Botanic Garden in Portland, Oregon. After 6 weeks of chilling, 80 percent of the seeds germinated. Under laboratory conditions, Wentworth (1994) achieved 47 percent germination of first-year seeds and 13 percent for second-year seeds, but germination appears to be much less under natural conditions. Wentworth found that under natural conditions, first year germination of seeds (from the seed bank for 2 different years) was 8 percent and 12 percent. Second year germination was only 2 percent. Three year old seeds did not germinate (Wentworth 1994).

Although seed dispersal has not been directly observed, the seeds are probably shaken from the seed capsules and fall a short distance from the parent plant. The seeds are light and could possibly be dispersed short distances by the wind.

Seedlings are inconspicuous in the field. Most individuals familiar with the species suspect that seedling establishment is inhibited by an increase in grass and forb cover. Rhizomatous grasses may be a serious threat to seedlings. Under ideal conditions (*i.e.*, in pots in a greenhouse), seedlings can mature and flower in a single growing season (Wentworth 1994).

Wentworth's (1994) population characteristics study of *Castilleja levisecta* found that the smallest plants had the greatest mortality, exceeding 50 percent in one plot. Individual plants sometimes regressed from a larger size class to a smaller one. Large reproductive plants were the most likely to regress in size. By

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1

Ecological succession is change in vegetation that occurs in the absence of disturbance, such as encroachment of trees and shrubs into grassland.

regressing from reproductive size to a size too small for reproduction, individuals may be able to survive in years in which resources are limited. Regressing carries a certain risk, however, since small individuals suffer the greatest mortality. A study of the effects of experimental fire regimes on American chaffseed (*Schwalbea americana*), a parasitic member of the figwort family from grassy vegetation of the southeastern United States, may be relevant to understanding *Castilleja*. The study demonstrated fire-induced flowering in *Schwalbea*. Burning, regardless of season, resulted in increased population density and expansion in areal extent. The timing of prescribed fire altered the timing of flowering (Kirkman *et al.* 1998). However, the study was conducted in longleaf pine (*Pinus palustris*) – grass vegetation with frequent dormant season fires, at 1 to 3 year return intervals. Fires would presumably have been much less frequent in Puget Sound prairies, so *Castilleja levisecta* may not necessarily respond to fire like *Schwalbea americana*.

#### **F. Reasons for Listing: Summary of Factors Affecting the Species**

Threats to *Castilleja levisecta* include habitat modification as succession causes prairies and grasslands to become shrub and forest lands; development of property for commercial, residential, and agricultural use; low potential for expansion of *C. levisecta* populations and their refugia because existing habitat is constricted; and recreational picking and herbivory. The following information is adapted from the final rule (62 FR 31740).

We believe the species is not currently in danger of extinction because several of the sites are designated as preserves or protected against certain threats through current management efforts. Three of the populations contain 1,000 or more individuals. But in the absence of a recovery program, *Castilleja levisecta* is likely to become endangered within the foreseeable future throughout all or a significant portion of its range because the remaining populations face the chronic threats described above. The species, therefore, fits the Endangered Species Act's definition of threatened. The threats were specified in the final rule as follows:

## **1. The present or threatened destruction, modification, or curtailment of its habitat or range**

Historic loss of prairie and grassland habitat in the Puget Trough reduced the range of *Castilleja levisecta*, and habitat loss continues to be the primary threat to remaining populations. Currently, the primary cause of habitat modification is encroachment by native and non-native woody species, as discussed below (see “Other natural or manmade factors . . .,” starting on page 16).

Development for residential or commercial use is a potential threat at five of the privately owned sites: False Bay, Davis Point, Bocker Environmental Reserve, Ebey’s Landing, and West Beach. The three privately owned sites on Whidbey Island (Bocker Environmental Reserve, Ebey’s Landing, and West Beach) are zoned for residential development (County Planning, Island County, pers. comm. 1996). The site on San Juan Island (False Bay) is designated as rural (Planning Department, San Juan Island County, pers. comm. 1996), indicating that the area is dominated by agricultural, forestry, and recreational uses and can be used for the extraction of sand, gravel, and mineral deposits. This designation also allows residential development. The Davis Point population on Lopez Island is a “designated conservancy” (Planning Department, San Juan Island County, pers. comm., 1996), which allows the construction of homes and the management of resources on a sustained-yield basis. Although no plans for development have been initiated at these sites, the habitat for these populations remains vulnerable to threats from adjacent areas that receive high human use (see “Other natural or manmade factors . . .,” below), and to the potential for development on these privately owned sites.

In recent history (since 1850), fire suppression has played a critical role in reducing the extent of grassland habitat in the Puget Trough (Kruckeberg 1991) and, therefore, in reducing the numbers and size of *Castilleja levisecta* populations. While a large, high intensity fire at any of the remaining sites where *C. levisecta* occurs might temporarily reduce or eliminate populations, we are unaware of permanent extirpations of any populations of this species due to fire.

Loss of suitable habitat, whether from encroachment of woody species or from development in the areas surrounding the disjunct populations, prevents expansion of the species, and eliminates potential refugia for the species if catastrophic events affect existing populations. Because the grassland habitat in the areas surrounding the existing populations has been lost, it is doubtful that the populations could expand naturally. Thus, the continued existence of *Castilleja levisecta* is threatened by the absence of available habitat for recruitment and colonization.

## **2. Overutilization for commercial, recreational, scientific, or educational purposes**

*Castilleja levisecta* has no known commercial use. Because of its showy golden-yellow bracts, *C. levisecta* is vulnerable to trampling, picking, and collection at public sites including Fort Casey State Park, the Bocker site, and Forbes Point, which have high levels of public use (see “Other natural or manmade factors . . .,” starting on page 16). At Fort Casey State Park, the potential for overcollection is considered a genuine threat because visitor use has increased within the last decade, and park users have been observed picking the flowering plant (K. Hageman, pers. comm. 1994). Once numbering more than 500 plants (Hageman, pers. comm. 1994; Fayette F. Krause, The Nature Conservancy of Washington *in litt.* 1994), by 1995 the Fort Casey State Park population had declined to approximately 230 individuals (Gamon 1995; Krause, *in litt.* 1994) and to 179 individuals in 1998 (Washington Natural Heritage Program files). *C. levisecta* may become vulnerable to collection as a result of increased publicity resulting from publication of the final rule.

## **3. Disease or predation**

Disease is not known to threaten *Castilleja levisecta*. Predation in the form of livestock and rabbit grazing may have reduced populations from historical levels (Sheehan and Sprague 1984, Gamon 1995, J. Wentworth, pers. comm. 1996). Grazing of the flowering stems of *C. levisecta*, probably by rabbits and/or deer, has been observed at the Bocker property. Though the effects of grazing are not known, grazing presumably affects seed number and

reproductive viability (K. Ludemann, pers. comm. 1991; J. Wentworth, pers. comm. 1996). Livestock and non-native wild rabbits graze the False Bay population (Sheehan and Sprague 1984). At the Forbes Point site, Klope (pers. comm. 1996) observed heavy rodent predation on herbaceous material and seeds in 1990 and 1991. Grazing had previously been noted at Forbes Point in 1984 and 1985 (Clampitt 1985), so grazing may be reducing the reproductive potential at that site. Significant grazing by rabbits was observed at the Forbes Point population during 1995 (J. Wentworth, pers. comm. 1996). At Fort Casey State Park, rabbits ate all of the flowering stems of a small colony of *C. levisecta* during the spring of 1996, eliminating seed set and reproduction for that year (J. Wentworth, pers. comm. 1996). Small mammals extensively browsed flowering stems (greater than 60 percent) at Rocky Prairie in 1998 (P. Dunwiddie, pers. obs. 1998).

Insect larvae have been observed feeding on inflorescences (flowering parts) of *Castilleja levisecta* (Gamon 1995). Caterpillars of several species of butterfly or moths are known to feed on *C. levisecta* (Sheehan and Sprague 1984, Evans *et al.* 1984), and have caused considerable damage at several sites (P. Dunwiddie, pers. obs. 1998).

The Rocky Prairie Natural Area Preserve population of *Castilleja levisecta* has historically harbored a population of the Whulge checkerspot butterfly (*Euphydryas editha taylori*), a State sensitive species that is a potential seed predator. Because *C. levisecta* is not a specific host and no individual butterflies were observed at the site in 1991, the threat from this species of butterfly is likely low (M. Sheehan, pers. comm. 1991; F. Krause, The Nature Conservancy, pers. comm. 1996).

Predation (grazing and seed predation) by native herbivores is one of the natural pressures historically faced by *Castilleja levisecta*, but plant populations that have been reduced or stressed due to other factors are more vulnerable to decline and are less able to rebound after periods of heavy predation. In some cases, human activities may have caused herbivore populations to be artificially large, causing unnaturally excessive grazing pressure on *C. levisecta* plants.

#### 4. The inadequacy of existing regulatory mechanisms

At the time of listing, no regulatory protection for *Castilleja levisecta* or its habitat existed. Although *C. levisecta* is designated as endangered by the Washington Natural Heritage Program (Washington Natural Heritage Program 1997), no legal protection is provided by the Natural Heritage Program's classification, nor does the State of Washington have an endangered species statute that covers plants. Island, San Juan, and Thurston Counties in Washington have ordinances (not mentioned in the final rule) that provide opportunities to protect *Castilleja levisecta* and/or its habitat. These ordinances provide mechanisms for reviewing development proposals and they can trigger requirements to prepare habitat management plans.

Although *Castilleja levisecta* is listed as endangered under the State Endangered Species Act of Oregon (Oregon Natural Heritage Program 1995), the species has not been observed in the State of Oregon (Meinke 1982) for more than 50 years.

Three sites are included in the State of Washington's Registry of Natural Areas (Laura Smith, Associate Director, The Nature Conservancy, Washington State Office, pers. comm. 1996). These designations are important because they recognize the sensitive status of the species and encourage private landowners and land management agencies to consider the species in management plans; however, they provide no legal protection. Therefore, changing land management priorities or inadequate funding for protection could leave the species vulnerable at several of the sites.

Two populations occur on State-managed lands and benefit from agency policies. Rocky Prairie Natural Area Preserve, managed by the Washington State Department of Natural Resources, is part of a statewide system of natural areas. The natural areas are managed to maintain the significant natural features present. *Castilleja levisecta* is the primary feature for which this site was identified, acquired, and designated as a Natural Area Preserve. This site has been actively managed, including the use of prescribed burning and hand removal of invasive plants to eliminate non-native and invasive species. Approximately 3 hectares (7 acres) of encroaching Douglas-fir (*Pseudotsuga*

*menziesii*) were directionally felled and removed from Rocky Prairie during the winter of 1996. This effort was accomplished through a cooperative agreement between the Service's Washington State Ecosystems Conservation Program and the Washington Department of Natural Resource's Natural Heritage Program. Despite the initial success of these efforts, continued funding of restoration cannot be assured. Additionally, efforts by the Washington Department of Natural Resources to eliminate the invasive Scots broom (*Cytisus scoparius*) and mouse-ear hawkweed (*Hieracium pilosella*) at this site are voluntary on the agency's part and not mandated by statute. This population continues to face threats from invading woody species as well as weedy herbs and grasses.

Another publicly-owned population is in Fort Casey State Park. Park managers are managing the vegetation by mowing, clipping, and removing vegetation to improve the conditions of the grassland habitat, and they are employing protective measures (fencing) to reduce trampling of the *Castilleja levisecta* plants. However, the plant continues to be vulnerable to encroaching vegetation, picking, trampling, herbivory, and seed predation.

The Forbes Point population is on Federal land at Naval Air Station Whidbey Island. The Department of Defense participates in the Washington Registry of Natural Areas Program. A Navy staff biologist is evaluating the status of the population. Efforts have been made to eradicate some invasive non-native species. A 0.5-hectare (1.2-acre) area with the densest concentration of plants has been fenced to restrict people from trampling or picking the plants and to keep rabbits from browsing *Castilleja levisecta*; however, rodents still enter the fenced area and consume seed (M. Klope, pers. comm. 1996). Signs have been erected designating the site as a research area, but the Navy does not prohibit public use of this site, which receives occasional foot traffic associated with a popular nearby beach (M. Klope, pers. comm. 1996).

Populations of the species at Ebey's Landing, Bocker Environmental Reserve, West Beach, Davis Point, False Bay, and Long Island are on private property and receive no legal protection. Ebey's Landing and Bocker Environmental Reserve, in addition to Fort Casey State Park, are located within the designated boundary of Ebey's Landing National Historic Reserve, which was established



by the combined efforts of the local landowners, the National Park Service, and the U.S. Congress in 1978 as a unit of the National Park Service. The National Historic Reserve designation gives recognition to the local landowners for maintaining their dwellings and landscapes in a specific historic fashion. The designation encourages covenants that restrict the type of landscaping and architectural design used for the maintenance or remodeling of any existing structures or the construction of new structures within Ebey's Landing National Historic Reserve. The designation does not prohibit development or extraction of natural resources and provides no protection for biological resources, although the Historic Reserve's enabling legislation does mandate that the comprehensive plan for the reserve identify areas or zones within the reserve that would most appropriately be devoted to natural preservation, and authorizes Federal acquisition of lands or interests when necessary to accomplish this purpose (National Parks and Recreation Act, 1978, P.L. 95-250). The National Park Service's jurisdiction over Ebey's Landing National Historic Reserve is advisory in nature and is limited to providing technical assistance to State and local governments and local landowners in the management, protection, and interpretation of the Historic Reserve (Gretchen Luxenberg, National Park Service, pers. comm. 1997; Curt Soper, Director of Agency Relations, The Nature Conservancy, pers. comm. 1997; Stacey Tucker, Island County Planning and Community Development Department, pers. comm. 1997). Although *Castilleja levisecta* is considered in the current management of the Historic Reserve, management is not specifically directed toward its long-term conservation. No sites where *C. levisecta* is found, within the Historical Reserve, are currently protected by scenic easements or fee ownership held by the National Park Service.

The Bocker Environmental Reserve, owned by Seattle Pacific University, is managed as a natural area and is used for educational purposes. It is included in the Washington Registry of Natural Areas. At the time of listing, there was no explicit goal for management to retain grassland habitat. However, in 1997/1998 the Fish and Wildlife Service, The Nature Conservancy, and the Washington Department of Natural Resources undertook tree and shrub removal at this site.

The Province of British Columbia uses The Nature Conservancy's rating system and has designated *Castilleja levisecta* as a category G1S1 species (critically imperilled due to extreme rarity or because of vulnerability to extinction, and with typically fewer than five occurrences<sup>2</sup>) (G. Douglas, pers. comm. 1996). However, the *Castilleja levisecta* populations in Canada receive no regulatory protection. Currently no Federal or Provincial law protects sensitive plant species, although legislation to protect endangered species has been proposed to the government of British Columbia. The British Columbia Ministry of Parks has designated two *Castilleja levisecta* sites as Ecological Reserves: Trial Island, offshore from the city of Victoria, and a small population at Alpha Islet. Ecological Reserves are protected areas that generally require permits for entry and do not allow consumptive activities, like plant collection or other activities destructive to resources (L. Ramsey, Conservation Data Center, Ministry of Environment, Lands and Parks, British Columbia, pers. comm. 1997). However, the Ecological Reserve designation does not require specific management recommendations for the plant. Because this designation is an administrative one, it could potentially be reversed by administrative decision, and the site could be used for other purposes (G. Douglas, pers. comm. 1996). Neither population is being monitored and no ecological management is being implemented.

In summary, 5 of the 11 known populations occur in areas that have at least some land management protection at the policy level. Three of these sites are being actively managed to benefit *Castilleja levisecta*, as are two additional sites on private land. However, habitat management for *C. levisecta* is not assured.

## **5. Other natural or manmade factors affecting its continued existence**

Grassland habitat was historically maintained by periodic fires that prevented encroachment by woody plants (Sheehan and Sprague 1984; J. Agee, pers. comm. 1996). Since the mid-nineteenth century, when European settlement

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"Occurrence" is a technical term used in data management systems designed by The Nature Conservancy, including State Heritage programs. In this recovery plan, an occurrence is equivalent to a site or a population.

began, fire has been suppressed and the cover of several native species has increased. They include Douglas-fir (*Pseudotsuga menziesii*), wild rose (*Rosa* sp.), snowberry (*Symphoricarpos albus*), bracken fern (*Pteridium aquilinum*), Pacific blackberry (*Rubus ursinus*), and tall Oregon grape (*Berberis aquifolium*). As a result, competition from these species seriously threatens *Castilleja levisecta*. Increasing cover of some or all of these species threatens populations of *C. levisecta* at the Rocky Prairie Natural Area Preserve, Bocker Environmental Reserve, West Beach, Fort Casey State Park, Forbes Point, portions of False Bay, and Davis Point.

Grasslands have also been colonized by non-native species such as Scots broom (*Cytisus scoparius*), sweet vernal grass (*Anthoxanthum odoratum*), common vetch (*Vicia sativa*), clovers (*Trifolium* spp.), and mouse-ear hawkweed (*Hieracium pilosella*). These species are invasive and can dominate and successfully compete with *Castilleja levisecta* for space, light, and nutrients.

Both native and non-native species threaten *Castilleja levisecta* at many of the sites. At Davis Point, for example, *C. levisecta* inhabits a small patch in a 12-hectare (30-acre) overgrown lot, where non-native pasture grasses and native wild rose are abundant and threaten to overtake it. This site has not been managed and the *C. levisecta* population has declined from about 100 plants prior to 1994, to 4 plants in 1996 (Wentworth 1996). No plants were located on a field visit to this site in 1998.

Impacts associated with fire management may be a threat. Fire suppression activities associated with wildfires may damage plants and habitats (James Agee, pers. comm. 1996). For example, on August 9 through 11, 1996, a fire ignited from the spark of a train that runs adjacent to Rocky Prairie in Thurston County, Washington, and burned grasses and shrubs along more than 16 kilometers (10 miles) of the railroad right-of-way. Emergency vehicles were activated to suppress the fire. To allow access to the fire adjacent to Rocky Prairie, the fence surrounding Rocky Prairie Natural Area Preserve was cut at two locations. The vehicles ran directly over a portion of the *Castilleja levisecta* population, breaking and compacting individual plants.

Trampling as a result of monitoring activities is of concern, particularly at the Rocky Prairie Natural Area Preserve site, where pathways around plots are evident. Trampling by recreationists may threaten the plant at Fort Casey State Park on Whidbey Island where paths have been worn into the soil and pass directly through a *Castilleja levisecta* population. A decorative fence erected in 1995 partially restricts foot traffic through the *C. levisecta* population, so trampling by the public at this site has been reduced (J. Gamon, pers. comm. 1996), although invasion by wild rose remains a threat. The few plants that formerly occurred in Beacon Hill Municipal Park in Victoria were located in a heavily used area of the park. Trampling by the public may have contributed to the extirpation of the population at Beacon Hill (G. Douglas, pers. comm. 1996).

None of the privately owned sites have been fenced, or are otherwise protected. The West Beach occurrence of *Castilleja levisecta* is adjacent to a maintained yard; mowing and other lawn maintenance activities may threaten a portion of this population. The Bocker Environmental Reserve population, across Fort Casey Road from several new homes, is threatened by foot traffic. At False Bay, several foot paths have been established through the population and individual plants have been trampled. The only access to the beach from the resort at False Bay is through the population.

The Ebey's Landing occurrence is adjacent to a road on a steep slope overlooking the ocean. Erosion and slumping have occurred on the slope and potentially threaten the species at this location. The Ebey's Landing site is used by some people as a scenic overlook. Some damage to the plants near the upper edge of this slope (*i.e.*, the area closest to the road) may be occurring.

The small sizes of many of the populations and the small area they occupy make *Castilleja levisecta* vulnerable to demographic and random environmental events. Most of the populations occupy less than 0.4 hectare (1 acre) of habitat. The Ebey's Landing population is precariously situated on a steep slope above the Straits of Juan de Fuca, so the entire site could be lost as a result of a winter storm or seismic activity.

## G. Conservation Measures

### Federal Endangered Species Act

On May 10, 1994, we published in the *Federal Register* (59 FR 24106) a proposal to list *Castilleja levisecta* as threatened. That proposal was based primarily on information contained in status reports prepared by the Washington Natural Heritage Program and on personal communications with knowledgeable resource scientists and site managers. A final rule listing *C. levisecta* as threatened was published on June 11, 1997 (U.S. Fish and Wildlife Service 1997). As stated in the final rule, conservation measures provided under the Endangered Species Act include recognition, recovery actions, requirements for Federal protection, and prohibitions against certain activities.

Section 7(a) of the Endangered Species Act requires Federal agencies to evaluate their actions with respect to any species that is proposed or listed as endangered or threatened, and with respect to its critical habitat, if designated. Section 7(a)(2) requires Federal agencies to ensure that activities they authorize, fund, or carry out are not likely to jeopardize the continued existence of a listed species or to destroy or adversely modify its critical habitat. If a Federal action may affect a listed species or its critical habitat, the responsible Federal agency must enter into formal consultation with the Fish and Wildlife Service.

The Forbes Point population of *Castilleja levisecta* is on Federal land at Naval Air Station Whidbey Island. Federal actions there are subject to section 7 requirements. The National Park Service administers Ebey's Landing National Historic Reserve, where three populations of *C. levisecta* are located on private lands. The National Park Service's jurisdiction over the Reserve is advisory in nature. However, in the event the National Park Service funded or carried out any activities that may affect the species, it would be required to consult with the Fish and Wildlife Service. In addition, sections 2(c)(1) and 7(a)(1) of the Endangered Species Act require Federal agencies to utilize their authorities to carry out conservation programs for endangered and threatened species.

All other extant sites in the United States are owned by the State of Washington or by private landowners. However, projects authorized or funded by various

Federal agencies, or requiring Federal permits, could affect the species. Such federally-funded projects, including road construction or maintenance, and habitat enhancement projects for *Castilleja levisecta* and other rare species, would be subject to section 7 review.

### **Federal Agency Protections**

A majority of the *Castilleja levisecta* population at the U.S. Navy-managed Forbes Point is inside a fenced enclosure that was built to protect it. The Navy has also undertaken several management actions to protect the population, with the assistance of the Fish and Wildlife Service, the Washington State Department of Natural Resources, The Nature Conservancy, and the U.S. Department of Agriculture, Animal Plant Health Inspection Service (APHIS) Wildlife Services. These management actions have included weed control, mowing, prescribed fire, and rodent control.

### **Protections Provided by the State of Washington**

As stated on page 13, the State of Washington does not have an endangered species law that includes provisions for plant species. However, *Castilleja levisecta* does benefit from various State agency policies and land management designations. Rocky Prairie Natural Area Preserve is managed by the Washington State Department of Natural Resources. It is managed as part of a statewide system of natural areas. The natural areas are managed to maintain their significant natural features. *Castilleja levisecta* is the primary natural feature for which this site was identified, acquired, and designated as a Natural Area Preserve. It should be emphasized, however, that despite designation as a Natural Area Preserve, the site faces significant, ongoing threats.

The population in Fort Casey State Park receives policy-level protection. Although the Park has undertaken some management actions to benefit the species, the overall management of the area for recreational pursuits creates the potential for conflict.

## **Voluntary Protection — The Washington Registry of Natural Areas**

Three sites are included in Washington’s Registry of Natural Areas: Bocker Environmental Reserve, Forbes Point, and a portion of False Bay. The Bocker property, owned by Seattle Pacific University, is a natural area used for education purposes. Recent management actions have been aimed at retaining and enhancing grassland habitat. The Bocker property is also located within the designated boundary of Ebey’s Landing National Historic Reserve. Although *Castilleja levisecta* is considered in the current management of the Historic Reserve, management is not specifically directed toward the long-term conservation of the plant. The Forbes Point population is on land managed by the U.S. Navy (Naval Air Station Whidbey Island). As noted on page 20, a majority of this population is within a fenced enclosure designated for conservation and research purposes. The registered portion of the False Bay population is within a developed resort area. No specific conservation measures are currently being undertaken at this site.

### **County-level protections**

Island, San Juan, and Thurston Counties have ordinances that provide differing levels of protection to *Castilleja levisecta* and/or its habitat. These ordinances provide mechanisms for review of development proposals, which can trigger requirements for the preparation of habitat management plans. Island County has a list of “protected species” which includes *Castilleja levisecta*. San Juan County has provisions relating to “environmentally sensitive areas” to protect species tracked by the Natural Heritage Program. Thurston County does not list any plant species, but the County’s critical areas ordinance includes the “native outwash prairies” to which *C. levisecta* is restricted in Thurston County.

The State of Washington’s “Open Space Tax Act” has also been used by Thurston County as an incentive to landowners. Parcels with an “important habitat or species” qualify for this program.

## **Protection in British Columbia**

Although *Castilleja levisecta* in Canada receives no regulatory protection (page 16), the Trial Islands, offshore from the city of Victoria, are designated as an Ecological Reserve by the British Columbia Ministry of Parks. The small population at Alpha Islet also is located within a designated Ecological Reserve. Ecological Reserves are protected areas that generally require permits for entry and do not allow consumptive activities, like plant collection or other activities destructive to resources (L. Ramsey, Conservation Data Center, Ministry of Environment, Lands and Parks, British Columbia, pers. comm. 1997).

### **H. Strategy of Recovery**

The first step toward recovery of *Castilleja levisecta* is to protect and manage the known populations. On public lands, we will work with the Washington State Department of Natural Resources' Natural Areas Program, Fort Casey State Park, and the U.S. Navy. The populations on privately owned lands will need protection through a combination of mechanisms including acquisition, conservation easement, management agreements, voluntary protection, or other approaches.

Maintaining extant populations depends on developing successful partnerships with public land managers and private landowners. It will also require gaining knowledge about how the ecosystems in which *Castilleja levisecta* is found function. Most sites have significant disturbances and/or threats and will require active management.

Recovery also requires establishing new populations and, where space and habitat allow, increasing the area occupied by existing populations. The first step in that process is to investigate the feasibility and appropriateness of establishing populations in the vicinity of historically known sites and expanding existing populations. At present, the number of extant populations is extremely small. Furthermore, many of the populations occupy small areas and have a small number of individuals present. These factors may make the species particularly vulnerable to random environmental events.



Another aspect of recovery is continued inventory effort. Small, isolated populations of *Castilleja levisecta* have been discovered in recent years. It is possible that additional populations are present on privately owned land that has not been surveyed and which is not visible from any points of public access. One strategy to increase the effectiveness of continued inventory is to prepare and make available educational materials that will enable the public to recognize the species and to appreciate its significance.

Research and monitoring are also key elements of the recovery strategy. Research needs to focus on 1) maintaining and enhancing populations at existing sites and 2) establishing and maintaining new, viable populations at appropriate sites. Most past studies have concentrated primarily on monitoring the status and trends of existing populations. These efforts need to be continued. Experimental research on the biology and ecology of *Castilleja levisecta* is limited (Evans *et al.* 1984, Wentworth 1994, Dunwiddie 1998), and has emphasized maintaining and enhancing existing populations. Research and relevant information on the establishment of new populations is almost entirely lacking. For recovery efforts to be successful, research should be designed to provide additional information in both areas.

## II. RECOVERY

### A. Recovery Plan Objective

The objective of this recovery plan is to recover *Castilleja levisecta* to the point where delisting is warranted. In order to delist, the recovery plan identifies ways to protect *C. levisecta* and enhance its habitat so that there will be at least 20 self-sustaining populations distributed throughout its extant and historic range. If this is achieved, there will no longer be a need for the protection provided to *C. levisecta* under the Endangered Species Act.

### B. Recovery Criteria

Delisting will be considered when all of the following conditions have been met:

1. There are at least 20 stable populations distributed throughout the historic range of the species. To be deemed stable, a population must maintain a 5-year running average population size of at least 1,000 individuals.
2. At least 15 of these populations are located on protected sites. In order for a site to be deemed protected, it must be either owned and/or managed by a government agency or private conservation organization that identifies maintenance of the species as the primary management objective for the site, or the site must be protected by a permanent conservation easement or covenant that commits present and future landowners to the conservation of the species.
3. Genetic material, in the form of seeds adequately representing the geographic distribution or genetic diversity within the species, is stored in a facility approved by the Center for Plant Conservation.
4. Post-delisting monitoring of the condition of the species and the status of all individual populations is ready to begin.
5. Post-delisting procedures for the ecological management of habitats for all populations have been initiated.

## **C. Narrative Outline of Recovery Actions**

### **1 Maintain the current geographic distribution of the species through maintaining habitat integrity.**

Only 11 *Castilleja levisecta* populations are known to exist. A majority of these populations occur on small isolated fragments of remaining habitat and consist of relatively few individuals. Each of the 11 populations is subject to a number of current and potential threats, all of which compromise the integrity of the habitat. Since *C. levisecta* is adapted to specific habitat conditions, maintaining or restoring the integrity of the habitat is essential.

Maintaining the current range of *Castilleja levisecta* (along with establishing new populations within its historic range) will provide the best protection against environmental and human-related random events that might otherwise cause its extinction.

#### **1.1 Develop and implement habitat management plans for *Castilleja levisecta* occurrences on Federal and State-managed lands.**

Successful management on these lands will be critical to the success of recovery efforts. Current management activities, as well as threats, vary from site to site, necessitating management plans tailored to the individual areas and agencies. These plans should include provisions for the protection of the sites with the best potential for providing long-term stable habitat, and maintenance of unoccupied, potential habitat in suitable condition, since such areas represent sites for potential future colonization.

##### **1.1.1 Periodically review Rocky Prairie management plan (Priority 1).**

##### **1.1.2 Develop management plan for Forbes Point population (Priority 1).**

##### **1.1.3 Develop management plan for population at Fort Casey State Park (Priority 1).**

**1.2 Promote protection of key occurrences on private lands through (1) development of site-specific management recommendations to landowners and (2) pursuing the highest level of protection agreeable to the individual landowners (Priority 1).**

All private landowners should be contacted regarding the presence of the species on their lands and the significance of their lands to the conservation of the species. Various protection options should be pursued, including registry, conservation easements, fee acquisition, and binding management agreements.

**1.3 Conduct research that will guide successful management of known existing populations and make possible the establishment and maintenance of new populations.**

Successful management of this species and its habitat will depend upon gathering additional information about its habitat requirements and biology, as well as effectively monitoring populations and their response to management activities.

**1.3.1 Clarify the mechanisms by which fire affects *Castilleja levisecta* populations (Priority 2).**

Fire played an historical role in the maintenance of the habitat for this species, at least within a portion of its range. However, fire suppression over the last century has resulted in significant changes to habitats, especially their species composition. Evidence from experimental prescribed fires suggests that fire can be used to enhance populations. However, the optimal time of year, severity, and return interval (frequency) are all critical components of any fire management plan. Additional information is needed on each of these components.

**1.3.2 Quantify and characterize the threat posed by encroachment into the species' habitat by Douglas-fir, snowberry, bracken fern, roses, blackberries, and other native species (Priority 2).**

Several of the sites that harbor *Castilleja levisecta* have changed significantly in terms of plant species composition and structure over the last several decades. Some sites changed dramatically in less than a decade. Generally, bracken fern, snowberry and/or blackberry, and Douglas-fir encroach into open areas dominated by grasses and forbs. Available data suggest that *C. levisecta* declines as the percent cover of these encroaching species increases. The rates at which the individual species are encroaching and the degree to which each species influences the presence (and/or vigor) of *C. levisecta* need to be determined in order to develop successful management strategies.

### **1.3.3 Conduct studies to identify effective means (in addition to prescribed fire) of controlling competing vegetation (Priority 2).**

The combination of fire suppression and various disturbances to the habitat of *Castilleja levisecta* has resulted in significant competition with other plant species. Wentworth (1994) suggested that this competition may limit the establishment of new seedlings. Both native and non-native species may be out-competing *C. levisecta*. Mowing, raking, breaking up thatch build-up, and herbicide applications have been discussed as possible methods. Each of these methods, and perhaps others, need to be investigated for its effectiveness in controlling competing vegetation while not negatively affecting *C. levisecta*.

### **1.3.4 Monitor the presence and trends of weedy species. Research methods of weed control and identify the most appropriate techniques for each species at each site (Priority 2).**

Weedy species directly threaten *Castilleja levisecta* at two sites, and similar threats are likely at other sites. While Pacific blackberry (*Rubus ursinus*) is an encroaching native plant and Canada thistle (*Cirsium arvense*) is a long-recognized noxious weed, mouse-ear hawkweed (*Hieracium pilosella*) and Scot's broom (*Cytisus scoparius*) are of particular concern. These two species are listed as

Washington State Noxious Weeds (RCW 17.10). Each has colonized Rocky Prairie Natural Area Preserve, which is the largest extant population of *C. levisecta* and possibly the population with the highest quality habitat. Scot's broom has been removed at Rocky Prairie during annual weed pulls organized by The Nature Conservancy of Washington since 1984. Control of this species has been accomplished through constant vigilance by volunteers, and this activity must continue to keep Scot's broom from reinvading the site. Mouse-ear hawkweed spreads rapidly and can develop a fairly dense ground cover, precluding successful occupation by other species. Control of this noxious weed may also be problematic, since weed control methods potentially have negative impacts. It will be important to identify the most effective methods of weed control that have the least negative impact on *C. levisecta*.

**1.3.5 Quantify and characterize the nature of the threat posed by herbivory by deer, rabbits, etc. (Priority 2).**

A number of occurrences have been affected by herbivory in the past. Potential threats associated with herbivory include direct removal of live material, including reducing the number of viable seeds produced in a given year.

**1.4 Determine critical aspects of the species' biology.**

A thorough understanding of the biology of *Castilleja levisecta* should improve the chances for its successful management. Several critical aspects of the biology of *C. levisecta* are unknown.

**1.4.1 Determine and characterize the genetic variation within and between known occurrences of the species (Priority 2).**

Prior to any reintroductions or population augmentations, the nature and distribution of genetic variation within the species should be characterized and understood.

**1.4.2 Investigate longevity of seed viability and the most effective method for the propagation of seed (Priority 2).**

Persistence of populations of this short-lived perennial species is likely to depend on maintenance of a large, viable seedbank. Determining how long seeds remain viable in the soil is necessary for a good understanding of population dynamics and trends. It is also a key piece of information for a successful program of seed storage. Learning how to efficiently and effectively propagate seed will be critical to efforts to establish new populations.

**1.4.3 Study the population dynamics of *Castilleja levisecta* (Priority 2).**

Populations naturally fluctuate due to numerous environmental and intrinsic factors. A better understanding of the magnitude, duration, and causes of these fluctuations is necessary to ensure the long-term maintenance of viable populations. It will allow for a better interpretation of the species' response to management activities.

**1.4.4 Study the pollination biology of *Castilleja levisecta*, including the necessity of cross-fertilization, and the identification and status of pollinators (Priority 2).**

*Castilleja levisecta* currently occupies small, isolated fragments of remnant habitat. A better understanding of the pollination biology of the species and the habitat requirements of pollinators is needed to ensure that management activities are compatible with meeting the pollination requirements of the species.

**1.5 Develop and implement monitoring plans for all known sites to assess trends (Priority 1).**

Successful management of individual occurrences will depend on the ability to detect long-term changes in the population or changes in the habitat and subsequently making specific management decisions based upon those changes.

**2 Identify and search potential habitat using standardized rare plant search methods developed by the U.S. Fish and Wildlife Service or other resource agencies.**

Although considerable inventory work has been undertaken for this species, the discovery in the last few years of previously unknown sites (two new occurrences and two new colonies within a previously known occurrence) suggests that other populations or colonies may yet be discovered. Comprehensive inventory is complicated because so much of the range of the species is privately owned, and because small remnant patches of habitat can be hidden from view from any point of public access. Although as yet undiscovered populations or colonies are likely to be small, they collectively have the potential to contribute substantially to the recovery effort.

**2.1 Continue efforts to relocate historically known occurrences (Priority 3).**

Significant effort has been taken in the past to search for the historic locations of *Castilleja levisecta*. However, given the potential significance of these sites, efforts should continue. Searches should be done systematically, starting with the identification of all potential sources of relevant information (*e.g.*, herbaria records, original survey notes, historic and current aerial photography, etc.).

**2.2 Conduct inventories in suitable habitats throughout the historic and extant range (Priority 3).**

As noted above, small, isolated populations or colonies of *Castilleja levisecta* may still exist that are undocumented. A new systematic inventory should be designed and implemented.

**2.3 Create a spatial database for inventory efforts, including negative searches (Priority 3).**

As mentioned above, a significant amount of inventory work has been undertaken for *Castilleja levisecta*. Unfortunately, there is little



documentation of areas that were searched without finding the species. Negative search results need to be documented to increase efficiency and to be able to complete the inventory efforts for the species. A systematic approach and a protocol for managing the information should be developed.

### **3 Establish new populations of *Castilleja levisecta* within the historic range of the species.**

As noted above, the long term survival of *Castilleja levisecta* is likely to depend on the establishment of new populations. In order to accomplish this, a carefully prepared reintroduction plan is needed, along with research into the technical aspects of successfully growing the species.

#### **3.1 Conduct research to obtain the necessary baseline information for the successful establishment of new populations.**

Because the number of known extant populations is extremely low, the size of several populations is low, and there are significant threats present for most of the populations, long-term maintenance of *Castilleja levisecta* in the wild is likely to depend on establishing new populations. For establishment efforts to succeed, a considerable amount of research must be undertaken.

##### **3.1.1 Identify and clarify site characteristics that are essential to sustain *Castilleja levisecta* (Priority 1).**

The currently known extant sites are quite variable in terms of physical characteristics and environmental processes. In order to maximize the probability of long-term success for managing existing sites and for establishing new populations, these characteristics need to be better defined.

##### **3.1.2 Determine how to quickly establish viable populations (Priority 2).**

Experiments are necessary to develop efficient, effective techniques for establishing *Castilleja levisecta* in the field. Methods for preparing sites, preparing and sowing seed, and growing and setting out plants need to be considered and tested.

**3.1.3 Determine whether, or under what circumstances, *Castilleja levisecta* requires a host plant to survive and/or reproduce (Priority 2).**

Heckard (1962) documented the tendency for members of the genus *Castilleja* to engage in root parasitism. The degree to which *C. levisecta* requires and/or derives benefit from parasitism needs to be investigated. Understanding the plant's parasitic behavior may play an important role in developing appropriate technology for managing and/or enhancing existing populations and/or in establishing new populations. Although Wentworth (1994) successfully grew individuals from seed to maturity in a sterile medium, individuals in the wild may behave differently.

**3.2 Develop a plan for reintroducing *Castilleja levisecta* into unoccupied areas of its former range, in consultation with all appropriate parties, after intensive surveys have confirmed extirpation (Priority 1).**

As noted in Falk and Olwell (1992), many factors need to be evaluated before reintroduction is undertaken. These factors include (1) the consequences of a reintroduction effort, (2) where will it take place, (3) who will maintain and manage the population, (4) how, from a biological perspective, the effort should be conceived and carried out, and (5) whether reintroduction is technically feasible.

**3.3 Implement the reintroduction plan (Priority 1).**

To achieve the recovery of this species, it is highly likely that establishing new populations will be required (recovery could be achieved without establishing new populations only if the number of extant naturally occurring populations increased from the current 11 to 20).

**4 Disseminate information about the species to appropriate audiences and landowners.**

**4.1 Develop and conduct training programs to be provided to concerned agency personnel, as well as private landowners (Priority 3).**

Many small, isolated fragments of habitat that may support *Castilleja levisecta* undoubtedly exist. A more comprehensive inventory can be accomplished by providing training to a variety of people, including County weed personnel, County extension service personnel, staff of the Natural Resources Conservation Service, County road maintenance crews, State Parks staff, and consultants. Training should include how to identify the species, basics of habitat management, and how to document and report information about sites.

**4.2 Develop a brochure or fact sheet for public dissemination, and provide presentations as appropriate (Priority 3).**

The training identified above can presumably reach a majority of the individuals most likely to encounter *Castilleja levisecta* in some work-related capacity. However, many more people could be reached by developing a brochure and/or fact sheet on the species. Such brochures/fact sheets could be distributed through a variety of outlets, including electronically via the Internet.

**4.3 Develop and disseminate species information to private landowners (Priority 3).**

Six of the 11 known extant sites are owned and managed by private individuals. These individuals should be kept informed of habitat requirements of *Castilleja levisecta*, and how it responds to various land management activities. Information may be provided to the public, as requested, through the State Natural Heritage programs and other appropriate agencies.

**5 Promote State and county level legal protection for occurrences on non-Federal lands.**

Due to the limited number of known areas that harbor this species, and the limited number of known occurrences within those areas, it is important to secure the maximum legal protection available to all occurrences.

**5.1 Promote development and implementation of new laws and ordinances for the protection of *Castilleja levisecta* (Priority 3).**

The individual States (Washington and Oregon) should be encouraged to pursue State-level avenues for protection on non-Federal lands that would complement the Endangered Species Act's protection on Federal lands.

**5.2 Promote compliance with all State laws and county ordinances and regulations protecting *Castilleja levisecta* (Priority 3).**

Although there are no known extant occurrences in Oregon, the State does have an endangered species law providing protection for listed plant species. If the species is rediscovered in Oregon, the State endangered species law could and should be used to provide maximum protection.

**6 Establish a technical working group to periodically review the status of the species and assess the effectiveness of the management plans and other recovery tasks (Priority 3).**

Through periodic review, improvements to the overall recovery effort can be made, thereby accelerating recovery.

**7 Collect seed adequately representing the genetic diversity within the species and store in a Center for Plant Conservation approved facility (Priority 3).**

The small number of known populations, area occupied, and the fact that many populations are few in number of individuals, make the species more vulnerable to random environmental and human-caused events. As a hedge

against the loss of significant genetic material, seed representing the diversity within the species should be collected and stored in a Center for Plant Conservation approved facility. The stored seed could also be used in efforts to establish new populations.

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### III. IMPLEMENTATION SCHEDULE

The Implementation Schedule that follows outlines actions and estimated costs for the recovery program. It is a guide for meeting the objectives discussed in Part II of this recovery plan. This schedule indicates task priorities, task numbers, task descriptions, duration of tasks, the responsible agencies, and lastly, estimated costs. These actions, when accomplished, should protect the species habitat and bring about the recovery of the species. It should be noted that the estimated monetary needs for all parties involved in recovery are identified and, therefore, Part III reflects the total estimated financial requirements for the recovery of this species.

Priorities in the first column of the implementation schedule are assigned as follows:

1. **Priority 1** - An action that *must* be taken to prevent extinction or to prevent the species from declining irreversibly in the *foreseeable* future.
2. **Priority 2** - An action that must be taken to prevent a significant decline in species population/habitat quality, or some other significant negative impact short of extinction.
3. **Priority 3** - All other actions necessary to meet the recovery objectives.

Acronyms used in the implementation schedule:

WA DNR	Washington State Department of Natural Resources
USFWS	U.S. Fish and Wildlife Service
TNC	The Nature Conservancy
NHPs	Natural Heritage Programs (in Washington and Oregon)
BC CDC	British Columbia Conservation Data Centre

Implementation schedule for the <i>Castilleja levisecta</i> recovery plan										
Task Priority	Task Number	Task Description	Task Duration (years)	Responsible Parties	Cost Estimate (in \$1,000 units)					Comments
					Total Costs	FY 2001	FY 2002	FY 2003	FY 2004	
1	1.1.1	Management plan, Rocky Prairie NAP	Ongoing	WA DNR	34	3	3	3	2	Interim management plan completed; periodic review and revision will be necessary.
1	1.1.2	Management plan, Forbes Point, Whidbey Island Naval Air Station	Ongoing	US Navy	20	2	2	2	1	Interim management plan completed; section 7 consultations between Navy and USFWS completed.
1	1.1.3	Management plan, Fort Casey State Park	Ongoing	WA State Parks	20	2	2	2	1	Park will undergo overall planning process in the future.
1	1.2	Promote protection of occurrences on private lands by pursuing the highest level of protection agreeable to the individual landowners.	Ongoing	USFWS, WA DNR	49	5	5	5	3	Options to be considered should include acquisition by a public agency or conservation organization, conservation easement, management agreement, and registry.
1	1.5	Develop and implement monitoring plans for all known sites.	Ongoing	USFWS, WA DNR, US Navy, State Parks, TNC	142	6	8	5	5	The individual land-managing agency should have the responsibility for monitoring. A plan is needed to ensure monitoring on private lands.

**Implementation schedule for the *Castilleja levisecta* recovery plan**

Task Priority	Task Number	Task Description	Task Duration (years)	Responsible Parties	Cost Estimate (in \$1,000 units)					Comments
					Total Costs	FY 2001	FY 2002	FY 2003	FY 2004	
1	3.1.1	Identify and clarify site characteristics that are essential to sustain <i>C. levisecta</i> .	5 years	USFWS, WA DNR, US Navy, State Parks, TNC, research institutions	10	2	2	2	2	This task is partially addressed by task 1.4.3.
1	3.2	Develop a plan for reintroducing <i>C. levisecta</i> into unoccupied areas of its historic and extant range.	4 years	USFWS, WA and OR NHPs, BC CDC	26	8	8	5	5	Recovery depends on successful reintroduction.
1	3.3	Implement reintroduction plan.	10 years	USFWS, WA DNR, US Navy, State Parks, TNC, research institutions	60	6	6	6	6	Recovery depends on success of this task.

Implementation schedule for the <i>Castilleja levisecta</i> recovery plan										
Task Priority	Task Number	Task Description	Task Duration (years)	Responsible Parties	Cost Estimate (in \$1,000 units)					Comments
					Total Costs	FY 2001	FY 2002	FY 2003	FY 2004	
2	1.3.1	Conduct studies to clarify the mechanisms by which fire affects <i>Castilleja levisecta</i> .	8 years	USFWS, WA DNR, US Navy, State Parks, TNC, research institutions	64	8	8	8	8	Evidence suggests that prescribed fire can be used to enhance populations. However, additional information is needed on the optimal time of year, severity, and return interval. Costs for this task are mostly in design and implementation of the treatments.
2	1.3.2	Conduct study to quantify and characterize encroachment by Douglas-fir, snowberry, Scots broom, bracken fern, roses, and blackberries.	Ongoing	USFWS, WA DNR, US Navy, State Parks, TNC, research institutions	25	0	5	5	5	Some sites have undergone dramatic change in species composition in the last 10–15 years. The effects of this change on <i>C. levisecta</i> need to be better understood.
2	1.3.3	Conduct studies to identify effective means (in addition to prescribed fire) of controlling competing vegetation.	10 years	USFWS, WA DNR, US Navy, State Parks, TNC, research institutions	30	4	4	4	4	To successfully manage the habitat, efficient and effective methods to control competing vegetation without negatively affecting <i>C. levisecta</i> will need to be identified.

**Implementation schedule for the *Castilleja levisecta* recovery plan**

Task Priority	Task Number	Task Description	Task Duration (years)	Responsible Parties	Cost Estimate (in \$1,000 units)					Comments
					Total Costs	FY 2001	FY 2002	FY 2003	FY 2004	
2	1.3.4	Monitor weedy species such as <i>Hieracium pilosella</i> and <i>Cirsium arvense</i> .	Ongoing	USFWS, WA DNR, US Navy, State Parks, TNC	16	2	2	2	2	Noxious weed control is required by state law within some sites. Control methods may pose a threat to <i>C. levisecta</i> .
2	1.3.5	Conduct studies on herbivory by deer, rabbits, etc.	Ongoing	USFWS, WA DNR, US Navy, State Parks, TNC, research institutions	16	2	2	2	2	Several occurrences have been affected by herbivory. The overall impact of herbivory needs to be assessed.
2	1.4.1	Determine and characterize the genetic variation within and between known occurrences of the species.	3 years	USFWS, NHPs, TNC, research institutions	35	15	10	10	0	Information is critical to planning reintroduction.
2	1.4.2	Investigate longevity of seed viability.	Ongoing	USFWS, NHPs, TNC, research institutions	54	5	5	5	5	Important for assessing population trends and potentially for developing site management plans.

Implementation schedule for the <i>Castilleja levisecta</i> recovery plan										
Task Priority	Task Number	Task Description	Task Duration (years)	Responsible Parties	Cost Estimate (in \$1,000 units)					Comments
					Total Costs	FY 2001	FY 2002	FY 2003	FY 2004	
2	1.4.3	Conduct research to better understand population dynamics of <i>C. levisecta</i> .	10 years	USFWS, WA DNR, US Navy, State Parks, TNC, research institutions	27	4	4	4	2	Critical for developing site management plans.
2	1.4.4	Study the pollination biology of <i>C. levisecta</i> .	2 years	UFWFS, research institutions	18	9	9	0	0	A better understanding of the status and habitat requirements of pollinators is needed.
2	3.1.2	Determine how to quickly establish viable populations.	5 years	USFWS, WA DNR, US Navy, State Parks, TNC, research institutions	5	1	1	1	1	Funding is included under seed viability studies, task 1.4.2.
2	3.1.3	Conduct research to ascertain whether, or under what circumstances, <i>C. levisecta</i> requires a host plant to survive and/or reproduce.	4 years	USFWS, WA DNR, US Navy, State Parks, TNC, research institutions	8	2	2	2	2	Identifying requirements relating to host plants will be critical to successful establishment of new populations.

Implementation schedule for the <i>Castilleja levisecta</i> recovery plan										
Task Priority	Task Number	Task Description	Task Duration (years)	Responsible Parties	Cost Estimate (in \$1,000 units)					Comments
					Total Costs	FY 2001	FY 2002	FY 2003	FY 2004	
3	2.1	Continue efforts to relocate historically known occurrences.	Ongoing	WA and OR NHPs, BC CDC	27	2	2	2	1.5	Small, undetected populations may yet exist. If they do, they could play a key role in recovery efforts.
3	2.2	Conduct inventories in suitable habitats throughout the historic and extant range.	Ongoing	WA and OR NHPs, BC CDC	27	2	2	2	1.5	Small, undetected populations may yet exist. If they do, they could play a key role in recovery efforts.
3	2.3	Create a spatial database for inventory efforts, including negative searches.	Ongoing	WA and OR NHPs, BC CDC	17	1.5	1.5	1	1.5	Important for tracking status of each population.
3	4.1	Develop and conduct training programs (e.g., to be given to concerned agency personnel, as well as private landowners, etc.).	Ongoing	USFWS, WA and OR NHPs, BC CDC	12	2	1	2	1	Important for disseminating information to resource professionals and landowner.
3	4.2	Develop a brochure or fact sheet for public dissemination.	5 years	USFWS, WA and OR NHPs, BC CDC	10	3	3	2	1	Broaden awareness of the public regarding the species.



Implementation schedule for the <i>Castilleja levisecta</i> recovery plan										
Task Priority	Task Number	Task Description	Task Duration (years)	Responsible Parties	Cost Estimate (in \$1,000 units)					Comments
					Total Costs	FY 2001	FY 2002	FY 2003	FY 2004	
3	4.3	Develop and disseminate species information to private landowners.	10 years	USFWS, WA and OR NHPs, BC CDC	16	3	2	1	1	Broaden awareness of the public regarding the species.
3	5.1	Promote development and implementation of new laws and ordinances for the protection of <i>C. levisecta</i> .	Ongoing	USFWS, WA and OR NHPs, BC CDC	7.5	0.5	0.5	0.5	0.5	Investigate opportunities for improving legal protection for the species.
3	5.2	Promote compliance with all state laws and county ordinances and regulations protecting <i>C. levisecta</i> .	Ongoing	USFWS, WA and OR NHPs, BC CDC	7.5	0.5	0.5	0.5	0.5	Coordinate conservation efforts within existing legal framework.
3	6	Establish a technical working group to periodically review the status of the species and assess the effectiveness of the management plans and other recovery tasks.	Ongoing	USFWS	18	1	1	1	1	To implement adaptive management as new information becomes available.

**Implementation schedule for the *Castilleja levisecta* recovery plan**

Task Priority	Task Number	Task Description	Task Duration (years)	Responsible Parties	Cost Estimate (in \$1,000 units)					Comments
					Total Costs	FY 2001	FY 2002	FY 2003	FY 2004	
3	7	Collect seed adequately representing the genetic diversity within the species and store in a Center for Plant Conservation approved facility.	Ongoing	Berry Botanic Garden, UW Center for Urban Horticulture	24	2	2	2	1.5	Assist with reintroduction as insurance against future extinction.
Total estimated costs, years 2001-2018, for recovery: \$825,000										

## IV. APPENDICES

### APPENDIX A. Land Ownership

#### Rangewide Summary

Rangewide, the 11 known occurrences of *Castilleja levisecta* occur on lands owned or managed by the following:

United States government (1 total):

U.S. Department of Defense:

Naval Air Station Whidbey Island

State of Washington:

Department of Natural Resources (1)

Parks and Recreation Commission (1)

British Columbia government (2 total)

Ministry of Parks (2)

Private owners in Washington (6):

Seattle Pacific University (1)

Private individuals (5)

**APPENDIX B. Federal and State laws applicable to the protection of  
*Castilleja levisecta* and its habitat**

**U.S.:** Listed as **Threatened** under the Endangered Species Protection Act of 1973 (U.S. Fish and Wildlife USFWS 1997).

**States:**     **Washington:** There is no State endangered species legislation in Washington. However, *Castilleja levisecta* is listed as **Endangered**, meaning it is in danger of becoming extinct or extirpated in Washington within the near future if factors contributing to its decline continue. The Washington Natural Heritage Program has identified populations as being at critically low levels, or habitats as having been degraded or depleted to a significant degree (1997).

**Oregon:** Listed as **Endangered** under the Oregon Endangered Species Act (Oregon Department of Agriculture). Listed as **1-ex** (meaning the taxa is threatened throughout its range), and possibly extirpated from the State (Oregon Natural Heritage Data Program 1995).

**APPENDIX C. Summary of Agency and Public comments on the Draft Golden Paintbrush Recovery Plan.**

On April 5, 1999, we released the draft recovery plan for the golden paintbrush (*Castilleja levisecta*) for a 60-day comment period that ended June 3, 1999 (64FR16478). Over 60 copies of the draft recovery plan were sent out to perspective reviewers, including notification to 20 agencies or elected public officials.

A total of 4 letters were received. One substantive issue was provided. Other comments regarding new information were incorporated into the final recovery plan. Additional comments related to wording and clarity were also incorporated into the final plan.

Comment 1: One commenter pointed out that under Priority 3, Task 21, the Task Description “Continue efforts to relocate historically known occurrences” would be better described as “continue efforts to locate historically known occurrences”.

Response 1: The authors conferred that relocate was the appropriate term to use. The intent was to visit and survey known historic locales and determine if suitable habitat remained available for the species and if opportunities for restoration and reintroduction were appropriate. Our interest is to relocate sites where the species previously occurred, not to just locate plants within the historic range of the species.

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**Ecological Services**  
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**August 2000**