

Golden Paintbrush
(Castilleja levisecta)

5-Year Review
Summary and Evaluation

September 26, 2007

U.S. Fish and Wildlife Service
Western Washington Fish and Wildlife Office
Lacey, Washington 98503

5-YEAR REVIEW
Species reviewed: Golden Paintbrush (*Castilleja levisecta*)

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5-YEAR REVIEW

Golden Paintbrush (*Castilleja levisecta*)

1.0 GENERAL INFORMATION

1.1 Reviewers

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Lead Field Office: Ted Thomas, Western Washington Fish and Wildlife Office,
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1.2 Methodology used to complete the review:

This 5-year review is the joint effort of the *Castilleja levisecta* Technical Team (Technical Team). Participating members include:

- Joseph Arnett, Botanist, Washington Natural Heritage Program (WNHP) (the primary author of this document);
- Ted Thomas, Senior Ecologist with the U.S. Fish and Wildlife Service, Western Washington Fish and Wildlife Office (USFWS);
- Peter Dunwiddie, Senior Ecologist with the Washington Field Office of The Nature Conservancy;
- Ed Guerrant, Conservation Director with the Berry Botanic Garden; and
- Thomas Kaye, Executive Director of the Institute for Applied Ecology.

The participation of the Technical Team is with the support of the agency or organizations to which they are employed. Participation of the WNHP is partially supported by an Endangered Species Act section 6 cooperative agreement between the Washington Department of Natural Resources and the USFWS.

The findings of this review are based on ongoing research and monitoring of each of the known occurrences of the species that has been conducted since development of the 2000 Recovery Plan (USFWS 2000). Population monitoring data, new information, and results of research on *Castilleja levisecta* subsequent to the Recovery Plan are summarized below in the Synthesis section (2.4) and are presented in more complete format in Appendix A.

1.3 Background:

1.3.1 FR Notice citation announcing initiation of this review: July 6, 2005. Endangered and Threatened Wildlife and Plants; Initiation of 5-year Reviews (of 33 species in Region 1). 70 FR 38972-38975,

1.3.2 Listing history

FR notice: Final Rule, 62 FR 31740

Date listed: June 11, 1997

Entity listed: Species

Classification: Threatened

Revised Listing, if applicable - N/A

1.3.3 Associated rulemakings: None

1.3.4 Review History: None

1.3.5 Species' Recovery Priority Number at start of this 5-year review: --2--

reflecting a high degree of threat, a high potential for recovery, and that this plant's taxonomic rank is a full species, as identified in the 2006 Annual Recovery Data Call Report.

1.3.6 Current Recovery Plan or Outline

Name of plan or outline: Recovery Plan for the Golden Paintbrush (*Castilleja levisecta*) (the Recovery Plan)

Date issued: August 23, 2000

Dates of previous revisions, if applicable: N/A

2.0 REVIEW ANALYSIS

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

2.1.1 Is the species under review a vertebrate?

Yes

No, the DPS policy only applies to vertebrate species.

2.2 Recovery Criteria

2.2.1 Does the species have a final, approved recovery plan containing objective, measurable criteria?

Yes

No

2.2.2 Adequacy of recovery criteria.

2.2.2.1 Do the recovery criteria reflect the best available and most up-to date information on the biology of the species and its habitat?

Yes

No

2.2.2.2 Are all of the 5 listing factors that are relevant to the species addressed in the recovery plan?

Yes

No

2.2.3 List the recovery criteria as they appear in the recovery plan, and discuss how each criterion has or has not been met, citing information:

Recovery Criterion 1. 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.

This criterion has not been met. Currently, 2 of the 11 known extant populations, Rocky Prairie, Washington and Trial Island, British Columbia, are stable and include at least 1,000 individuals. When last counted in 2003, a third population known from San Juan Valley, on San Juan Island, Washington, U.S. appeared to be stable and well over the 1,000-plant threshold. This population is on private property and the landowner has not permitted access to his land to count the plant population since 2003. A fourth population – located at Ebey’s Landing on Whidbey Island, Washington – appeared to be increasing and was over the 1,000 plant threshold until 2002, when an accidental fire destroyed approximately one-half of this population. Since the fire, this population has continued to decline and has fluctuated well below the recovery threshold of 1,000 plants. When it was counted in 2006 the population numbered approximately 200 flowering plants, well below the several thousand plants present as recent as 2002. Because the Ebey’s Landing population is located on a steep, eroding slope that is subject to massive landslides, the long-term persistence of this population is uncertain but the population is declining.

The following listing factors pertain to this criterion: (A) present or threatened destruction, modification or curtailment of habitat or range, (C) vulnerability to disease and predation, and (E) other human and natural factors affecting its continued existence. For factor E, this includes vulnerability to the invasion by nonnative species, competition, genetic contamination, and potential effects of soil microbes (other than diseases addressed in factor C). All of these threats are exacerbated by the species occurring in a limited number of stable populations on protected lands.

Based on observations of population dynamics since the Recovery Plan, the Technical Team is recommending modifications to this criterion. The Technical Team recommends that this criterion include the qualification that to be considered stable, a population should demonstrate *a zero or positive overall trend* in population size over the 5 years. This recommendation is based on the observation that even large populations, well over the threshold of 1,000 individuals, might experience precipitous long term declines. A declining population, regardless of its size, should not be considered to meet the stability criterion. The Technical Team further recommends the following clarification to how plants are counted during annual monitoring. Because it is impractical to count individual vegetative plants, we have found that counting flowering plants is more accurate and efficient. This criterion should be modified to specifically account for a “recovered” population as equal to 1,000 **flowering** individuals and known to be stable or increasing as evidenced by population trends.

Recovery Criterion 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.

This criterion has not been met. Currently, only 2 of the known populations with greater than 1,000 flowering plants are stable and on legally protected sites. These sites are Rocky Prairie Natural Area Preserve, a Washington Department of Natural Resources parcel in south Thurston County and Trial Island, an Ecological Reserve in British Columbia, Canada. A third site, at Ebey's Landing, is owned by the Nature Conservancy and managed with the conservation of *Castilleja levisecta* as a high priority. However, since it was burned by an accidental fire in 2002 it has not recovered to its former size of greater than 1,000 plants. Therefore, Ebey's Landing no longer qualifies as a stable population and the long-term persistence of this population is not certain because of the hillslope erosion that occurs at this site. The Naas/Admiralty Natural Area Preserve is an additional site and is protected by a Washington Department of Natural Resources conservation easement. Other publicly owned sites that remain below the threshold of 1,000 plants include Fort Casey (increasing), Forbes Point (decreasing), and Alpha Islet (unknown population status). Public ownership conveys a high likelihood that conservation of *Castilleja levisecta* will be prioritized on these properties, but protection of these sites may still be subject to occasional conflicting management priorities. Recent restoration (mowing, burning, woody shrub removal) at each of these sites may help to improve the habitat for *Castilleja levisecta* and contribute to an increasing population size. *Castilleja levisecta* and its habitat are best maintained in early successional vegetation stages and ecosystem processes like prescribed fire, or mowing as a surrogate for prescribed fire will be needed to maintain these early seral vegetation conditions.

The following listing factors pertain to this criterion: (D) the inadequacy of existing regulatory mechanisms, and (E) other human and natural factors affecting its continued existence, including effects to habitat brought on by unpredictable events such as slope erosion that may remove large numbers of plants in a single event as occurred at Ebey's Landing in 2004.

Recovery Criterion 3. Genetic material, in the form of seeds adequately representing the geographic distribution or genetic diversity within the species, is collected periodically and stored in an approved Center for Plant Conservation facility.

This criterion has been met, and has been a high priority for completion because the results of this work will focus the reintroduction efforts for *Castilleja levisecta*. Seed representing the geographic range of the species is currently stored at the Berry Botanic Garden in Portland, Oregon and the Center for Urban Horticulture at the University of Washington, Seattle, Washington. Appendix 4 includes *C. levisecta* accession records for each of these seed banks, both of which have been approved as Center for Plant Conservation facilities. Seed collections may be augmented if new populations are discovered, if review determines gaps in the representation of genetic diversity, or if viability tests indicate that additional accessions are needed.

Dr. Ed. Guerrant (2003) reviewed the genetics work that was completed for *Castilleja levisecta* (Godt and Hamrick 2003) and made the following recommendations for reintroduction of *C. levisecta* based on patterns of genetic diversity as revealed by the

analysis of allozyme data (See Appendix C in the Reintroduction Plan (Caplow, WDNR, 2004)). We have prioritized his recommendations.

1. Prioritize conserving existing sites
2. Utilize the most vulnerable populations for sources of new populations
3. Evaluate the potential detrimental effects of using off site seed sources for planting new or reintroduced populations; single seed sources (founders) should be used when planting near existing populations
4. Consider mixed seed sources for planting at new sites (introduction or reintroduction) that are well-removed from existing populations
5. Develop and execute a seed collection plan

The following listing factors pertain to this criterion: Factor A; Loss of habitat from destructive events like landslides and accidental fire focus the need for seed collection, storage and outplanting of genetic material from source populations that are threatened. This criterion will help to preserve the genetic diversity of the taxon.

2.3 Updated Information and Current Species Status

2.3.1 Biology and Habitat

2.3.1.1 New information on the species' biology and life history:

Since completion of the Recovery Plan (2000) new information about the species biology and its life history, particularly the species' reproductive capabilities have emerged. Results from research on the reproduction of *Castilleja levisecta* are summarized below.

Research conducted by Pearson and Dunwiddie (Final Report 2006) has revealed new information about the success of direct seeding versus planting seedlings onto introduction (or reintroduction) sites. The success of direct seeding resulted in 0.2 to 1 percent germination rate and very few of these seedlings survived to flower in the second season. In contrast, nursery grown plants outplanted in the field survived at a rate of 76 percent to 80 percent during year one and more than 35 percent of the seedlings survived to the second growing season.

These results suggest that planting plants (seedlings) grown in nurseries is an effective way to produce mature flowering plants and have a natural production of seed in a relatively short period of time. Results from this study indicate that the production of seed (number of seed capsules) appears to increase in the second year after planting.

This research also indicates that plants are more successful when grown with a host (wooly sunshine, *Eriophyllum lanatum*) and that burning the site is advantageous compared to growing the plants alone and not treating (burn, mow, or scarify) the site.

This work was conducted at sites that have natural populations of *Castilleja levisecta* and through experimental outplantings at sites that have never had the species. The success of plant survival and growth at some of the sites that have never had the species indicates that these sites would be good candidate sites for introducing the species.

2.3.1.2 Abundance, population trends (e.g. increasing, decreasing, stable), demographic features (e.g. age structure, sex ratio, family size, birth rate, age at mortality, mortality rate, etc.), or demographic trends:

Since the preparation of the Recovery Plan for *Castilleja levisecta* (USFWS 2000), the overall abundance of the species has remained fairly constant, and while some populations have increased, others have declined. The species has apparently been extirpated from one of the known sites – Davis Point on Lopez Island – and conversely has been discovered in a location from which it was not previously known, specifically the San Juan Valley on San Juan Island, WA. Therefore the number of locations where the species is known has remained stable at 11 populations. See census data in Appendix A.

We intend to continue to evaluate sites for reintroduction of *Castilleja levisecta* throughout the range of the species to improve the species distribution and contribute to the species recovery. Grassland sites within the Willamette Valley of Oregon are being assessed for their feasibility for planting *Castilleja levisecta*, with the intent to plant the species in the Willamette Valley in autumn 2008. This would fulfill recovery objectives established in the Recovery Plan for *Castilleja levisecta* (2000) and is consistent with the recovery goals established for *Castilleja levisecta* in the Willamette Valley Prairie Species Recovery Plan.

Research conducted by Lawrence and Kaye (2006) has shown that *Castilleja levisecta* can be successfully planted in the Willamette Valley on sites that are dominated by native vegetation and have low competition from nonnative shrubs and trees. The reintroduction of *Castilleja levisecta* into the Willamette Valley would improve the range wide distribution of the species and counter threats to the species at sites in the northern portion of the species range.

2.3.1.3 Genetics, genetic variation, or trends in genetic variation (e.g. loss of genetic variation, genetic drift, inbreeding, etc.):

An analysis of genetic variation based on allozyme distribution was conducted by Godt and Hamrick (2003) and published by Godt et al. (2005) on all known populations of *Castilleja levisecta*. This analysis revealed an exceptionally high degree of genetic diversity among and within all populations. Genetic distance typically corresponded to geographic distance, though the Alpha Islet population was more widely separated genetically from the other north Puget Trough populations.

Fitness effects of inbreeding and outbreeding were examined by Kaye and Lawrence (2003) and Lawrence and Kaye (2006), providing insight into the species genetics information that is applicable to recovery efforts. The results of these projects, in combination with the genetics study, provide a rational basis for selecting the source of seeds for the introduction of new populations within the historic range of the species or to augment existing populations.

2.3.1.4 Taxonomic classification or changes in nomenclature: None

2.3.1.5 Spatial distribution, trends in spatial distribution (e.g. increasingly fragmented, increased numbers of corridors, etc.), or historic range (e.g. corrections to the historical range, change in distribution of the species within its historic range, etc.):

Since the Recovery Plan was prepared in 2000, a large population of *Castilleja levisecta* was discovered at San Juan Valley on San Juan Island, WA. This discovery is not a range extension, but increases the distribution of the species within the northern portion of its range. It is by far the largest population in north Puget Sound (~7,000 flowering plants) and increases the potential viability of the species. This population is located on a private parcel where access to the property is restricted by the landowner. No opportunity for seed collection or counting the population has been available at this population since 2003. The discovery of this population has been offset by the loss of another population, formerly known from Davis Point, on Lopez Island. This population of *Castilleja levisecta* from Davis Point has not received any form of management for more than a decade and the last plant observed at the site was counted in 1996 (Caplow, WDNR 2004). It is now presumed to be extirpated.

2.3.1.6 Habitat or ecosystem conditions (e.g. amount, distribution, and suitability of the habitat or ecosystem):

Populations of *Castilleja levisecta* that receive some form of management, such as mowing or prescribed burning, tend to have populations of *Castilleja levisecta* that increase, at least in the short term. The implementation of prescribed fire during the fall season, after the plant has matured and seed has been dispersed from the seed capsules has shown a positive response to the plant population when plants are counted the following spring (see discussion of prescribed fire under section 2.4: Synthesis). Even simple actions such as mowing shade forming woody shrubs, such as rose and snowberry, have a short term positive effect. When waist high rose patches were removed from the West Beach site in the spring of 2005, there was an immediate increase in the *C. levisecta* population and the population continued to expand throughout the first growing season after these actions. These results clearly indicate the need for habitat management of *C. levisecta*, and that in order to see an increasing trend in populations, there will be a need for funding and

ongoing management to maintain population numbers above the recovery threshold. Management does not occur at many of the populations on a regular basis. Most of the management that does occur is at locations managed by resource agencies (Washington State Parks, and the Washington Department of Natural Resources, Washington Department of Fish and Wildlife, Department of Defense) or nongovernmental organizations (The Nature Conservancy or Whidbey Camano Land Trust) that prioritize conservation of *C. levisecta* as a primary goal for the site's management.

Restoration of habitat and conservation partnerships with local agencies and organizations, such as Department of Defense, The Nature Conservancy, and local land trusts has focused funding and management on several Puget Sound grassland parcels. The purchase of several local prairie parcels will help to promote the protection and conservation of this ecosystem through acquisition and management. Over \$500,000 has been funded directly for regional Puget Sound purchase and restoration activities during the past 3 years, in addition each agency, The Nature Conservancy and the Whidbey-Camano Land Trust provides in-kind services as a contribution to the conservation of *Castilleja levisecta*.

2.3.1.7 Other: Not applicable

2.3.2 Five-Factor Analysis (threats, conservation measures, and regulatory mechanisms)

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

Continued development in the Puget Trough and the Willamette Valley is increasing habitat fragmentation (Lawrence and Kaye 2006), and loss of native grasslands. This trend is anticipated to continue or increase with regional population growth. However, this threat has been somewhat mitigated for *Castilleja levisecta* through land acquisition, protection of suitable prairie lands, and active management as a priority. The purchase and conservation of land has increased the amount of potential habitat available for the species.

During 2006, two populations were directly affected by development pressures. The landowners of the population at West Beach on Whidbey Island added a small residence, new well, and a shop to their property. The landowner worked closely with the FWS to site these new structures on their property in a way to avoid harming plants. This landowner has been caring for this population by mowing back competing vegetation, and allowing access to their property to count the plants and place small enclosures over the plants to keep herbivory to a minimum. Although the landowner has made efforts to protect and encourage *Castilleja levisecta* on their property, due to adjacent development, this population is now surrounded by private residences to the south and north, and a County

road to the east. The ability for this population to expand is limited by this development, the small size of the area, and unsuitable habitat to the west.

The second population of *Castilleja levisecta* that has been directly affected by development is the small grassland at Forbes Point, located on Department of Defense land at Whidbey Island Naval Air Station. This population is now isolated on a small grassland point adjacent to Puget Sound due to new residential construction directly north of the population. Opportunities for future expansion are limited to the small grassland area in close proximity to the *Castilleja levisecta* population.

In the vicinity of introduced populations in south Puget Sound, grassland habitat is being lost as rural residential developments continue to be established.

Castilleja levisecta has benefited from Department of Defense (Fort Lewis) funding through their Area Compatible Use Buffer (ACUB) program. This program was developed to reduce development encroachment on Department of Defense lands, reduce noise and to contribute to recovery of listed species found on grassland habitat. Currently the program is funding activities on regional grasslands in close proximity to Fort Lewis to conserve and recover listed and candidate species.

2.3.2.2 Overutilization for commercial, recreational, scientific, or educational purposes:

Castilleja levisecta still does not appear to be at risk from commercial activities. Recreational use of areas where it is known to occur, such as at Fort Casey, will continue to present a risk associated with flower picking, plant collection, and trampling. Some of this may be unavoidable, but park management continues to work to integrate conservation and recreational use of this and other similar sites. Loss of plants from flower picking or trampling leads to loss of seed for that year, which has a direct affect on seedling recruitment. Because the plant is a prolific seed producer this may have a limited impact at the Fort Casey site.

The collection of seed for research and utilization of the species for educational purposes should continue to be conducted in consultation with the Technical Team. Any collection or utilization of the species should be respectful of a landowner's desire for privacy and permission to access any private lands should be granted prior to conducting these actions.

2.3.2.3 Disease or predation:

Herbivory by deer, rabbits, and voles has been observed, sometimes resulting in serious damage at two populations (Forbes Point and Naas Preserve). At each site deep thatch and dense shrub cover has produced vole and rabbit habitat, respectively. At both of these populations, there

have been years when the entire population was browsed, which leads to complete loss of that year's natural seed reproduction. A fence was constructed to exclude rabbits and voles from approximately one-half of the population at Forbes Point and the decline of the *C. levisecta* population slowed, but herbivory continues outside of the quarter hectare (0.62 acres) fenced enclosure. At the Naas Preserve, most flowering plants in the native populations are caged to prevent herbivory and all plants that have been augmented into this population are fenced to keep out deer, rabbits and voles.

A minor threat is present at most locations from herbivory by butterfly larvae and other insects but no serious damage has been observed. Microbial interactions are largely unknown.

2.3.2.4 Inadequacy of existing regulatory mechanisms:

Critical Habitat was determined to not be prudent at the time of listing. The final rule to list the species as threatened has not been revisited in regards to designation of critical habitat. Outside of the protections afforded to the species through section 7 consultation for activities that are authorized, funded, or carried out by Federal agencies there is little additional protection given to the species through other means. The Endangered Species Act does not extend protection to listed plant species on private land. Although Washington State classifies plant species as endangered, threatened, or sensitive, the state does not provide protection to rare plants or the habitat upon which they depend.

The Washington Natural Heritage Program of the Department of Natural Resources classified *Castilleja levisecta* as an endangered species. This classification provides no direct protection to threatened or endangered plants or the habitat upon which they depend. The only protections provided to plants are the prohibitions specifically related to State criminal trespass law.

County regulations do provide some protections and have special provisions for listed species. *Castilleja levisecta* is found in Thurston, Island and San Juan Counties. In their current Critical Areas Ordinance, Thurston County classifies native outwash prairie as an important habitat, but at the time it was last updated in 1996 it did not specifically include *Castilleja levisecta* as an important or protected species known to occur on this geomorphic formation. Thurston County Development Services is in the process of updating their Critical Areas Ordinance (C. Wilson, pers. comm., Thurston County Development Services 2007). *Castilleja levisecta* will be included as a species of special interest and a site assessment would be required for any development permits requested on native outwash prairies. If *Castilleja levisecta* is found or habitat is available for occupancy by *Castilleja levisecta*, a management plan would be required for any development that would be permitted within this habitat or in close proximity to the plant.

In Island County, *Castilleja levisecta* is a protected species. If the species is found, or development is planned in the vicinity of West Beach or Ebey's Landing, an area of the island inventoried as a significant plant community including *Castilleja levisecta*, there is a requirement to prepare a biological site assessment pursuant to Island County Code (ICC) 17.02.050.C.2 and a habitat management plan according to ICC 17.02.050 to ensure protection of the plant.

In San Juan County, the county defers to Washington State's list of endangered, threatened and sensitive plant species, which includes *Castilleja levisecta*, but it provides no specific protective measures if the plant is found on a parcel.

As the species is not known to be extant in Oregon, regulatory mechanisms for that area have not been addressed.

2.3.2.5 Other natural or manmade factors affecting its continued existence:

Fires at the wrong time of the year and natural erosion compounded by anthropogenic activities have proven to be detrimental to *Castilleja levisecta*.

An accidental fire occurred at the Ebey's Landing site during the growing season of 2002 and again during July 2007 when fireworks ignited the grass and forbs at this site. In each case the fire was extremely hot because the fuels on the site were abundant. Because the plant was flowering and no mature seed had formed for the year, the population was severely impacted by this event in both years that fire occurred. The fire intensity was hot enough to char the soil organic layers. Thus, the plants were killed by the fire, no seed was produced for the year, and the site was invaded by several species of invasive, nonnative plants. Up to one-half of the *Castilleja* plants were burned in each of these fires and the site has been dominated by nonnative species since the initial fire burned in 2002.

Erosion at the same site has been a recurring problem and in 2004, a large section of the hillslope eroded from the site, carrying a large slab of soil and plants onto the beach and into the surf below. This erosion event removed an area of approximately 50 feet in width for the entire run of the slope. This type of random environmental event is not predictable in timing or in the amount of soil material that may be removed. However, because of the steepness of the slope at Ebey's Landing, erosion is expected to continue and this site may become extirpated at some time in the future.

Between these two events (accidental fire and deep seated slope failure) this population has been reduced from several thousand flowering plants in 2000 to about 200 flowering plants in 2006, the last time a complete census of the site was made.

2.4 Synthesis

The status of *Castilleja levisecta* has improved slightly in the 5 years since implementation of the Recovery Plan began in the spring of 2001, although all indications of improvement in the status of the species are mixed. A large new population has been discovered on San Juan Island, and finding this population has demonstrated that additional existing populations, even large ones, may yet remain to be detected. Conversely, a small population has been lost and is presumed extirpated from Davis Point on Lopez Island. Its present distribution and abundance indicate that *C. levisecta* is still threatened, and that the risk of becoming endangered in the foreseeable future remains.

The likelihood that this species can be recovered is moderately high. Seed production and viability is high, and the species is relatively easy to propagate from seed in a nursery. Plants have been successfully established in the field from seedlings. The greatest challenge to survival for the species is (1) the low germination of seed on native prairie; (2) seedling survival in the wild; (3) the vulnerability of the species to competition from nonnative invasive plants and native woody plants; (4) herbivory; and (5) the continuing loss of habitat due to human development. The cumulative effect of these on-going threats to establishing plants in the wild is a challenge for this species, even on lands that are dedicated to conservation of this species.

Since the development of the Recovery Plan, our understanding of the ecology and biology of the species has increased. The plant mortality that occurred from accidental fire in 2002 at Ebey's Landing, Whidbey Island was unexpected. Research on prescribed fire for this species previously indicated that the species is fire-adapted based on observations of controlled burns at Forbes Point and Rocky Prairie (Dunwiddie et al. 2001). In both instances, the population at Ebey's Landing did not respond in the same positive way as would be expected after a prescribed fire, apparently due to the timing of the fire. Prescribed fire is normally set during the fall, after the plant has completed its flowering and the fruits have dispersed their seeds. Generally, prescribed fires set in the fall have resulted in an increase in the plant population. In other situations, woody shrub and tree removal (either due to fire or mechanical removal) has increased the amount of habitat and the number of *Castilleja* plants. Tree and shrub removal at several sites, including the Naas/Admiralty Inlet Natural Area Preserve and private lands at West Beach (Whidbey Island) and False Bay (San Juan Island) has stimulated an increase in population size and led to the discovery of a new subpopulation (at False Bay in 1999).

Allozyme analysis has demonstrated a high degree of genetic variation within the species, suggesting that genetic depression that is sometimes present in small populations is not a threat in this case (Godt et al. 2005, Lawrence and Kaye 2006). This will be valuable as we consider reintroducing the plant into portions of its historic range, such as the Willamette Valley in Oregon.

Reintroduction efforts are in the initial stages, but much of the groundwork has been established for a science-based, methodical approach to site selection and development. Reintroduction efforts need to be well planned and implemented to be successful. Conserving existing populations of *Castilleja levisecta*, combined with the establishment

of new viable populations within its historical range, appear to offer this species a good chance for recovery.

To improve our outreach about *Castilleja levisecta* to private landowners and to assist with the species recovery we have produced a brochure about *Castilleja levisecta*, entitled “Recovering the Gem of the Pacific Northwest Grasslands.” This brochure discusses the historic and current distribution of *Castilleja levisecta*, its ecological relationships and information on the kind of habitat where we would expect to find the species and provides information on who should be contacted if plants or populations of the plant are found. The WWFOW has also produced a poster that challenges all landowners to find “new” native populations of the species with the incentive of a reward to anyone who can document the existence of a new population. The intent of the poster and brochure is to increase awareness about the plant and its habitat requirement. We are especially interested in documenting the presence of the plant in the Willamette Valley, where it has not been detected in a native population since 1937, and in the islands of north Puget Sound, where a new population was documented as recently as 2000.

3.0 RESULTS

3.1 Recommended Classification:

- Downlist to Threatened
- Uplist to Endangered
- Delist
 - Extinction
 - Recovery
 - Original data for classification in error
- No change is needed

3.2 New Recovery Priority Number: No change recommended

4.0 RECOMMENDATIONS FOR FUTURE ACTIONS

A. Modify Recovery Criterion 1

Three items should be addressed when the Recovery Plan for *Castilleja levisecta* is revised: (1) modify how individual plants are counted during population monitoring by counting only flowering plants; (2) modify the number of populations that should be required to meet recovery based on our experience with restoring habitat and recovering *Castilleja levisecta*; and (3) re-evaluate how we partition populations and determine if populations that are within close proximity to one another should be considered a single population using the current definition of “element occurrence” .

Upon completing this 5-year review of the status of *Castilleja levisecta* and its recovery plan, we recommend that surveyors monitoring the populations for *Castilleja levisecta* count only flowering plants. Counting vegetative individuals is difficult and impractical because small vegetative seedlings may be obscured by shrubs or tall grass and may not survive the growing season. To ensure monitoring is consistently applied across all ownerships and locations, the criterion used for monitoring the population should be modified to specify 1,000 *flowering*, rather than vegetative, plants as the threshold for a recovered population.

In addition to how we account for the number of plants in a population, we recommend that the number of populations that will be required to meet recovery of the species be reconsidered and modified. Currently, the Recovery Plan calls for at least 20 self-sustaining populations distributed throughout the species historic range. Because the species is reliant on regular management actions to sustain itself, it may be practical to focus on having fewer populations (for example, 15 protected populations) to meet the recovery needs of the species and to make sure these populations receive funding and regular management. It would still be required that a population would need to maintain a stable or positive trend for the number of plants in a population for a minimum of 5 years.

Lastly, it will be important to recognize the spatial relationship of populations. Closely situated populations should be counted as a single population and not be considered as separate populations. The standard definition for “element occurrence”, as it is used by the Washington Natural Heritage Program, is an area of land (or water) in which a species is, or was, present. Furthermore, the distance between occurrences of the element determines whether they are considered the same or separate occurrence. In addition to the distance criteria between populations, the pollination flight distance attributed to insects that are known to pollinate *Castilleja levisecta* and the availability of suitable habitat between two existing populations needs to be considered. The Recovery Plan should be revised to show our intent to apply the standard for element occurrence to *Castilleja levisecta*, which would combine some populations into single occurrences and would reduce the number of populations that we have currently, which would make each of the populations larger and more robust.

B. Prioritize Conservation of Existing Populations

As discussed in the Synthesis section, the protection of existing populations will continue to be a high priority.

C. Prioritize Reintroduction Efforts

Meeting recovery criteria will require establishing several new populations on protected lands or on lands where the private landowner has a conservation easement or site specific management recommendations wherein *Castilleja levisecta* is identified as a priority species for conservation. Given that the species exhibits high seed production and experimental work has shown the species can be successfully grown and outplanted, we remain confident that viable populations can be reintroduced and that there is a high likelihood for recovery of the species. We use the term reintroduction broadly to include augmenting extant populations, reintroducing populations that have become extirpated, and establishing (introducing) new populations in areas within its historical range.

D. Refine and Continue the Reintroduction Site Selection Process

After characterizing all known existing *Castilleja levisecta* sites (Chappell and Caplow 2004), Caplow and Chappell (2005) implemented a methodology for site evaluation in the southern Puget Trough of Washington, and this process of selection should be assessed and revised. A limitation to this methodology is that a single population (Rocky Prairie Natural Area Preserve) was used as the reference site for comparison to potential reintroduction sites. Seeding experimentation in both the south Puget Trough region and on Whidbey Island (Pearson and

Dunwiddie 2006) suggested that microsite characteristics, beyond the scope of the current site evaluation process, may have profound effects on reintroduction success. Another unknown in the site evaluation process is the relative importance of ecological variables, notably species composition and soil characteristics. These were used to formulate an index of similarity for comparison to the reference site.

In order to refine the site evaluation process, a series of experimental planting was recommended by the Technical Team at potential reintroduction sites, including many sites evaluated by Caplow and Chappell (2005). This experimental work will use the response of *Castilleja levisecta* outplantings as a measure of the suitability of the site for establishing *Castilleja levisecta* populations. This project would also provide additional information on optimal characteristics that are needed at a reintroduction site. Improved understanding of critical environmental factors could provide helpful indicators for the selection of favorable sites. This information could be valuable when evaluating potential reintroduction sites throughout the range of *Castilleja levisecta*.

The site evaluation process, incorporating experimental plantings, will be continued in the southern Puget Trough and was begun on Whidbey Island in autumn 2006. We will begin experimental plantings on the San Juan Islands in autumn 2008. Experimental plantings in the Willamette Valley in Oregon will also provide information for site evaluation in the southern extent of the species historic range and these will begin in autumn 2008.

Because the number of existing populations falls far short of the number specified in the recovery criteria, and because of the scarcity of remnant prairie vegetation for potential reintroduction sites, the Technical Team also supports experimentation with establishing *Castilleja levisecta* as part of prairie restoration on former agricultural land at appropriate sites. Our experience with *C. levisecta* at one San Juan Island location that is located within an agricultural field leads us to believe that the species can be restored to former agricultural sites if treatments like weed control and mowing are applied annually.

E. Evaluate the potential for genetic contamination by hybridization with other species of *Castilleja*

This question is being researched under an Endangered Species Act section 6 cooperative agreement between USFWS and the Washington Natural Heritage Program. This work is in the planning stage and we have no results to report at this time.

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U.S. FISH AND WILDLIFE SERVICE

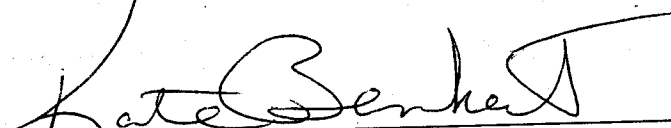
5-YEAR REVIEW of Golden Paintbrush (*Castilleja levisecta*)

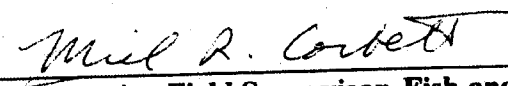
Current Classification: Threatened

Recommendation resulting from the 5-Year Review:

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

Review Conducted By: Ted Thomas, U.S. Fish and Wildlife Service; Joseph Arnett, Washington Department of Natural Resources, Natural Heritage Program; and the *Castilleja levisecta* Technical Team including Dr. Peter Dunwiddie, Dr. Ed Guarrant, Dr. Thomas Kaye, and Ms. Florence Caplow.


for Kate Benhart Date 9-26-07
Lead Field Supervisor, Fish and Wildlife Service


Mil R. Corbett Date Sept 26, 07
Cooperating Field Supervisor, Fish and Wildlife Service

Appendix A

Castilleja levisecta Population Information and Biological Review

Compiled in support of the 5-Year Review, Table 1 presents annual data on population size since 1999. Table 2 presents a summary of the extant or recently extirpated occurrences, along with information on population size and trend. Table 3 includes information on current experimental plantings. Table 4 is a compilation of all known census data.

Table 1. *Castilleja levisecta* population size and trend since 1999. All numbers report the number of flowering plants (counted or extrapolated). These numbers represent naturally occurring plants; plants from seedings or outplantings are described in Table 3.

	1999	2000	2001	2002	2003	2004	2005	2006	Average	5 yr average
Rocky Prairie	5,864	-	-	5,493	-	-	7,056	-	6,138	6,275
Naas/Admiralty Inlet	277	97	97	98	122	59	120	94	121	99
Ft. Casey	175	151	166	185	307	235	260	760	280	349
West Beach	797	463	167	53	54	82	130	189	197	102
Ebey's Landing	1,079	7,627	-	?	-	-	669	214	2,397	441
Forbes Point	1,572	1,882	1,834	711	765	532	123	260	960	478
Long Island	43	87	-	154	-	-	-	-	95	154
Davis Point	0	-	-	0	-	-	-	-	0	0
False Bay	<100?	-	-	269	-	247	-	376	297	297
San Juan Valley	-	4,021	-	-	7,528	-	-	-	5,775	7,528
Trial Island	-	-	-	2,150	-	-	-	3,192	2,671	2,671
Alpha Islet	953	-	-	800	-	1,333	-	-	1,029	1,067

Table 2. *Castilleja levisecta* 2006 Population Summary for the 5-Year Review.

Site Name	County or Province	Recovery Plan population size (year)	Current Population size (year)	Ownership or Status	Area (acres)	10-year trend (2000 Recovery Plan)	Current 5-year trend
Rocky Prairie Natural Area Preserve	Thurston	2,942 (1996)	7,056 (2005)	Washington State Natural Area Preserve	ca. 30	Stable/increasing	Stable/increasing
Naas/Admiralty Inlet Natural Area Preserve (formerly Bocker)	Island	367 (1998)	120 (2005)	Whidbey Camano Land Trust	ca. 1	Increasing in the short term	Increasing in the short term
Fort Casey State Park	Island	179 (1998)	260 (2005)	Washington State parks	< 1	Increasing in the short term	Increasing in the short term
West Beach	Island	479 (1998)	130 (2005)	Private	< 1	Stable?	Stable?
Forbes Point	Island	----	123 (2005)	U.S. Navy	< 1	declining	
Ebey's Landing	Island	4,000+ (1993) (estimated)	669 (2005)	The Nature Conservancy	ca. 1	stable?	declining
False Bay	San Juan		247 (2004)	Private	< 1	portions declining, others stable	portions declining, others increasing
Davis Point	San Juan	0 (1998) 4 (1996)	0 (2002)	Private	< 1	extirpated	extirpated
Long Island	San Juan	22 (1998)	154 (2002)	Private	< 1	unknown	unknown
San Juan Valley	San Juan	not known in 2000	7,528 (2003)	Private		not known in 2000	unknown
Trial Island	British Columbia	2,560 (1994)	3,192 (2006)	Canadian Ecological Reserve		stable	stable
Alpha Inlet	British Columbia	ca 1,000 (1994)	800 (2002)	Canadian Ecological Reserve	< 1	unknown	unknown

Experimental outplantings and augmentation plantings have been conducted at several locations, and in some cases plants remain in the ground. Table 3 presents numbers of living plants currently surviving as augmentation plantings (not included in the site plant totals) or at the sites of experimental plantings. By the next 5-year review for *Castilleja levisecta*, the Technical Team will need to make a decision about when, and if, plantings will be included in the species census.

Table 3. Experimental and augmentation plantings remaining alive at the present time, based on 2006 monitoring, except where noted.

Location	Type or Source of Planting	Number of Flowering Plants (Total Number of Plants)
Rocky Prairie NAP, Thurston County, WA	Augmentation planting by Jarish in 2004	31 in 2005
Kah Tai Prairie, Port Townsend, WA	Experimental planting by Lawrence in 2004	16 (25)
Perego Lagoon, Whidbey Island, WA	Experimental planting by Wayne in 2001, 2003	15
Sherman Farm Field, Whidbey Island, WA	Experimental planting by Swenerton in 2002	29
Au Sable Institute, Whidbey Island, WA	Experimental planting by Swenerton in 2002	4
Fort Casey, Whidbey Island, WA	Augmentation planting, 2003 and 2005	117
Forbes Point, Whidbey Island, WA	Augmentation planting, TNC 2004	47
Forbes Point, Whidbey Island, WA	Augmentation planting , TNC 2005	12
Forbes Point, Whidbey Island, WA	Augmentation planting, Wayne 2002	12
Naas/Admiralty Inlet Preserve, Whidbey Island, WA	Augmentation planting in 2005	684
Pigeon Butte, Finley NWR, OR	Experimental planting by Lawrence in 2004	6
Baskett Slough #1, Baskett Slough NWR, OR	Experimental planting by Lawrence in 2004	35
Baskett Butte #2, Baskett Slough NWR, OR	Experimental planting by Lawrence in 2004	38
Baskett Butte #3, Baskett Slough NWR, OR	Experimental planting by Lawrence in 2004	8
Bell Fountain Prairie, Finley NWR, OR	Experimental planting by Lawrence in 2004	52
Heritage Seedling, Salem OR	Experimental planting by Lawrence in	25

	2004	
Black River, Mima Prairie Glacial Heritage Preserve, WA	Experimental seeding and planting by Dunwiddie and Pearson, 2001-2005	99 (307)
Mima Mounds Natural Area Preserve, WA	Experimental seeding and planting by Dunwiddie and Pearson, 2001-2005	73 (322)
Rocky Prairie Natural Area Preserve, WA	Experimental seeding planting by Dunwiddie and Pearson, 2004-2005	46 (88)

A chronological description of the history of research and recovery activities at each of the extant populations of *Castilleja levisecta* since completion of the Recovery Plan in 2000 is listed below. Included in these notes are scientific studies, augmentation plantings, seed collection, and habitat restoration efforts.

Rocky Prairie Natural Area Preserve

1994 to present. Nearly annual monitoring large ecology plots (Dunwiddie)
2000 Seed collection by Tom Kaye for Berry Botanic Garden and for germination study
2002 Population Census at Rocky Prairie (Kellum 2002)
2003 Seed collection (for seeding and outplanting experiments, time vs. germination study, Lawrence research, and reintroduction plantings)
2005 Population Census at Rocky Prairie (Pischalko and Holmes 2005)
2005 Seed burial experiment initiated (Caplow 2005)
2005 Draft Prairie Restoration Project
2005 Outplanting: monitoring recorded 31 plants that had been planted (Dunwiddie)

Naas/Admiralty Inlet Natural Area Preserve (formerly Bocker)

2000 Seed collection by Tom Kaye for Berry Botanic Garden and for germination study
2000 Proposal from Dunwiddie for burning in Fall 2000 (apparently not conducted)
2000, 2001, 2002, 2003, 2004, 2005 Population census
2005 Acquisition by the Whidbey Camano Land Trust, with conservation easement held by WDNR
2005 Fall augmentation outplanting of ca. 1,000 *Castilleja levisecta* plants

Fort Casey State Park

2000, 2001, 2002, 2003, 2004, 2005 Population census
2000 Seed collection by Tom Kaye for Berry Botanic Garden and for germination study
2001 Seed collection by TNC
2003 and 2005 *Castilleja levisecta* augmentation outplanting
2003? And 2004 Seed collecting by Marion Jarisch
2003, 2004, 2005 Exclusion cages
2005 Informal testing of deer repellent by State Parks staff

West Beach

2000, 2001, 2002, 2003, 2004, 2005 Population census
2000 Seed collection by Tom Kaye for Berry Botanic Garden and for germination study
2005 Ongoing mowing by land owner, agreement to exclusion cages, construction on the property near *Castilleja levisecta*

2005 Seed collection by Florence Caplow and Mark Sheehan, Accession at Miller Seed Bank

Forbes Point

2000, 2001, 2002, 2003, 2004, 2005 Population census
2000 Seed collection by Tom Kaye for Berry Botanic Garden and for germination study
2002 Outplanting by Wendy Wayne and Sarah Reichard, including exclusion fencing for voles. Noted on site map.
2002 Report of heavy vole activity
2002 Seed collection by Wendy Wayne, accession at Miller Seed Bank
2003 Seed collection by Lawrence
2003 Reference to proposal to burn
2003 Reference to Sarah Reichard having plants propagated from this site
2004 Seed collection by Marion Jarisch for planting
2004 Outplanting of approximately 1,000 plants
2005 Extremely heavy vole infestation, most outplantings eaten, extant population heavily browsed
2005 Prescribed burn over entire site
2005 Outplanting of 1,000 plants

Ebey's Landing

2000, 2005 Population census
2000 Seed collection by Tom Kaye for Berry Botanic Garden and for germination study
2001 High intensity fire that impacted a portion of the Ebey's Landing *Castilleja levisecta* population
2001 Seed collection by Eliza Habegger, accession at Miller Seed Bank
2003 Seed collection by Lawrence
2005 Seed collection by Steve Erickson, accession at Miller Seed Bank

False Bay

2002, 2004, Population census
2000 Seed collection by Tom Kaye for Berry Botanic Garden and for germination study
2003 Seed collection by Lawrence

Davis Point

Four plants in 1996, no plants observed in 1998
Possibly extirpated

Long Island

2000, 2002 Population census

San Juan Valley

2000 and 2003 Population census
2003 Seed collection by Lawrence

Trial Island

2000 Seed collection for Berry Botanic Garden
2002 Population census
2000 to present: Demographic study by Fairbarns

Alpha Inlet

2000 Seed collection for Berry Botanic Garden
2002 Population census
2004 Population census
2000 to present: Demographic study by Fairbarns

Numerous experimental studies addressing the biology of *Castilleja levisecta* have been undertaken since the Recovery Plan was completed (USFWS 2000b). A summary of the results of these efforts is presented below. The following sections address recovery actions specified in part IIC of the Recovery Plan:

Management plans have been developed for Rocky Prairie Natural Area Preserve, and an interim management plan is currently being prepared for Naas/Admiralty Inlet Natural Area Preserve. Habitat restoration guidelines for Ft. Casey and Naas/Admiralty Inlet Natural Area Preserve were established in 1998. Communications with owners of privately held populations have been established and continue at West Beach, False Bay, and Long Island. Communications with the owner of the San Juan Valley population have been discontinued at the owner's request.

Fire effects have been studied experimentally at Rocky Prairie in three long-term studies (Dunwiddie et al. 2001), and field observations were made at Ebey's Landing subsequent to the high intensity fire that occurred in 2002. Other studies have examined the effectiveness of fire and other treatments as preparation for planting *Castilleja levisecta* (Pearson and Dunwiddie 2002, 2003, and 2006; and Wayne 2004).

Encroachment by shrubs and trees has been observed in many population areas, and the increase of *Castilleja levisecta* plant numbers appearing after mowing have been documented in the census numbers at West Beach, the Naas/Admiralty Inlet Natural Area Preserve, False Bay, and Fort Casey.

Non-native weeds have been documented as a primary inhibitor of *Castilleja levisecta* establishment in the Willamette Valley (Lawrence 2005). Control of weeds is a major management priority at Rocky Prairie.

Herbivory by deer, rabbits, and rodents has been observed at numerous sites (Naas/Admiralty Inlet, Ft. Casey, Forbes Point) and exclusion cages have been placed at Ft. Casey and Forbes Point to reduce this impact.

Genetic variation analysis based on allozyme distribution was conducted by Godt et al. (2005) on all known populations of *Castilleja levisecta* and revealed an exceptionally

high degree of genetic diversity among and within all populations. Genetic distance typically corresponded to geographic distance, though the Alpha Islet population was more widely separated genetically from the other north Puget Trough populations.

Seed viability was examined by Kaye (2001) and also tested by the Ransom Seed Laboratory (2005). Caplow (2006) initiated a seed longevity study at Rocky Prairie. For unknown reasons, germination rates of Rocky Prairie seed are consistently lower than for any of the other sites.

Population dynamics understanding is one of the primary goals of an ongoing population census that is conducted annually in most *Castilleja levisecta* populations.

Pollination biology of *Castilleja levisecta* is not yet well studied. Seed set appears high, indicating that pollination is highly successful and not a limiting factor at the present time for this species. Pollination has been observed to be largely by bumblebees (*Bombus*), but entomologists have noted that many other large bees, most often leaf-cutter bees, may be mistaken for bumblebees (Erik Johanson, WSDA entomologist, pers. comm.).

Monitoring plans have not been formalized, but as indicated in Table 1, annual monitoring of *Castilleja levisecta* occurs at most of the known occurrences. This information has provided the primary basis for assessing species viability and stability.

Searches for unknown occurrences has continued. Land in public ownership that is potential habitat for *Castilleja levisecta* is fairly widely surveyed, and a San Juan Islands study group began field surveys in 2005 of many of the smaller islands in the San Juans. No populations of *Castilleja levisecta* have yet been found on these islands, though the presence of this species on Long Island, Alpha Islet, and Trial Island suggest that these islands are suitable habitat. To date, no systematic record-keeping has been established to record negative surveys. However, different agencies have conducted systematic inventories of the land under their management and keep track of areas that have yet to be inventoried. Washington State Parks, in particular, has systematically contracted botanical inventories, including for this species.

Because much of the potential unsurveyed habitat for *Castilleja levisecta* occurs on private land, these areas receive inventory on a case-by-case basis, based on approval and the willingness of the landowner. In this way a large population on San Juan Island was discovered, and initially the landowner allowed access for scientific purposes.

In other cases, notably at False Bay, landowners near to known occurrences were alert to the potential for *Castilleja levisecta* to be present. When brush was mowed on their property, in some cases the species was found to be present, and because they had been informed of the significance of this species, the landowners notified Natural Heritage Program staff.

Attempts to relocate historical occurrences have not been successful. The Washington Natural Heritage Program maintains records of known occurrences, but so far a systematic data base of negative searches has not been established.

Reintroduction in the broad sense includes augmentation, reintroduction to previously occupied sites, and introduction to sites within the historical range of the species not known to have been previously occupied. The Reintroduction Plan (Caplow 2004) established a process for characterization of existing occurrences and evaluating potential reintroduction sites, and these processes were carried out in a site characterization study (Chappell and Caplow 2004) in which all known *Castilleja levisecta* populations were analyzed on the basis of soils, physical characteristics, and associated vegetation. Following on this an evaluation was made of potential reintroduction sites in the southern Puget Trough area (Caplow and Chappell 2005). Fifteen sites were ranked on the basis of a similarity to the *Castilleja levisecta* population found at Rocky Prairie Natural Area Preserve, the only known extant population of the species in the southern Puget Trough. A similarity index was developed by scoring and ranking a range of ecological characteristics.

Lawrence (2005) examined potential reintroduction sites in the Willamette Valley in Oregon and compared them to extant Washington occurrences. In common garden experiments she examined a range of genetic and ecological factors affecting reintroduction success, and conducted field and greenhouse experiments on host relationships with *Castilleja levisecta* (a hemiparasite). Overall, potential reintroduction sites in the Willamette Valley tended to be characterized by non-native annual species and silty-clay soils that were high in potassium and phosphorous, while the remaining Puget Trough *Castilleja levisecta* sites were characterized by high percentages of native perennial species and sandy soils with high levels of magnesium and sulfur. Transplant survival and performance was correlated with abundance of native perennial species. Lawrence (2005) suggested that reintroduction sites with the highest quality native vegetation offered the highest likelihood of success. Common garden experiments with a variety of source locations for seed indicated that seed from Whidbey Island populations was best adapted to introduction sites in the Willamette Valley.

Host interactions varied between the greenhouse and the field. In greenhouse experiments plants did equally well without host plants, with woolly sunshine (*Eriophyllum lanatum*), or with both *E. lanatum* and Roemer's fescue (*Festuca roemerii*). Plants grown only with *Festuca* did not grow as well. However, in the field, vole tunneling and associated mortality of *Castilleja levisecta* was associated with the presence of *Eriophyllum lanatum*, and the highest first year survival was obtained by *C. levisecta* plants grown without any host plant. While she did not recommend planting *C. levisecta* with *Eriophyllum*, Lawrence (2005) did recommend planting it in association with *Festuca*, expecting that presence of the host plant would increase the survival of *C. levisecta* in the long run.

Other research informing the reintroduction process has included seeding experiments (Lawrence 2005; Dunwiddie and Pearson 2002, 2003, and 2006; Swenerton 2003; and Wayne 2004) and seed viability analysis (Ransom Seed Laboratory, Inc. 2005). Experimental planting has been undertaken at the following locations, in order to provide information on methods for reintroduction and optimum reintroduction site characteristics. See Table 3 above for numbers of plants still alive at these locations as of July, 2006.

Kah Tai Prairie Preserve, Port Townsend WA (Lawrence 2005)

Glacial Heritage and Mima Mounds, Thurston County, WA (Pearson and Dunwiddie 2002, 2003)

Rocky Prairie NAP, Thurston County, WA (Dunwiddie 1998; Pearson and Dunwiddie 2004)

Whidbey Island: the Sherman Experimental Site near Ebey's Landing and the Smith Experimental Site on Au Sable Institute property at Smith Prairie (Swenerton 2003); Forbes Point and Whidbey Bluff near Perego lagoon (Wayne 2002, 2004). NPS overlook (NPS 2006)

Willamette Valley: Basket Butte 2, Baskett Butte 3, Baskett Slough 1, Bell Fountain Prairie, Heritage Seedling, Pigeon Butte, Plant Materials Center, Sandy River Delta, and Starck (Lawrence 2005)

Seed longevity: a seed burial study (Caplow) has commenced at Rocky Prairie NAP

Compiled for Appendix A of the 5-Year Review

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Appendix B

Castilleja levisecta Seed Bank Accession Records

Compiled in 2006 for the 5-year Review

Berry Botanic Garden

ACC# first in series	STATE	COUNTY	LOCATION	COLLECTION DATE	GOOD	# of PLANTS	EO#	COLLECTOR
SB1985-0025	WA	Thurston	Rocky Prairie, 13 mi. S of Olympia, on TNC lease	7/15/84 to 8/18/1984	35,410	75	?	Shelley A. Evans
SB1987-0070	WA	Thurston	Rocky Prairie, 13 mi. S of Olympia, on TNC lease (Mostly on s. side near road, old hwy. 99)	7/9/87	16,067	?	NONE?	Julie Kierstead
SB1987-0071	WA	Island	Whidbey Island, Camp Casey, Bocker Environmental Preserve, Seattle Pacific Univ.	7/10/87	12,278	multiple	NONE?	Kelly KuyKendall and Kimberely St. Hilaire
SB1987-0071	WA	Island	Whidbey Island, Camp Casey, Bocker Environmental Preserve, Seattle Pacific Univ.	7/10/87	4,111	?	NONE?	Kelly KuyKendall and Kimberely St. Hilaire
SB1987-0072	WA	Island	Whidbey Island, Camp Casey, Bocker Environmental Preserve, Seattle Pacific Univ.	7/10/87	5,556	?	NONE?	Kelly KuyKendall and Kimberely St. Hilaire
SB1987-0073	WA	Island	Whidbey Island, Camp Casey, Bocker Environmental Preserve, Seattle Pacific Univ.	7/10/87	2,611	?	NONE?	Kelly KuyKendall and Kimberely St. Hilaire
SB2001-0091	WA	Island	Bocker Environmental Reserve	9/13/00	569	9		Tom Kaye
SB2001-0100	WA	Island	West Beach, Whidbey Island	9/12/00	8,063	47		Tom Kaye
SB2001-0147	WA	Island	Ebey's Landing (Bluff)	9/13/00	9,650	30	21?	Tom Kaye
SB2001-0177	WA	Island	Forbes Point Naval Air Station	9/13/00	11,801	38		Tom Kaye
SB2001-0215	WA	Island	Fort Casey	9/13/00	5,026	30	5?	Tom Kaye
SB2001-0245	WA	Thurston	Rocky Prairie	9/28/00	4,093	31	11?	Tom Kaye
SB2001-0276	WA	San Juan	False Bay (1st stop)	9/12/00	877	17	20?	Tom Kaye

SB2001-0293	WA		San Juan Mar Vista Resort	9/12/00	559	14	20?	Tom Kaye
SB2001-1400	BC		Alpha Islet, Oak Bay Islands Ecological Preserve, Victoria, Vancouver Island, BC, Canada	9/26/00	34,603	30	2	Jenifer Penny
SB2001-1430	BC		Trial Island Ecological Reserve, Victoria, Vancouver Island, BC Canada, lat 482356, long 1231818	9/26/00	44,656	30	1	Jenifer Penny
TOTAL					195,930			

University of Washington Botanical Garden - Center for Urban Horticulture - Miller Seed Bank

SV03-001 - SV03-049	WA	Island	Ebey's Landing	9/28/2001	Approx. 6,000	?	21	Eliza Habegger
SV03-073	WA	Island	Forbes Point	9/2/2002	Approx. 6,400	?	16	Wendy Wayne
SV05-032 - SV05-081	WA	Island	Ebey's Landing	8/20/2005	3,883	?	27	Steve Erickson
SV05-128 - SV05-180	WA	Island	West Beach	9/1/2005	>20,000	?	12	Florence Caplow, Mark Sheehan
TOTAL					Approx. 36,000			