

Status of the Golden Paintbrush in British Columbia

by
Michael Ryan
and
George W. Douglas

Wildlife Bulletin No. B-91

March 1999

British Columbia, Canada's most westerly province, has a bounty of biological diversity. British Columbia's snowclad peaks, rain-drenched forests, arid grasslands, all sizes of rivers, lakes, and wetlands, and a long and rugged coast provide habitats for more species of living organisms than are found anywhere else in Canada. However, this very diversity means that there is much to be discovered about these organisms — their distribution, abundance, habitat requirements, and interrelationships with their environment. Increasing our knowledge of this biodiversity will help us with the complex task of sustainably managing our land and waters.

In 1992, the Provincial Government initiated a co-operative biodiversity research program with funding from the Corporate Resource Inventory Initiative, the British Columbia Ministries of Forests (Research Branch), Environment, Lands, and Parks (Wildlife and Habitat Protection Branches), and Tourism and Culture (Royal B.C. Museum); and the Forest Resource Development Agreement (FRDA II). In 1996, funding from Forest Renewal BC (FRBC) was received for a biodiversity research extension proposal. One goal of the original research program, and more recently the FRBC extension project, is to extend information to scientists, resource managers, and the public through biodiversity publications. These publications are intended to increase awareness and understanding of biodiversity, promote the concepts and importance of conserving biodiversity, and communicate provincial government initiatives related to biodiversity. We hope that they will be used as tools for the conservation of British Columbia's rich, living legacy.

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and
Resources Inventory Branch
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FRONTISPIECE

Castilleja levisecta



by Elizabeth Stevens

FOREWORD

In cases where a Wildlife Bulletin is also a species' status report, it may contain a recommended status for the species by the author. This recommendation is the opinion of the author and may not necessarily reflect that of the Wildlife Branch.

Official designation will be made by the Wildlife Branch in consultation with experts, and the data contained in the status report will be considered during the evaluation process.

ABSTRACT

In British Columbia, golden paintbrush (*Castilleja levisecta*) is restricted to southeastern Vancouver Island and two adjacent Gulf Islands. Of the nine sites in which *C. levisecta* has been collected, the populations at three sites have been confirmed in recent years, whereas the populations at four sites are known to be extirpated. The status of populations at two other sites are uncertain because the precise locations for these populations are not known. Extant populations represent the northern range limits of *C. levisecta* which, historically, extended southwards to central Oregon. However, all populations in Oregon are believed to be extirpated and the only known extant populations in Washington State are found at seven sites in the Puget Trough area and on San Juan Island. All populations in British Columbia and the United States are restricted to grass-dominated meadows that are very limited in area and most of which have been destroyed as a result of agricultural or residential development. Furthermore, fire suppression appears to have resulted in the invasion of some meadows by trees and shrubs. Both of these factors impose severe limitations on the likelihood of this species becoming established at other sites in the future. Two populations in British Columbia are protected in ecological reserves on small islands, thus human activities are less likely to disturb these populations. The third population is also in a protected area, but only comprised three plants in 1991, and has not been seen since (Douglas, pers. comm.). Other populations have much less protection. Therefore, it is recommended that *C. levisecta* should be considered Endangered in British Columbia.

ACKNOWLEDGEMENTS

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The production of this final report (extension project) was made possible through the funding support of Forest Renewal British Columbia (FRBC) and the B.C. Ministry of Environment, Lands and Parks, Wildlife Branch and Resources Inventory Branch. Publication production coordination was provided by G.F. Harcombe.

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INTRODUCTION

The status report on golden paintbrush (*Castilleja levisecta*¹) is part of an ongoing program of the British Columbia Ministry of Environment, Lands, and Parks, Wildlife Branch, designed to manage species at risk more effectively for long-term viability.

Castilleja levisecta is atypical of the genus in that it is a distinct species and does not appear to intergrade with other species². Ownbey (1959) assigned this species to the Chrysanthae where it is most closely aligned with *C. cusickii*. Since it is rare and presents no taxonomic problems, workers of *Castilleja* have ignored *C. levisecta* other than providing taxonomic descriptions in regional floras (e.g., Pennell 1951; Ownbey 1959; Rickett 1971).

Castilleja levisecta is an herbaceous perennial, 10-50 cm tall. Stems are several, erect, more or less decumbent or creeping at the base, usually unbranched, and softly viscid-villous. Leaves are viscid-villous to hispidulous, the lower ones linear-lanceolate, entire, and the upper ones oblong-ovate or obovate, with mostly 1-3 pairs of short lateral lobes from the distal 1/3 of the blade. Bracts are about the width of the upper leaves, oblong, obtuse, entire, or more often, with 1-3 pairs of short lateral lobes from near the apex, puberulent, more or less viscid-villous, and golden-yellow. Flowers are in a strict and ultimately elongate inflorescence, the flowers remote and mostly hidden by the overlapping bracts. The calyx is 15-18 mm long, deeply and subequally cleft above and below, its primary lobes again rather deeply divided into 2 linear obtuse segments. Corollas are 20-23 mm long, and the galeas are rather slender, puberulent, and about 3-4 times the length of the unpouched lower lip.

Of the twenty species of *Castilleja* that occur in British Columbia, only two other species are known from southwestern British Columbia: *C. hispida* var. *hispida* and *C. miniata* (Douglas 1991). The latter species usually have red bracts although those of *C. miniata* may also be orange or yellow. However, *C.*

miniata is distinguished from *C. levisecta* by having longer "beaks" and herbage that is slightly pubescent but not glandular.

The destruction of grass-dominated meadows within the range of *C. levisecta* have left few areas with suitable habitat for this species. In addition, there are no longer any sites that could be considered "natural" due to intensive disturbance and invasion by exotic species since European colonization. Therefore, the prognosis for *C. levisecta* is not good. Concern for this species resulted in the basis for this report, which was provided by a national status report submitted in 1996 to the Committee on the Status of Endangered Wildlife in Canada (COSEWIC).

GENERAL BIOLOGY

There is no information in the literature on the biology and ecology of *C. levisecta* other than general habitat information. However, it is likely that this species shares many of the same traits that are typical of the genus.

Castilleja levisecta emerges in spring and flourishes in the warm, moist conditions typical of the time of year. Flowering occurs in late April or May followed by fruit set in June. During July, when drought conditions are prevalent in these meadows, the plants are senescent and remain dormant until the following year. Most, if not all, *Castilleja* species require cross-pollination to reproduce. According to Duffield (1972) and Pennell (1948), many species appear to be pollinated by hummingbirds, but bees may also be important pollinators of other species (Duffield 1972; Bauer 1983). Evans *et al.* (1984, in Sheenan and Sprague 1984) have observed the bumblebee, *Bombus californicus* visiting *C. levisecta* flowers. The average number of seeds produced by an individual is not known, although Sheenan and Sprague (1984) report that it is not uncommon to observe more than 100 seeds produced by a single capsule. Seed production is likely to be of critical importance to *C. levisecta* because it does not appear to be capable of reproducing by any other means.

¹ Nomenclature follows Douglas *et al.* (1989-1994).

² Sheenan and Sprague (1984) report that *C. levisecta* appears to be hybridizing with *C. hispida* at one site in the United States.

As with other species of *Castilleja*, it is likely that *C. levisecta* is a facultative parasite on the roots of other species. Heckard (1962) investigated the growth of 11 species of *Castilleja* with and without hosts. All plants are capable of completing their life cycle in the absence of a host. However, when they are grown in culture with other species, all but one *Castilleja* species exhibits faster growth rates, produces a larger number of branches, and flowers earlier than when grown in isolation. An examination of the roots indicate that *Castilleja* species form haustorial connections with the roots of other plants as well as with that of other *Castilleja* plants (although they exhibit reduced vigour when grown with members of the same genus).

HABITAT

Description

The vegetation on the eastern side of Vancouver Island and some of the Gulf Islands is remarkably different to that found elsewhere along the west coast and other places in Canada. On mesic sites, the vegetation is dominated by *Pseudotsuga menziesii*, a dominant, fire-climax species. In dry areas, where rainfall is low or soils are shallow, particularly in the Victoria region, the vegetation is characterized by open stands or discontinuous clumps of *Quercus garryana* mixed with grass-dominated meadows or rock outcrops.

Castilleja levisecta appears to be restricted to grass-dominated meadows on southeastern Vancouver Island and adjacent Gulf Islands. These meadows usually occur on relatively deep soils in areas receiving very little precipitation in comparison to other coastal areas; drought conditions are prevalent during the summer months. *Castilleja levisecta* likely can withstand very little shading by trees and shrubs (Sheenan and Sprague 1984).

Ecoprovince and Biogeoclimatic Zone

Ecoprovinces — *Castilleja levisecta* occurs in one ecoprovince in British Columbia, the Georgia Depression (GED). Within this ecoprovince, it occurs in the Juan de Fuca Strait (JDF), Leeward Island Mountains (LIM), Nanaimo Lowlands (NAL), and Southern Gulf Islands (SGI) ecoregions. The ecoregions of British Columbia have been delineated by Demarchi (1995).

Biogeoclimatic zones — All occurrences of *C. levisecta* in the province fall in the Coastal Douglas-fir (CDF) zone of south-eastern Vancouver Island. Biogeoclimatic zones were delineated by the B.C. Ministry of Forests Research Branch (1992).

DISTRIBUTION

In British Columbia, *C. levisecta* is restricted to southeastern Vancouver Island and two adjacent Gulf Islands. The historical range of *C. levisecta* extended along the west coast of North America from southern Vancouver Island to the Willamette Valley in Oregon (Peck 1961) (Figure 1). In recent years Sheenan and Sprague (1984) report that the only recently verified American populations are restricted to the Puget Trough area and San Juan Island in Washington State. All other populations in Washington and Oregon are extirpated.

POPULATION SIZE AND TRENDS

Castilleja levisecta has been collected in nine sites in British Columbia (Table 1; and Figure 2). All populations have been found on southeastern Vancouver Island except for two populations located on small islands (Alpha Islet and Trial Island) off the Victoria waterfront. Of the nine locations, four populations are likely extirpated and three populations are extant. Other than this, there are no population trends known. The locations cited on the herbarium labels for two other populations are too general to verify.

Trends in Recently Verified Populations in Victoria

Alpha Islet — Alpha Islet, located off the Victoria waterfront, supported about 1000 plants of *Castilleja levisecta* in 1994. The small islet covers 0.28 ha (Table 1; Figure 2)

Beacon Hill Park — A total of three plants were recently verified in 1991 in Beacon Hill Park (Table 1). The rare taxon, *Viola praemorsa* var. *praemorsa* is also located at this site. Unfortunately, no plants could be located at this site in 1993 or 1994. However, they may have easily been overlooked so that the status of this population will have to be confirmed by future visits to this site.

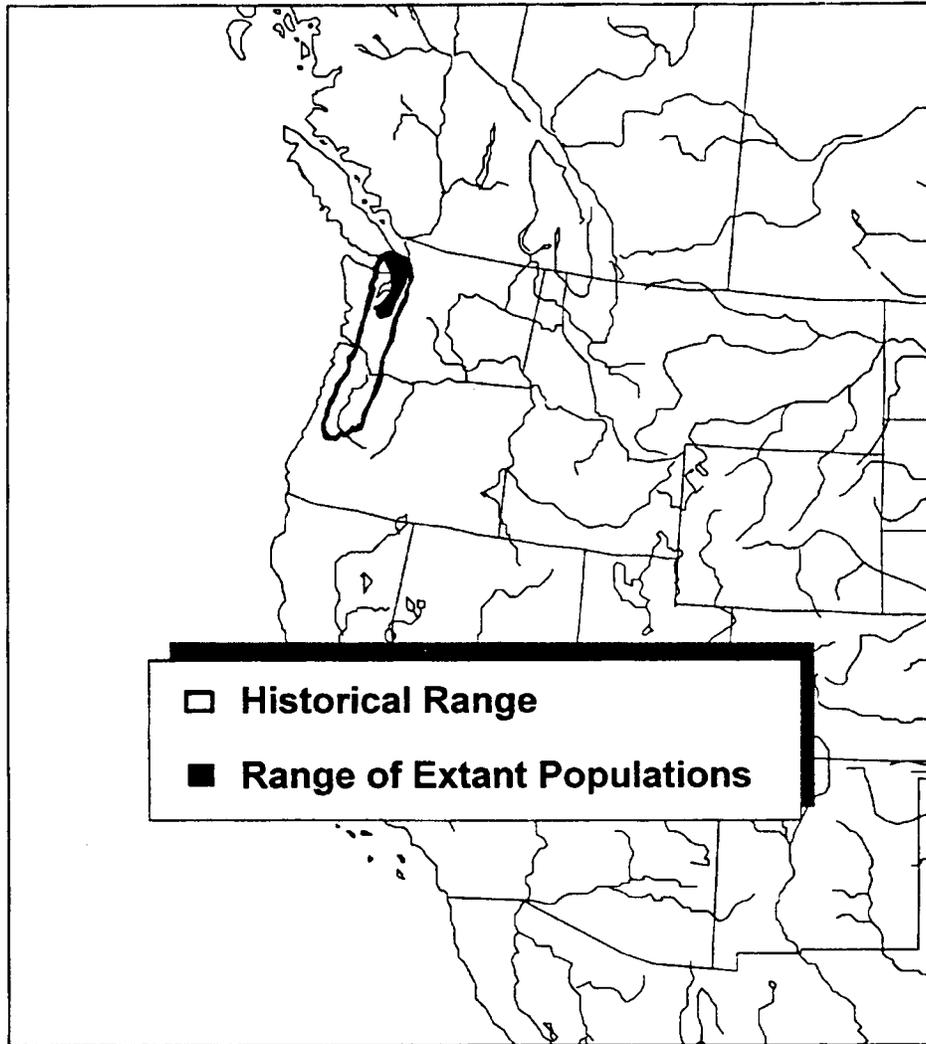


Figure 1. The historical and current ranges of *Castilleja levisecta* In North America.

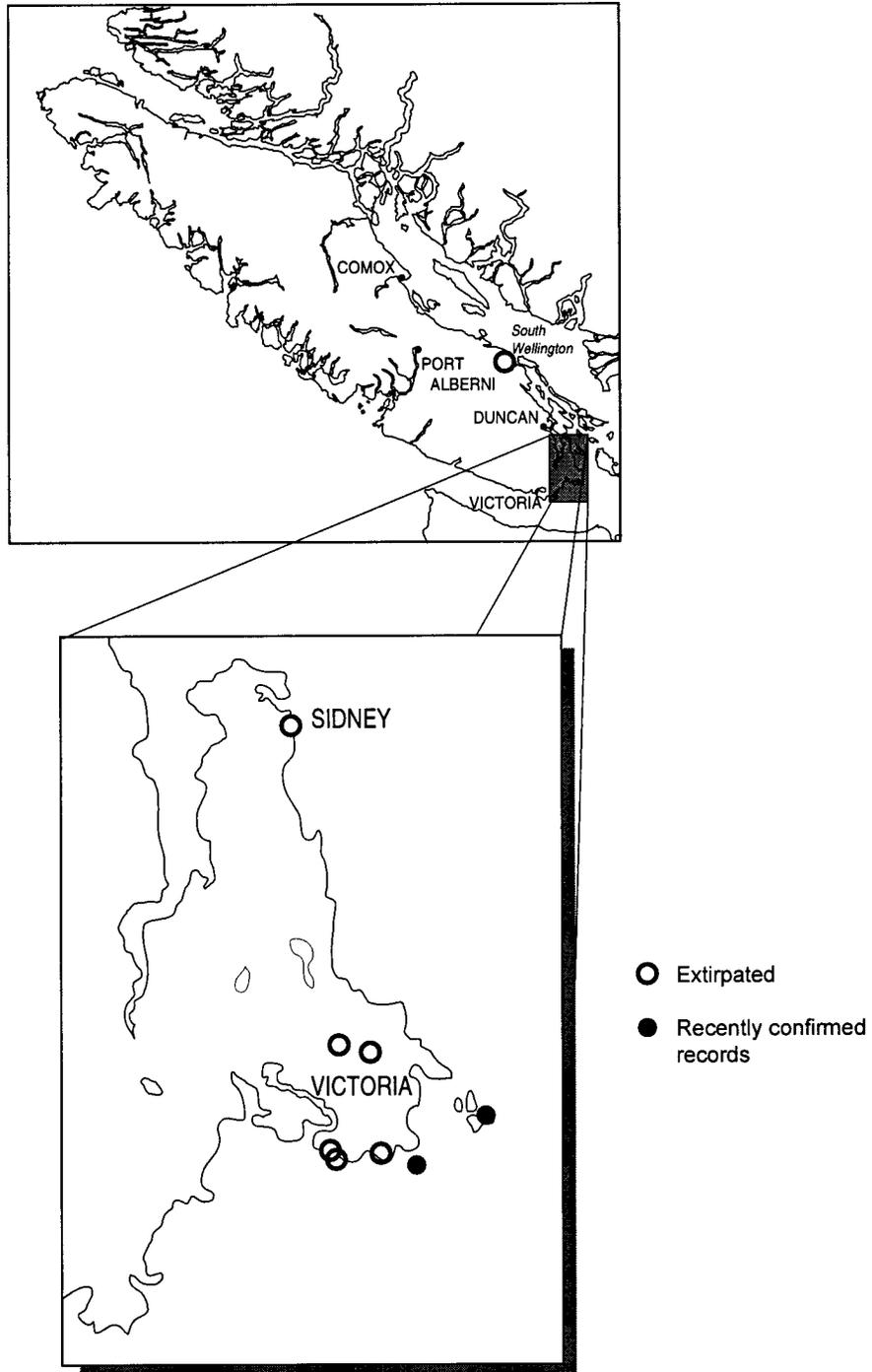


Figure 2. The location and status of *Castilleja levisecta* populations in British Columbia

Table 1. *Castilleja levisecta* sites in British Columbia.

Collection Site	Last Observation	Collector	Population (no./area)
Alpha Islet (Victoria)	1994	Cannings	1000/100 m ²
Beacon Hill (Victoria)	1991	Brayshaw	3 plants
Cedar Hill (Victoria)	1887	Macoun	
Dallas Cliffs (Victoria)	1969	Clark	
Foul Bay (Victoria)	1918	Carter	
Lost Lake (Victoria)	1945	Hardy	
Trial Island (Victoria)	1992	Douglas	2560/4900 m ²
Sidney	1927	Goddard	
Wellington	1898	Fletcher	

The largest British Columbian population of *C. levisecta*, comprising several thousand plants, is located on Trial Island, which is located off the Victoria waterfront (Table 1). Rare species found here include *Lotus formosissimus*, *Aster curtus*, and *Sanicula bipinnatifida* (B.C. Ecological Reserves Program 1992).

Status Unknown

The specific locations in which *C. levisecta* were collected in Sidney (1927), and Wellington, south of Nanaimo (1898) are not known, hence, these populations could not be verified. However, given the extent to which residential and agricultural development has occurred in these areas since the time of collection, it is unlikely that *C. levisecta* is extant.

Extirpated Populations

Between 1887 and 1969, *C. levisecta* was collected in four sites where it has been extirpated, Cedar Hill, Dallas Cliffs, Foul Bay, and Lost Lake (Table 1; Figure 2). Cedar Hill area is now residential and almost all of the native vegetation has been eliminated except for some mature *Q. garryana* trees.

Likewise, the Dallas Cliffs have been heavily disturbed, and there no longer appears to be any suitable habitat for *C. levisecta*. The Foul Bay area is also residential and almost completely devoid of native vegetation, particularly along the shoreline where there has been extensive landscaping with introduced species. Lost Lake has also been heavily disturbed, but mostly with agricultural development. In addition, it is possible *C. levisecta* was never collected here because the habitat conditions noted on the herbarium label ("in peat meadow with *Ledum* and *Spiraea douglasii*") do not correspond to other habitats in which this species has been found. Hence, the herbarium label may be incorrect and this specimen may have been collected elsewhere. It is extremely unlikely that *C. levisecta* is still extant any of these areas.

PROTECTION

Currently there is no specific legislation for the protection of rare and endangered vascular plants in British Columbia. Pending federal endangered species legislation may eventually protect a few special cases. However, most rare vascular plants would not be conserved under this legislation, whereas pending under the *Forest Practices Code Act*

of British Columbia, more species could be protected; red-listed vascular plants may be protected when they become designated as *Identified Wildlife*.

Existing populations of *C. levisecta* in British Columbia, in the Victoria area are protected to a certain extent by their location on public property.

Alpha Islet — Alpha Islet is a part of the Oak Bay Islands Ecological Reserve. Hence, the population of *C. levisecta* has the best legal protection currently available in British Columbia. Despite its proximity to Victoria, the site is only accessible by boat, hence, it does not experience the same degree of disturbance by recreational activities that would otherwise result if this population was located in a more accessible area on Vancouver Island or one of the larger Gulf Islands.

Beacon Hill Park — Beacon Hill Park is a municipal park managed by the City of Victoria. Because of its location near downtown Victoria, it is heavily utilized by the public and has been extensively altered with the construction of roads and recreational facilities, and the conversion of many natural areas to landscaped, managed gardens and ponds. The site at which the three *Castilleja* plants were observed in 1991 has been less strongly impacted than other areas of the park. Park staff leave this area relatively untouched and do not actively manage it like other areas where the grass-dominated vegetation is often mowed. Although their location in the park may provide them some protection from habitat destruction, the focus of park management is more on recreational activities than on the preservation of natural vegetation. This focus has resulted in the elimination of several rare species by direct habitat destruction (A. Ceska, pers. comm.). However, three naturalist groups, "The Friends of Beacon Hill Park", "The Garry Oak Meadow Preservation Society", and "The Victoria Natural History Society" have taken an active role in publicizing and promoting the preservation of the natural vegetation and rare species located in the park.

Given the fact that only three *Castilleja* plants were observed in 1991, this population is in immediate danger of extirpation, particularly if they rely on cross-pollination and seedling recruitment to maintain the population.

Trial Island — The largest British Columbia population of *C. levisecta* occurs in the Trial Island Ecological Reserve. It is provided with the greatest

degree of legal protection that is available in British Columbia. This reserve, despite its proximity to Victoria, has very limited public access since it is only accessible by boat and permits are required by the Ecological Reserves Program before access is allowed.

LIMITING FACTORS

Specific Threats

Habitat Destruction — Although few records are available indicating the extent of meadow communities in the Victoria area prior to, and during, colonization by European settlers, it is likely they once formed a significant component of the area now presently occupied by residential and urban developments (see map pp. 9-10 in McMinn *et al.* 1976). The destruction of grass-dominated meadows, particularly by residential development, has continued to the present resulting in the elimination of almost all collection sites for *C. levisecta*. Furthermore, today there are no longer any sites which could be considered "natural," and used as a basis by which to measure current threats and impacts. Fire suppression and introduced species have also altered the landscape to a lesser, but still significant degree as compared to urban and agricultural development.

Fire Suppression — Presently, the suppression of both natural and human-induced fires, appears to have resulted in changes to some grass-dominated communities. For example, in some areas the shrub *Symphoricarpos albus* appears to be expanding at the expense of herbaceous species. It often forms dense thickets that are interconnected by a web of roots in the soil. These thickets expand in area with the production of young shoots from roots at the edge of the thicket. As the colony expands, it shades out almost all herbaceous species. Fortunately, this species appears to be better suited to shaded areas where *Q. garryana* is more abundant than in open meadows where *C. levisecta* is found.

Introduced Species — Likewise, the introduced shrub, *Cytisus scoparius*, has become a dominant species at the perimeter of some meadows and appears to negatively impact all herbaceous species. It is a very resilient shrub which invades a site (particularly after fire and other forms of disturbance) and forms dense thickets which shade out much of the herbaceous vegetation. Additionally, it may alter

soil conditions because its roots are associated with nitrogen-fixing bacteria.

Two other introduced woody species that are may also threaten the native vegetation in meadows are *Rubus discolor* and *Ulex europaeus*. Both species have the ability to spread rapidly once they are established at a site and eliminate all other species.

The herbaceous vegetation observed today in all meadows has been drastically altered with the introduction of European species. Although a large number of native species persist in these stands, much of the vegetation is dominated to a large extent by introduced species, particularly grasses, including *Holcus lanatus*, *Anthoxanthum odoratum*, *Cynosurus echinatus*, and a number of species of *Bromus*. Today, it is likely that introduced species account for > 90% of the biomass composing the herbaceous vegetation. As noted by Roemer (1972), it is not possible to know which native species and to what extent they have been displaced because all stands are composed primarily of introduced species and there is no longer any examples of "pre-European" vegetation. It is difficult to judge whether introduced grasses and forbs pose an immediate threat to *C. levisecta* because nothing is known of the competitive interactions of *C. levisecta* with other species. It is possible that although *C. levisecta* may be able to parasitize other species, it may do poorly under crowded conditions, as suggested by Heckard's results (1962) for other *Castilleja* species.

Unlike the effect of competitive interactions, shrub species do not appear to be an immediate threat to known *Castilleja levisecta* populations in British Columbia, but their abundance at other meadow sites signifies a loss of potential habitats in which this species may be established and further imposes limits on the long term survival of this species. In the United States, Sheenan and Sprague (1984) report that some meadows have been eliminated by invading trees and shrubs and, presently, they appear to be invading two sites inhabited by *C. levisecta*. They identified *Pseudotsuga menziesii* and *C. scoparius* as two common invasive species. Evans et al. (1984, in Sheenan and Sprague 1984) report that eight species of caterpillars have been observed damaging *C. levisecta*; only three have been identified and include *Occidryas editha* (a species of plume moth) and a species of parasitic wasp.

Changes in Populations

It is not possible to determine if existing populations of *C. levisecta* are declining since none have been monitored over time. However, it is possible that *Q. garryana* stands, and possibly, grass-dominated meadows, were much more extensive several thousand years ago as suggested by an examination of pollen in soil cores sampled on southeastern Vancouver Island (R. Hebda, pers. comm.). Existing populations of *C. levisecta* may represent remnants of a more contiguous distribution along the southeastern portion of Vancouver Island.

SPECIAL SIGNIFICANCE OF THE TAXON

Castilleja levisecta is atypical of the genus, *Castilleja* in that it is a distinct species and does not appear to intergrade with other species. As is the case with other members of the Scrophulariaceae, it is likely this species parasitizes the roots of other species occurring in the same habitat, although these species have not yet been identified. Extant populations represent the northern range limits of *C. levisecta* which, historically, extended southwards to central Oregon. *Castilleja levisecta* is rare throughout its entire, limited range in British Columbia and the United States.

RECOMMENDATIONS AND MANAGEMENT OPTIONS

Management of *C. levisecta* is hampered because very little is known regarding the ecology of this species and its relationship to the environment. Furthermore, nothing has been reported regarding the identity of host species and its ability to compete with other species for resources. The lack of demographic information also impedes the ability to judge if existing populations are decreasing or increasing in numbers. In addition, a better understanding of the floral biology of this species is required including the extent to which it relies on cross-pollination to produce viable seed.

EVALUATION

Comments on Status

Castilleja levisecta is ranked as a G1 S1 species by the Conservation Data Centre (B.C. Ministry of Environment, Lands, Parks; Douglas *et al.* 1998). This ranking indicates that, on both a global and sub-national scale, it is considered to be "Critically imperiled because of extreme rarity (5 or fewer extant occurrences or very few remaining individuals) or because of some factor(s) making it especially vulnerable to extirpation or extinction."

Status Recommendations

Castilleja levisecta should be ranked as Endangered for the following reasons:

1. Only three extant populations are known in British Columbia of which one (Beacon Hill) comprises three plants and may soon be extirpated. Although the remaining two sites are in Ecological Reserves, these sites have numerous introduced species (mainly grasses) which may cause a further decline in population sizes.
2. Suitable habitats for *C. levisecta* are extremely rare and limited to southeastern Vancouver Island and adjacent islands. Therefore, the potential of this species to become established at other sites is extremely limited and seriously limits its long term survival.
3. The current range of *C. levisecta* is less than half the size of its historical range. In the United States, it is known from only seven sites in Washington of which five are located on private property and subject to destruction.
4. *Castilleja levisecta* in British Columbia represents the northern limits of this taxon and may represent populations that are genetically distinct to those found elsewhere (see p. IV-122, Forest Ecosystem Management Assessment Team 1993).

Prognosis

The prognosis for this species is not good. Although recently verified populations in British Columbia are protected on public land, it is possible that some of these populations may disappear without some form of management. Some assurance would be provided if the meadows in which *C. levisecta* occur could be considered stable natural ecosystems. However, with the introduction and domination of these sites by many non-native species and the suppression of fire, it is apparent that the composition and structure of the vegetation are changing in some stands and it is difficult to predict what impact these changes will have on *C. levisecta* populations. There are no existing meadows in which introduced species are not a significant component of the vegetation; hence, there is no basis by which to compare existing stands with those that were present before Europeans settled on the west coast of British Columbia. Furthermore, given the limited number of isolated extant populations in British Columbia and the United States, it is likely that the potential to maintain genetic variability within these populations has declined. Thus, they may be more vulnerable to extirpation because they lack the genetic variability which may be necessary to respond to changes in the environment.

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