

Recovery Strategy for cliff paintbrush (*Castilleja rupicola*) in British Columbia



Prepared by the Cliff Paintbrush Recovery Team



Ministry of
Environment

March 2009

About the British Columbia Recovery Strategy Series

This series presents the recovery strategies that are prepared as advice to the province of British Columbia on the general strategic approach required to recover species at risk. The Province prepares recovery strategies to meet its commitments to recover species at risk under the *Accord for the Protection of Species at Risk in Canada*, and the *Canada – British Columbia Agreement on Species at Risk*.

What is recovery?

Species at risk recovery is the process by which the decline of an endangered, threatened, or extirpated species is arrested or reversed, and threats are removed or reduced to improve the likelihood of a species' persistence in the wild.

What is a recovery strategy?

A recovery strategy represents the best available scientific knowledge on what is required to achieve recovery of a species or ecosystem. A recovery strategy outlines what is and what is not known about a species or ecosystem; it also identifies threats to the species or ecosystem, and what should be done to mitigate those threats. Recovery strategies set recovery goals and objectives, and recommend approaches to recover the species or ecosystem.

Recovery strategies are usually prepared by a recovery team with members from agencies responsible for the management of the species or ecosystem, experts from other agencies, universities, conservation groups, aboriginal groups, and stakeholder groups as appropriate.

What's next?

In most cases, one or more action plan(s) will be developed to define and guide implementation of the recovery strategy. Action plans include more detailed information about what needs to be done to meet the objectives of the recovery strategy. However, the recovery strategy provides valuable information on threats to the species and their recovery needs that may be used by individuals, communities, land users, and conservationists interested in species at risk recovery.

For more information

To learn more about species at risk recovery in British Columbia, please visit the Ministry of Environment Recovery Planning webpage at:

<<http://www.env.gov.bc.ca/wld/recoveryplans/rcvry1.htm>>

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Disclaimer

This recovery strategy has been prepared by the Cliff Paintbrush Recovery Team, as advice to the responsible jurisdictions and organizations that may be involved in recovering the species. The British Columbia Ministry of Environment has received this advice as part of fulfilling its commitments under the *Accord for the Protection of Species at Risk in Canada*, and the *Canada - British Columbia Agreement on Species at Risk*.

This document identifies the recovery strategies that are deemed necessary, based on the best available scientific and traditional information, to recover cliff paintbrush populations in British Columbia. Recovery actions to achieve the goals and objectives identified herein are subject to the priorities and budgetary constraints of participatory agencies and organizations. These goals, objectives, and recovery approaches may be modified in the future to accommodate new objectives and findings.

The responsible jurisdictions and all members of the recovery team have had an opportunity to review this document. However, this document does not necessarily represent the official positions of the agencies or the personal views of all individuals on the recovery team.

Success in the recovery of this species depends on the commitment and cooperation of many different constituencies that may be involved in implementing the directions set out in this strategy. The Ministry of Environment encourages all British Columbians to participate in the recovery of cliff paintbrush.

RECOVERY TEAM MEMBERS

Kym Welstead, B.C. Ministry of Environment
Brenda Costanzo, B.C. Ministry of Environment
Kathleen E. Wilkinson, Contractor

Former Recovery Team Members:

Ted Lea (retired), B.C. Ministry of Environment

AUTHORS

Cliff Paintbrush Recovery Team

RESPONSIBLE JURISDICTIONS

The British Columbia Ministry of Environment is responsible for producing a recovery strategy for cliff paintbrush under the *Accord for the Protection of Species at Risk in Canada*. Environment Canada's Canadian Wildlife Service participated in the preparation of this recovery strategy.

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EXECUTIVE SUMMARY

Cliff paintbrush is currently listed as Threatened under the *Species at Risk Act* and is known in Canada to be restricted to 15 populations in southwestern British Columbia including two historic records – one from the Coast Mountains and one from the Chilliwack River drainage of the Cascades Mountain Range. In 2005, the number of individuals in the province was estimated at fewer than 250 plants. Cliff paintbrush also occurs in Washington and Oregon, where it is more common and widespread.

Cliff paintbrush is a short, herbaceous perennial that occurs in rock crevices; on rocky ridges and slopes, talus, and scree at high elevations in the subalpine to primarily alpine vegetation zones. The plant is likely a facultative parasite, and likely on different host species. Cliff paintbrush is believed to be pollinated by hummingbirds and bees. Reproduction is solely by seeds, which are likely dispersed by wind, birds, and small mammals.

Potential threats to this species include resource extraction, recreational use, and climate change.

The long-term goal is to enable the persistence and maintenance of self-sustaining populations of cliff paintbrush with limited occurrence in the Cascade Mountain Range of British Columbia.

The objectives are to:

1. Confirm the presence and the population sizes at all current known locations and determine if additional populations exist in the Cascade Mountains by 2012.
2. Determine level of threat to populations by 2012 and establish mitigation measures as needed.
3. Address knowledge gaps relating to species biology, particularly reproductive success, and habitat requirements; and establish population trends through monitoring by 2013.

No critical habitat can be identified for cliff paintbrush in Canada at this time. It is expected that critical habitat will be proposed following the completion of outstanding work required to quantify specific habitat and area requirements for the species, further research on the biology of the species, and monitoring of the populations to determine population trends. Consultation with affected landowners and organizations will also be necessary.

An action plan will be completed by 2013.

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BACKGROUND

Species Assessment Information from COSEWIC

Date of Assessment: March 2005

Common Name (population): cliff paintbrush

Scientific Name: *Castilleja rupicola*

COSEWIC Status: Threatened

Reason for designation: A perennial of restricted occurrence found on cliffs, rock outcrops and ridges at high elevations. The small, fragmented populations consist of scattered individuals, likely fewer than 250 plants, which are exceptionally vulnerable to stochastic events.

Canadian Occurrence: British Columbia

COSEWIC Status History: Designated Threatened in May 2005. Assessment is based on a new status report.

Description of the Species

The cliff paintbrush is a multi-stemmed, herbaceous perennial, growing 10–20 cm in height from a slightly woody base (Figure 1). Each stem is unbranched and sparsely covered with long, soft, curly hairs. Leaves are alternate, and most are divided into 3–5 (sometimes 7) narrow, somewhat spreading lobes. The lower leaves are occasionally undivided. The relatively few flowers occur in compact clusters at the top of the stems. Each greenish flower has four stamens, and is 25–45 mm long, with a short-hairy beak-like upper lip that is the same length or longer than the tube at the base, and a much shorter, three-toothed and thickened lower lip. Below, the flowers are much shorter, usually deeply five-lobed bright scarlet or crimson bracts that have both short and long hairs. Each calyx is 15–25 mm long, long-hairy, with two main lobes that are subdivided into two short (1–5 mm long) blunt to sharp segments. The fruit is a capsule that contains many net-veined seeds.

Two other species of paintbrush occur in the same area, but small-flowered paintbrush (*Castilleja parviflora*) usually has purple to pinkish or white bracts that are three-lobed above the middle, rather than deeply five-lobed; and the crimson bracts of alpine paintbrush (*Castilleja rhexifolia*) are unlobed.

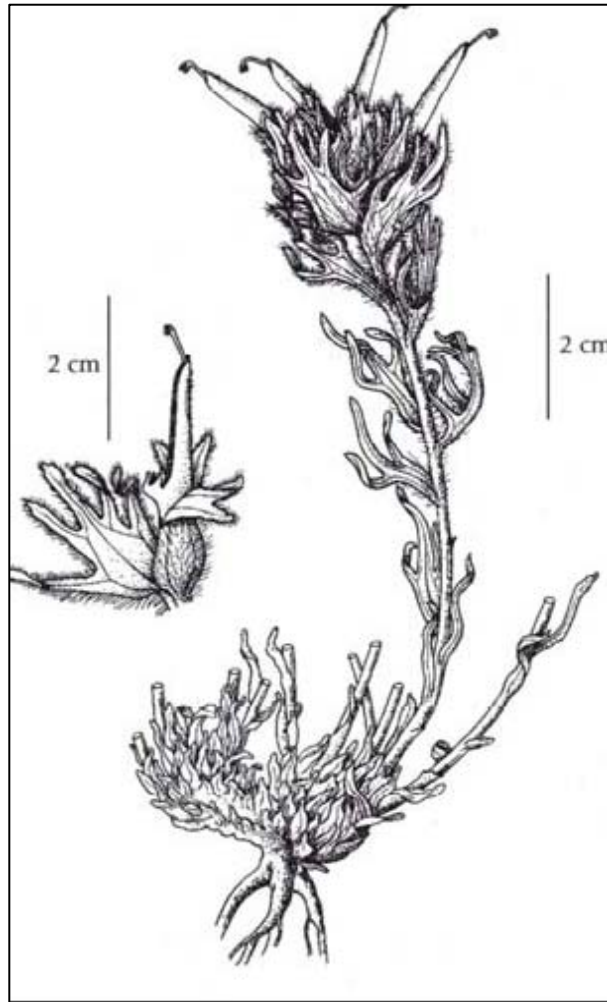


Figure 1. Illustration of cliff paintbrush. Line drawing by Elizabeth Stephen in Pojar 2000, with permission. Source: COSEWIC 2005.

Populations and Distribution

With the exception of one historical record from British Columbia's Coast Range, the only known locations for cliff paintbrush are in the Cascade Mountains from central Oregon through Washington and into southwestern British Columbia (Figure 2).

In Washington the plant is currently listed as SNR (status not yet assessed) by NatureServe (NatureServe 2008), but the species is listed as common in the western North Cascade Range (Douglas 1971; Taylor and Douglas 1995) and is considered uncommon but not rare in the state (Egger, pers. comm., 2007; Giblin, pers. comm., 2007). The plant is widely distributed in Washington, threats are minimal, and the population trend is likely stable (Egger, pers. comm. 2007; Giblin, pers. comm. 2007).



Figure 2. North American and global range of cliff paintbrush highlighted in grey. Source: COSEWIC 2005.

In Oregon, cliff paintbrush is more prevalent than was previously believed, there is a low level of threat, and populations appear to be stable (Vrilakas, pers. comm., 2007). The species is now considered to be of conservation concern but not currently threatened or endangered. NatureServe ranks this species in Oregon as S3 (vulnerable to extirpation or extinction; NatureServe 2008).

Approximately 15% of the global distribution of the plant occurs within Canada, all in British Columbia. Known Canadian populations are restricted to the Chilliwack and Skagit River drainages plus one historical occurrence in the Coast Mountains above Lion's Bay (Table 1; Figure 3). The latter population has not been relocated since the initial observation from 1912, and is potentially extirpated. The total extent of occurrence of extant populations in Canada was estimated at <1000 km² and area of occupancy at 200–300 m². Numbers in the province were estimated at less than 250 plants (COSEWIC 2005).

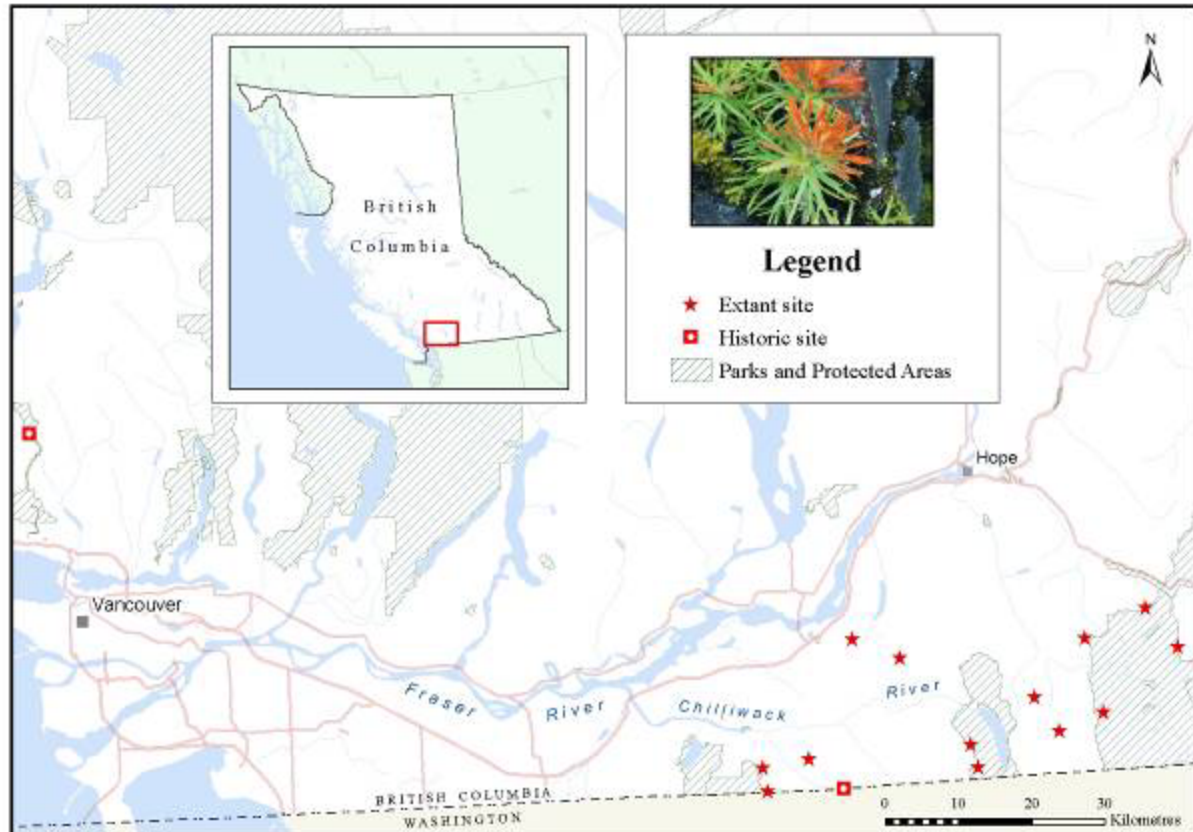


Figure 3. British Columbia locations for cliff paintbrush.

Table 1. Known records for cliff paintbrush in British Columbia.

Population number	Location	Date observed	Population/subpopulation numbers	Habitat	Elevation	Land ownership
1	Tomyhoi Peak	1901 (historical)	Unknown	Unknown	Unknown	Unknown
2	Mt. Brunswick, Coast Mtn. Range	1912 (historical)	Unknown	Unknown	Unknown	Cypress Provincial Park?
3	Mt. Cheam	(1) 1954 (2) 1981 (3) 2006	(1) Unknown (2) Unknown (3) At least 20 plants	(1) South slope; rocky, open (2) Exposed outcrop crevices on mountain slope (3) Exposed steep rocky slope, S-facing	1829-2100 m	Provincial Crown Land
4	Finlayson Peak, Whitworth Peak, Unnamed Mountain	(1) 1975 (2) 1988 (3) 1988	(1) Few plants (2) Few plants (3) Unknown	(1) Mountainside below peak (2) SE slopes (3) Rocky alpine peak and ridge	2150-2200 m	Skagit Valley Provincial Park
5	Mount Lindeman	1984	Few plants	Unknown	1981 m	Chilliwack Lake Provincial Park
6	Marmot Mountain	2003	1 plant/1m ²	Sparsely vegetated moist scree, 20% slope, SW aspect rocky alpine ridge	2020-2032 m	Skagit Valley Provincial Park
7	Mt. Bryce	2003	3 plants /5 m ²	Sparsely vegetated rocky peak, sheltered rocky outcrops, slope 40%, NW aspect	2120-2167 m	Skagit Valley Provincial Park
8	Mt. Rideout	2003	2 plants /2 m ²	Alpine scree/fine talus, slope 5%, SW aspect	Unknown	Provincial Crown Land
9	Klesilkwa Mountain	1992	Few plants	Alpine scree/fine talus, N slope	1950 m	Provincial Crown Land
10	Church Mountain	1984	Few plants	Subalpine south limestone cliff	Unknown	Provincial Crown Land
11	Thompson Peak	1984	Few plants	Unknown	Above 2000 m	Provincial Crown Land
12	Mt. Liumchen	(1) 1974 (2) 1984	(1) 1 plant (2) Few plants	(1) Gravelly soil below limestone ridgetop (2) Base of cliffs on SE slopes	1700–1800 m	Provincial Crown Land

13	Mt. McGuire	(1) 1984 (2) 1997 (3) 1999	(1) Few plants (2) Occasional (3) Locally abundant	(1) On SE slopes; in scree and at base of cliffs (2) On scree slopes above treeline (3) On steep rocky ridge; rock crevices	1600-2000 m	Provincial Crown Land
14	Foley Peak	1999	Few plants	Dry, exposed, rocky alpine 40% slope; SW aspect	1800-2200 m	Provincial Crown Land
15	Macdonald Peak	2006 – new since Status Report	Small patch 30 × 30 cm; scattered plants	Granite slab cliff, rocky ledge in high subalpine, N slope	1848-1878 m	Chilliwack Lake Provincial Park

Since the COSEWIC assessment and status report was prepared in 2005, cliff paintbrush has been recorded at one new location at Macdonald Peak, and re-discovered at one historic location on Mt. Cheam (see Table 1).

Detailed population information is unavailable for most recorded occurrences; however, based on the known records, the British Columbia population numbers appear to be very small. The available data for the populations range from noted as from one to three plants, scattered, or a “few” plants for all except two populations. The latter were described as being “locally abundant” and as “at least 20 plants observed” (CDC 2006). The alpine habitats occupied by the plant are quite isolated and remote from the major anthropogenic disturbances that have adversely affected so many rare species. It is therefore expected that populations in the province are relatively stable, similar to the situation in Washington and Oregon. However, it is not possible to determine the rate of change in geographic distribution and/or population trend in British Columbia based on limited existing data.

Current status of the species is summarized in Table 2. Cliff paintbrush is a priority 3 species under goals 1 and 3 of the B.C. Conservation Framework (see <http://www.env.gov.bc.ca/conservationframework/> for details).

Table 2. Status ranks of cliff paintbrush.

Location	Rank	Source
Global	G3	Nature Serve 2008
United States	N2N3	Nature Serve 2008
Washington	SNR	Nature Serve 2008
Oregon	S3	Nature Serve 2008
Canada	N2N3	BC CDC 2008
British Columbia	S2, Red-listed	BC CDC 2008

Needs of the cliff paintbrush

Habitat needs

The primary source for the following information is the COSEWIC status report (2005).

Cliff paintbrush is found in the Alpine Tundra and Mountain Hemlock biogeoclimatic zones of British Columbia (Province of B.C. 1991). The plant occurs at moderate to high elevation (from approximately 1600 to 2300 m) in the subalpine to alpine zones, and inhabits rocky ridges, outcrops, and crevices, exposed slopes, dry to mesic cliffs, scree, and talus, with various aspects.

Cliff paintbrush grows primarily on gravelly or stony soils derived from volcanic igneous rock (Figure 4), although it was noted as growing on or adjacent to limestone rock on two of the occurrences provided by the B.C. Conservation Data Centre (2006). Associated species include woolly pussytoes (*Antennaria lanata*), alpine paintbrush (*Castilleja rhexifolia*), golden fleabane (*Erigeron aureus*), Davidson's penstemon (*Penstemon davidsonii* var. *menziesii*), spreading phlox (*Phlox diffusa*), villous cinquefoil (*Potentilla villosa*), spotted saxifrage (*Saxifraga bronchialis*), Lyall's goldenweed (*Tonestus lyallii*), dwarf snow willow (*Salix nivalis*), moss campion (*Silene acaulis*), and spike trisetum (*Trisetum spicatum*).

Climatic conditions for the region are characterized by warm, dry summers and wet winters, with abundant snow at higher elevations.

There does not appear to be a lack of suitable habitat for the plant within its range in British Columbia, although microhabitat preferences have not been determined.



Figure 4. Alpine habitat of cliff paintbrush (Copyright Mark Egger).

Biological needs

Cliff paintbrush is likely a facultative parasite, but the host species are unknown. Many *Castilleja* species parasitize plants from a wide range of species (Heckard 1962; Ceska, pers. Comm., 2007; Egger, pers. comm., 2007) which suggests that some grasses may act as hosts in some B.C.

locations. Based on observations of the *Castilleja* genus as a whole, plants appear to be more vigorous, with earlier flowering if they are growing as a parasite on another plant (Heckard 1962; Egger, pers. comm., 2007). However, in many observed occurrences, such as in rock crevices, the cliff paintbrush does not appear to be parasitic.

As noted in the COSEWIC status report (2005), the plant likely requires cross-pollination and may be pollinated by bees or hummingbirds. Egger (pers. comm., 2007) indicates that Rufous Hummingbirds (*Selasphorus rufus*) are likely pollinators in Washington, and this may be the case in British Columbia as well. Reproduction appears to be solely by seeds, which are likely dispersed by gravity, wind, birds, and small mammals.

Ecological role

The ecological role played by cliff paintbrush is unknown. Given its small numbers in British Columbia it seems unlikely that it is an important food source for pollinating insects or herbivores, or is a significant colonizer of new or disturbed sites.

Limiting factors

No definitive information is available on biologically limiting factors for the cliff paintbrush.

The isolated occurrences and extremely small number of plants noted at many sites (B.C. CDC 2006) may limit reproductive success. Although most plants observed in British Columbia are described as healthy (Ceska, pers. comm., 2007; Lomer, pers. comm., 2007; Smith, pers. comm., 2007), almost no quantitative data is available regarding number of flowering stems, fruit and seed production, germination rate, and seedling survival. The small population sizes may subject the population to decreased genetic diversity and decreased population viability (Schaal and Leverich 2004), although research by Ellstrand and Elam (1993) suggests that species with a history of small, persistent population size are less susceptible. Small populations are also susceptible to catastrophic loss of individuals through random natural events.

Because the cliff paintbrush is at the extreme northern limit of its range in southern British Columbia, cold temperatures and growing seasons occasionally cut short by inopportune frosts may contribute to low numbers. As previously stated, the plant is more abundant in Washington and Oregon. Although the plant is capable of producing many seeds in the United States (Hitchcock et al. 1984), this may not be the case in British Columbia. Even if many seeds are produced it is possible there is low seed germination and/or seedling survival.

The availability of pollinators at a critical time may be a limiting factor, but this is regarded as unlikely, at least in Washington, for the cliff paintbrush (Giblin, pers. comm., 2007).

Other limiting factors potentially include herbivory and loss of populations from avalanches because the species occupies steep slopes in the alpine and subalpine.

Threats

There is no evidence to indicate that cliff paintbrush populations and their habitat are currently exposed to any significant threats because of their relatively isolated, high subalpine and alpine locations. There are some potential threats, however, and these are described below.

Resource extraction

Although the relatively isolated high-elevation rocky sites where the cliff paintbrush occurs would not be subject to direct impacts from logging, the Crown land could be considered for mineral mining or gravel extraction in the future. If site access improves in the future the threat free status could change. For example, if logging roads are extended close to plant locations, or if mining of high-elevation sites takes place.

Recreational use

Although all recorded populations of cliff paintbrush are situated in areas used for recreation (including four in Skagit Valley Provincial Park, two in Chilliwack Lake Provincial Park, and one possibly in Cypress Provincial Park), several of these locations are inaccessible except by helicopter. Other populations may be reached by hiking strenuous trails with considerable elevation gain. It is therefore considered unlikely that trampling and picking of flowers and other disturbance to habitat by outdoor recreationists is a significant threat to the species at this time.

Climate change

The only threat identified by the cliff paintbrush assessment and Status Report (COSEWIC 2005) was climate change, because it may cause habitat alteration. There appears to be a trend for summers to become warmer and drier within the species range. With longer growing period, population sizes may increase and/or the species may extend its range farther north. It is difficult to speculate on the effect increased winter rainfall and more extreme weather events (as is predicted in coastal B.C.) will have on the plant and its habitat. The effects of climate change on likely pollinator species (hummingbirds and bees) are also unknown.

Actions Already Completed or Underway

A recovery team has been established for the cliff paintbrush and the species is incorporated into the South Coast Conservation Program (<http://www.sccp.ca>), a landscape-level conservation initiative covering the south coast of British Columbia. Because there are no significant threats, no species-specific actions have been undertaken to protect the cliff paintbrush in British Columbia.

Knowledge Gaps

Little information is available on the cliff paintbrush in British Columbia. The species has been recorded from only 13 extant locations and, for many records, there is little or no information on numbers, habitat, associated species, or factors affecting the plant at the site.

Therefore, the following knowledge gaps are considered for the species at this time:

- Presence of additional populations
- Microhabitat and microclimatic requirements
- Reproductive capacity of populations
- Population trends
- Short- and long-term land-use plans for sites where cliff paintbrush occurs
- Pollinator species, their habitat requirements, and population trends
- Degree of parasitism and host species
- If augmentation of populations through *ex situ* propagation is considered at any time in the future, knowledge of propagation requirements would be useful. These have been described for other species of *Castilleja* (Guppy 1997), but not specifically for the cliff paintbrush.

RECOVERY

Recovery Feasibility

Recovery of the cliff paintbrush is considered feasible, based on technical and biological considerations.

Table 3. Recovery feasibility.

Criteria	Comments
1. Are individuals capable of reproduction currently available to improve the population growth rate or population abundance?	Yes. Observers indicate that at least some plants appeared healthy and were producing seed (Ceska, pers. comm., 2007; Lomer, pers. comm., 2007).
2. Is sufficient suitable habitat available to support the species or could it be made available through habitat management or restoration?	Yes. Sufficient habitat appears to be currently available to support the species.
3. Can significant threats to the species or its habitat be avoided or mitigated through recovery actions?	Yes. There are no known significant threats to the species at this time. Potential threats can be avoided or mitigated.
4. Do the necessary recovery techniques exist and are they demonstrated to be effective?	Yes. Necessary, effective recovery techniques exist to recover the species.

Recovery Goal

The long-term goal is to enable the persistence and maintenance of self-sustaining populations of cliff paintbrush with limited occurrence in the Cascade Mountain Range of British Columbia.

Rationale for the Recovery Goal

The species occurs as small, isolated populations in British Columbia where it is at the northern limits of its range and current knowledge suggests that the plant is naturally rare in B.C. Because the historical record from the Mt. Brunswick (Coast Mountains) has not been re-located, this location is not included in the recovery efforts. Maintaining multiple populations will help to mitigate the effects of catastrophic loss at any one site, which in this case could result from such factors as demographic collapse, avalanches, or herbivory. It does appear possible to maintain

most existing populations where they are currently found, simply by ensuring that they are not under threat from human activities. Active manipulation, such as propagation or transplanting, is not recommended at this time.

Recovery Objectives

The objectives are designed to achieve the long-term goal of persistence and maintenance of the species within its limited occurrence in the Cascade Mountain Range of B.C.

1. Confirm the presence and the population sizes at all current known locations and determine if additional populations exist in the Cascade Mountains by 2012.

Rationale: Many sites where cliff paintbrush have been recorded were visited only once, sometimes many years ago, and information on population size and/or habitat conditions is incomplete or lacking (see Table 1). To ensure the persistence of populations, it must be determined if they are extant.

2. Determine level of threat to populations by 2012 and establish mitigation measures as needed.

Rationale: Projected land use should be determined for all known sites to determine whether there will be future threats to the species from such activities as extension of logging roads and mineral exploration. If threats exist, tenure appropriate threat mitigation measures should be applied.

3. Address knowledge gaps relating to species biology, particularly reproductive success and habitat requirements; and establish population trends through monitoring by 2013.

Rationale: This information will assist in updating the population and distribution objectives and, combined with inventory results, could result in a change of status for the plant in Canada. It will also assist with an assessment of the potential impacts of climate change on cliff paintbrush and its potential survival in Canada over a longer time period.

Approaches Recommended to Meet Recovery Objectives

Table 4 summarizes the recommended recovery approaches to achieve the objectives.

Recovery planning table

Table 4. Recovery planning table for cliff paintbrush.

Priority	Obj. no.	Threat or need addressed	Broad strategy	Recommended approaches to meet recovery objectives
Necessary	1	Knowledge gap	Inventory	<ul style="list-style-type: none"> Examine known recorded sites to determine if cliff paintbrush is still present; record habitat conditions and population numbers. Conduct a targeted inventory of potential habitat to see if the plant occurs in additional locations in the Cascade Mountains.
Necessary	2	Resource extraction, recreational use	Determine level of threat	<ul style="list-style-type: none"> Determine proposed land use and potential threats affecting the plant and its habitat, and suggest appropriate mitigation options.
Necessary	2	Resource extraction, recreational use	Communication and coordination	<ul style="list-style-type: none"> Explore regulatory options to protect the species on Crown lands. Ensure that appropriate government departments and agencies (e.g., ministries of Environment, Agriculture and Lands, Forests and Range, Energy Mines and Petroleum Resources, Fraser Valley Regional District) are aware of plant's locations and need for protection. For populations within provincial parks, ensure that protection strategies for the plant are included in park management plans. Provide signage that rare species are present at sites that are accessible by recreationists.
Necessary	3	Knowledge gap, demographic collapse	Monitoring, research	<ul style="list-style-type: none"> Conduct surveys every 2-5 years over a 10- or 15-year period to determine population viability and help determine population trends. Determine microhabitat characteristics (soil and climatic conditions). Determine levels of parasitism and potential host plants.

Performance Measures

Table 5 outlines the recommended performance measures to evaluate progress in achieving recovery objectives.

Table 5. Performance measures to evaluate recovery objectives.

Objective	Broad approach	Performance measures
1	Inventory	<ul style="list-style-type: none"> Additional populations are found or locations are considered low potential. Presence of known populations is confirmed and population sizes are known.
2	Communication and coordination	<ul style="list-style-type: none"> Protection has been provided for known populations if required. Appropriate government agencies (Ministry of Forests and Range; Ministry of Energy, Mines and Petroleum Resources) and agencies are aware of the plant's locations, need for protection, and protection measures are in place. Strategies for protecting the plant in provincial parks are included in park management plans. Signs indicating that rare plant species are present are erected at sites accessible by recreationists. Proposed land use is known for all populations and potential threats are identified.
3	Inventory	<ul style="list-style-type: none"> All known populations confirmed as extant or not present at the time of the survey. More detail provided regarding habitat conditions and population sizes. Above information is used to help predict high-potential sites for additional surveys.
3	Research	<ul style="list-style-type: none"> Clearer understanding of viability of known populations. Standardized monitoring provides information on species biology and microhabitat requirements. Based on information provided through inventory, monitoring, and reporting of results, a population trend emerges for cliff paintbrush.

Critical Habitat

Identification of the species' critical habitat

No critical habitat can be identified for cliff paintbrush in Canada at this time. It is expected that critical habitat will be proposed following the completion of outstanding work required to quantify specific habitat and area requirements for the species, further research on the biology of the species, and monitoring of the populations to determine population trends. Consultation with affected landowners and organizations will also be necessary.

The general habitat characteristics (high alpine rocky slopes, ridges, crevices, scree, gravelly soil) are known for cliff paintbrush. However, many sites where the plant has been recorded have

been visited only once, sometimes many years ago or during an unusually unfavourable growing season (BC CDC 2006), and information on population extent of occurrence and/or detailed habitat conditions is incomplete or lacking (see Table 1). In addition, it is quite possible that additional populations exist within the Cascade Mountain range.

Recommended schedule of studies to identify critical habitat

Table 6 outlines activities to more fully delineate critical habitat and the anticipated outcomes from these activities. Further detail on methodology for these activities can be found in Table 4.

Table 6. Schedule of studies to identify critical habitat.

Activity	Rationale/outcome	Completion date
1. Re-survey existing populations	<ul style="list-style-type: none"> Determine extent of occurrence and fill in information gaps regarding population numbers and habitat conditions using BC Conservation Data Centre Rare Plant Survey forms 	2012
2. Identify additional populations through targeted surveys of high-potential habitat	<ul style="list-style-type: none"> Determine extent of occurrence and add to knowledge regarding overall population numbers, habitat conditions 	2012
3. Characterize microhabitat conditions during above surveys	<ul style="list-style-type: none"> Add to knowledge of soil conditions, microclimate, and hydrology to determine plant physiological tolerances 	2012
4. Assess species biological requirements	<ul style="list-style-type: none"> Gain knowledge of life history including dispersal ability 	2012
5. Map critical habitat for each extant population	<ul style="list-style-type: none"> Using results obtained from Activities 1-4 allows for mapping more quantitatively defined critical habitat 	2012
6. Monitor to assess population viability and population trends	<ul style="list-style-type: none"> Results obtained determine which populations are likely to be viable over the long term and critical habitat is modified as necessary 	2012

Existing and Recommended Approaches to Habitat Protection

All known populations of cliff paintbrush occur on provincial Crown land: four of these are situated in Skagit Valley Provincial Park and two are in Chilliwack Lake Provincial Park. Provincial parks fall under the administration of the B.C. *Park Act* (Queens Printer 1996). Within provincial parks, natural resources, including plants, cannot be removed, damaged, or disturbed except as authorized by a park use permit. Strategies for protecting cliff paintbrush should be included in relevant park management plans.

None of the other populations are currently protected, but the species has the potential to be added to the list of species for protection under the provincial *Wildlife Amendment Act* (2004).

If protection of all populations is not considered feasible, an alternative approach could be to prioritize locations for protection based on criteria such as numbers of plants present, connectivity of the population to other locations of the species, productivity of the habitat, and significance of the location for maintaining the species distribution.

Appropriate provincial government departments, ministries of Environment, Agriculture and Lands, Forests and Range, Energy, Mines and Petroleum Resources, and the Fraser Valley Regional District should be made aware of the plant's locations, need for protection, and protection measures that are proposed or in place.

Effects on Other Species

No negative effects are anticipated on non-target species, natural communities, or ecological processes as a result of the recommended recovery activities. Protecting sites under legislative tools may have a beneficial effect by preserving habitat for additional species, natural communities, and ecological processes. Also, surveys to confirm existing and potential new populations of cliff paintbrush may have a positive effect by identifying additional locations for other species at risk. Appendix A lists species at risk that may occur in habitat similar to cliff paintbrush.

Socioeconomic Considerations

The high-elevation alpine locations where the cliff paintbrush occurs are not currently slated for any form of industrial use and therefore recommended recovery objectives are not anticipated to cause any socioeconomic impacts at this time. If known locations are protected and no recreational use is allowed, this will have a low to moderate impact on recreational users.

Recommended Approach for Recovery Implementation

It may be possible to combine recovery planning for this species with efforts to recover other plant species at risk that occupy a similar habitat in the Cascades Mountain range under the South Coast Conservation Program. These species are listed in Appendix A. At this time, however, a single-species approach to recovery is recommended for the cliff paintbrush.

For successful implementation in protecting species at risk there will be a strong need to engage in stewardship on a variety of land tenures. Stewardship involves the voluntary cooperation of landowners to protect species at risk and the ecosystems they rely on. It is recognized in the preamble to the federal *Species at Risk Act* (SARA) that “stewardship activities contributing to the conservation of wildlife species and their habitat should be supported”. It is recognized in the Bilateral Agreement on Species at Risk, between British Columbia and Canada that: “stewardship by land and water owners and users is fundamental to preventing species from becoming at risk and in protecting and recovering species that are at risk” and that “cooperative, voluntary measures are the first approach to securing the protection and recovery of species at risk”.

Statement on Action Plans

A recovery action plan will be completed by 2013.

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Personal Communications

Adolf Ceska, January 2007. Private Consultant and Botanist, Victoria, BC.

Mark Egger, January 2007. Botanist, Seattle, WA.

David Giblin, January 2007. Herbarium Collections Manager, University of Washington, Seattle, WA.

Frank Lomer, January 2007. Private Consultant and Botanist, New Westminster, BC.

Shyanne Smith, January 2007. Botanist, Victoria, BC.

Susan Vrilakas, January 12, 2007. Botany Data Manager, Oregon Natural Heritage Information Program.

APPENDIX A

Species at Risk with high potential to occur in similar locations as cliff paintbrush.

Scientific name	Common name	Provincial status	B.C. list	COSEWIC designation	B.C. Conservation Framework	
					Priority	Goal
<i>Anemone drummondii</i> var. <i>drummondii</i>	Alpine anemone	S2S3	Blue	n/a	3	3
<i>Cryptogramma cascadiensis</i>	Cascade parsley fern	S2S3	Blue	n/a	3	3
<i>Draba lonchocarpa</i> var. <i>thompsonii</i>	Lance-fruited draba	S2S3	Blue	n/a	3	3
<i>Elmera racemosa</i> var. <i>racemosa</i>	Elmera	S2S3	Blue	n/a	3	3
<i>Epilobium glaberrimum</i> ssp. <i>fastigiatum</i>	Smooth willowherb	S2S3	Blue	n/a	3	3
<i>Polemonium elegans</i>	Elegant Jacob's-ladder	S2S3	Blue	n/a	3	3
<i>Smelowskia ovalis</i>	Short-fruited smelowskia	S2S3	Blue	n/a	3	3
<i>Viola purpurea</i> var. <i>venosa</i>	Purple-marked yellow violet	S1S3	Red	n/a	2	3
<i>Asplenium adulterinum</i>	Corrupt spleenwort	S2S3	Blue	n/a	2	1
<i>Papilio indra</i>	Indra Swallowtail	S1	Red	n/a	1	3
<i>Aplodontia rufa</i>	Mountain Beaver	S3	Blue	Special Concern	4	2
<i>Gulo gulo</i> ssp. <i>luscus</i>	Wolverine, <i>luscus</i> ssp.	S3	Blue	Special Concern	2	2
<i>Ursus arctos</i>	Grizzly Bear	S3	Blue	Special Concern	2	2