

**COSEWIC**  
**Assessment and Update Status Report**

on the

**Deltoid Balsamroot**  
*Balsamorhiza deltoidea*

in Canada



**ENDANGERED**  
**2009**

**COSEWIC**  
Committee on the Status  
of Endangered Wildlife  
in Canada



**COSEPAC**  
Comité sur la situation  
des espèces en péril  
au Canada

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Deltoid Balsamroot — Photo by Hans Roemer.

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## COSEWIC Assessment Summary

### Assessment Summary – April 2009

**Common name**

Deltoid Balsamroot

**Scientific name**

*Balsamorhiza deltoidea*

**Status**

Endangered

**Reason for designation**

A showy perennial comprising only eight natural populations containing about 1600 mature plants. The largest population has declined greatly due to site development in recent years and accounts for most of the 35-40% decline in the total Canadian population. All populations experience continued habitat degradation from competition with invasive introduced plants. Four of the eight populations are also at risk of extirpation from stochastic events due to the presence of only one to several plants in each.

**Occurrence**

British Columbia

**Status history**

Designated in April 1996 as Endangered. Status re-examined and confirmed Endangered in May 2000 and in April 2009. Last assessment based on an update status report.



**COSEWIC**  
**Executive Summary**

**Deltoid Balsamroot**  
*Balsamorhiza deltoidea*

**Species information**

Deltoid Balsamroot (*Balsamorhiza deltoidea*) is a perennial herb arising from a deep, fleshy taproot with stems reaching to heights of 1 m. It is a member of the aster family. The basal leaves are large, long-stalked and triangular. The stem leaves are much smaller and narrower. Each flower head consists of a central disk bearing small yellow flowers and a peripheral ring of larger yellow flowers. The fruits are small, dry, hairless achenes.

**Distribution**

Deltoid Balsamroot occurs from the southeast coast of Vancouver Island south through Puget Sound to the Willamette Valley of central Oregon onwards into California.

In Canada, it is known from coastal locations on the southeast side of Vancouver Island from Campbell River to the vicinity of Victoria. The extent of occurrence is approximately 1,000 – 1,200 km<sup>2</sup>. The Canadian populations are approximately 150 km from the nearest extant populations in the United States. The Canadian range constitutes less than 1% of the species' global range. The current Index of Area of Occupancy is 16 km<sup>2</sup>.

**Habitat**

In Canada, Deltoid Balsamroot occurs from low to mid elevations (up to 250 m asl). The soil tends to be well to rapidly drained. The soil is generally moist in the spring but the moisture level diminishes as the growing season progresses. By the time the fruits are developing and the plants are senescing, the soil experiences significant water deficits for prolonged periods.

Deltoid Balsamroot usually occurs in woodlands dominated by Garry Oak and/or Douglas-fir, or in meadow ecosystems. Shrubs are usually sparse although invasive shrubs are often present. The herb layer tends to be well developed and dominated by a relatively even mix of grasses and forbs. Invasive grasses are always present and often dominate the herb layer.

The amount of potential habitat on southeast Vancouver Island and the adjacent offshore islands has declined greatly over the past century as suitable woodlands and maritime meadows have been destroyed during the development of land for residential and recreational use. A significant portion of the habitat supporting the largest Canadian population, near Campbell River, has been converted into parking lots and light industrial developments since the species was last assessed in 2000.

First Nations on southeast Vancouver Island used fire extensively to stimulate the growth of food species and improve forage for game species. Fire suppression has led to major changes in vegetation and soil conditions that have greatly reduced the suitability of remaining habitat. The habitat at most locations has greatly deteriorated due to invasion by exotic invasive shrubs and grasses.

Two populations occur on federal lands: one in a national historic site and the other in an Indian Reserve. One population occurs in a provincial ecological reserve, as well as on adjacent private land. Three populations occur in parks managed by municipal or regional governments. The remaining two populations occur completely within private lands.

## **Biology**

In Canada, shoot dormancy begins to break in April and flowering peaks in May. The flowers are pollinated by insects. Seed production is often limited by vertebrate grazing, insects feeding in the flower heads, and high levels of seed abortion. The dry fruits are shed as the plants begin to wither, usually in late June, and most seeds probably fall close to the parent plants.

Seeds probably germinate in early spring. Most plants likely require several years to reach maturity.

In Canada, natural populations of Deltoid Balsamroot may be heavily affected by vertebrate and invertebrate defoliators.

## **Population sizes and trends**

Deltoid Balsamroot has been reported from at least 16, and perhaps as many as 20 locations in Canada, only eight of which have extant populations. Based on the most recent data, from each site, in 2007 there were 1,589 plants in Canada that are large enough to flower.

Most subpopulations/populations appear to have been relatively stable since 1996, however the largest population has declined from a peak of approximately 1,700 plants in 1992 to 345 plants in 2007. This is the result of commercial development of the site in 2003. The sharp decline in this population accounts for most of the 35-40% decline in the total Canadian population since 1996.

## **Limiting factors and threats**

Apart from the threats posed by invasive species and herbivory, some Deltoid Balsamroot populations are threatened by trampling, flower-picking and trail maintenance activities. Actions have been taken to protect five of the populations from invasive shrubs, trampling and/or herbivory. Little action has been taken to control invasive grasses and forbs.

Four of the populations contain 10 or fewer mature plants, which predisposes them to extirpation by random events.

## **Special significance of the species**

Deltoid Balsamroot has many traditional uses for culinary and medicinal purposes. Early settlers in the Victoria area used the seeds as chicken feed. The species has significant potential as a garden plant because of its showy blooms, although it tends to be susceptible to invertebrate herbivory.

## **Existing protection or other status designations**

Deltoid Balsamroot is globally secure. It is ranked as a critically imperilled (S1) species in British Columbia, the only province/territory where it occurs. COSEWIC assessed Deltoid Balsamroot as Endangered in Canada in 2000. This endangered species is protected under Schedule 1 of the *Species at Risk Act* on federal lands such as Indian Reserves and National Historic Sites.



## COSEWIC HISTORY

The Committee on the Status of Endangered Wildlife in Canada (COSEWIC) was created in 1977 as a result of a recommendation at the Federal-Provincial Wildlife Conference held in 1976. It arose from the need for a single, official, scientifically sound, national listing of wildlife species at risk. In 1978, COSEWIC designated its first species and produced its first list of Canadian species at risk. Species designated at meetings of the full committee are added to the list. On June 5, 2003, the *Species at Risk Act* (SARA) was proclaimed. SARA establishes COSEWIC as an advisory body ensuring that species will continue to be assessed under a rigorous and independent scientific process.

## COSEWIC MANDATE

The Committee on the Status of Endangered Wildlife in Canada (COSEWIC) assesses the national status of wild species, subspecies, varieties, or other designatable units that are considered to be at risk in Canada. Designations are made on native species for the following taxonomic groups: mammals, birds, reptiles, amphibians, fishes, arthropods, molluscs, vascular plants, mosses, and lichens.

## COSEWIC MEMBERSHIP

COSEWIC comprises members from each provincial and territorial government wildlife agency, four federal entities (Canadian Wildlife Service, Parks Canada Agency, Department of Fisheries and Oceans, and the Federal Biodiversity Information Partnership, chaired by the Canadian Museum of Nature), three non-government science members and the co-chairs of the species specialist subcommittees and the Aboriginal Traditional Knowledge subcommittee. The Committee meets to consider status reports on candidate species.

## DEFINITIONS (2009)

Wildlife Species	A species, subspecies, variety, or geographically or genetically distinct population of animal, plant or other organism, other than a bacterium or virus, that is wild by nature and is either native to Canada or has extended its range into Canada without human intervention and has been present in Canada for at least 50 years.
Extinct (X)	A wildlife species that no longer exists.
Extirpated (XT)	A wildlife species no longer existing in the wild in Canada, but occurring elsewhere.
Endangered (E)	A wildlife species facing imminent extirpation or extinction.
Threatened (T)	A wildlife species likely to become endangered if limiting factors are not reversed.
Special Concern (SC)*	A wildlife species that may become a threatened or an endangered species because of a combination of biological characteristics and identified threats.
Not at Risk (NAR)**	A wildlife species that has been evaluated and found to be not at risk of extinction given the current circumstances.
Data Deficient (DD)***	A category that applies when the available information is insufficient (a) to resolve a species' eligibility for assessment or (b) to permit an assessment of the species' risk of extinction.

\* Formerly described as "Vulnerable" from 1990 to 1999, or "Rare" prior to 1990.

\*\* Formerly described as "Not In Any Category", or "No Designation Required."

\*\*\* Formerly described as "Indeterminate" from 1994 to 1999 or "ISIBD" (insufficient scientific information on which to base a designation) prior to 1994. Definition of the (DD) category revised in 2006.



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COSEWIC Status Report**

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## TABLE OF CONTENTS

SPECIES INFORMATION.....	3
Name and classification.....	3
Morphological description.....	3
Genetic description.....	3
Designatable units.....	3
DISTRIBUTION.....	4
Global range.....	4
Canadian range.....	5
HABITAT.....	9
Habitat requirements.....	9
Habitat trends.....	10
Protection/ownership.....	12
BIOLOGY.....	12
Life cycle and reproduction.....	12
Herbivory.....	13
Physiology.....	13
Dispersal.....	13
Interspecific interactions.....	13
POPULATION SIZES AND TRENDS.....	13
Search effort.....	13
Abundance.....	15
Fluctuations and trends.....	15
Rescue effect.....	16
LIMITING FACTORS AND THREATS.....	16
SPECIAL SIGNIFICANCE OF THE SPECIES.....	17
EXISTING PROTECTION OR OTHER STATUS DESIGNATIONS.....	17
TECHNICAL SUMMARY.....	18
ACKNOWLEDGEMENTS AND AUTHORITIES CONSULTED.....	20
INFORMATION SOURCES.....	20
Authorities consulted.....	20
Literature cited.....	20
BIOGRAPHICAL SUMMARY OF REPORT WRITER.....	22
COLLECTIONS EXAMINED.....	22
<b>List of Figures</b>	
Figure 1. Illustration of Deltoid Balsamroot.....	4
Figure 2. Global distribution of Deltoid Balsamroot.....	5
Figure 3. Canadian distribution of Deltoid Balsamroot.....	6
Figure 4. Search effort by Fairbarns.....	14
<b>List of Tables</b>	
Table 1. Localities, population and land ownership for Deltoid Balsamroot.....	7

## SPECIES INFORMATION

### Name and classification

Scientific name: *Balsamorhiza deltoidea* Nutt.

Common name: Deltoid Balsamroot

Family: Asteraceae (Aster family)

Major plant group: Eudicot flowering plant

Deltoid Balsamroot is a well-defined species with no distinct subspecies or varieties (ITIS 2007).

### Morphological description

Deltoid Balsamroot (Figure 1) is a perennial herb arising from a deep, fleshy taproot that bears one or more crowns. Each crown may produce one to several erect, up to 1 m tall, unbranched stems from a common base. The basal leaves are long-stalked, with large triangular blades as much as 50 cm long and 20 cm wide. Their margins are toothed but never lobed. The stem leaves are much smaller and somewhat narrower and the leaf stalks are progressively smaller up the stem. Each flower head consists of a central disk bearing small yellow flowers and a peripheral ring of larger yellow flowers. The fruits are small, dry, hairless achenes (Hitchcock *et al.* 1955). Arrowleaf Balsamroot (*Balsamorhiza sagittata*) is the only other species in Canada that might be confused with Deltoid Balsamroot, but the ranges of the two species do not overlap in Canada.

### Genetic description

Deltoid Balsamroot is a diploid with a haploid number of  $n=19$  (Weber 1946). Studies of the internal transcribed spacer region of the nuclear ribosomal DNA indicate marked differences among different U.S. populations (Moore and Bohs 2003).

### Designatable units

A single designatable unit is recognized based on the occurrence of a single entity in Canada that is geographically restricted to a small region of British Columbia within the Pacific National Ecological Area recognized by COSEWIC.



Figure 1. Illustration of Deltoid Balsamroot. (J. Rumley from Hitchcock *et al.* 1955 with permission; entire plant; involucre and single floret)

## DISTRIBUTION

### Global range

Deltoid Balsamroot occurs from the southeast coast of Vancouver Island south through Puget Sound to the Willamette Valley of central Oregon onwards into California, where it occurs both in the foothills of the Sierra Nevada mountains and dry coastal areas as far as the vicinity of Santa Barbara (Figure 2).

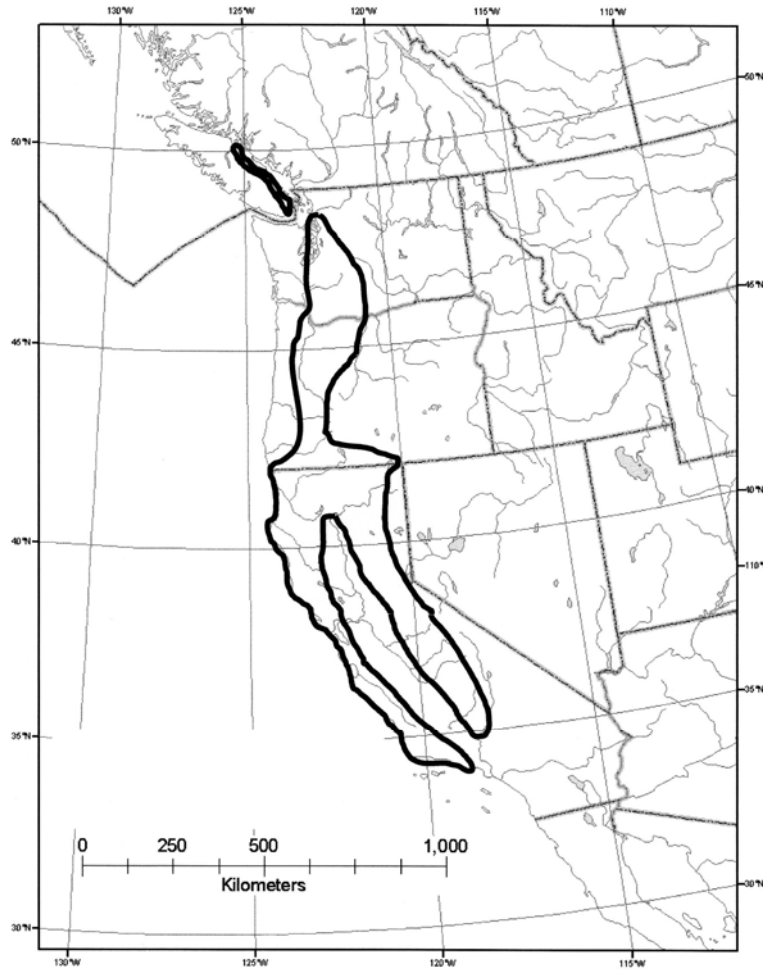


Figure 2. Global distribution of Deltoid Balsamroot.

### Canadian range

In Canada, Deltoid Balsamroot is known from coastal locations on the southeast side of Vancouver Island from Campbell River to the vicinity of Victoria (Figure 3). The Extent of Occurrence (EO) was estimated by calculating the approximate length (in km) of coastline between northernmost and southernmost locations and multiplying this value by 3.0 (because the species is unlikely to grow more than 3 km inland). Using this procedure, the EO is estimated at approximately 1,000 – 1,200 km<sup>2</sup>. This may represent an overestimate of its extent of occurrence in Canada because the collection history indicates that the Campbell River population is disjunct rather than continuous with its main range further south in Canada. Based on a 1 x 1 km grid, the historic Index of Area of Occupancy (IAO) is 16 km<sup>2</sup> and the present value is 8 km<sup>2</sup>. Based on a 2 x 2 km grid, the historic IAO is 32 km<sup>2</sup> and the present value is 16 km<sup>2</sup>. Given the small size of occupied habitat and adjacent suitable habitat at extant locations the 1 x 1 km grid is more biologically appropriate than the coarser grid.

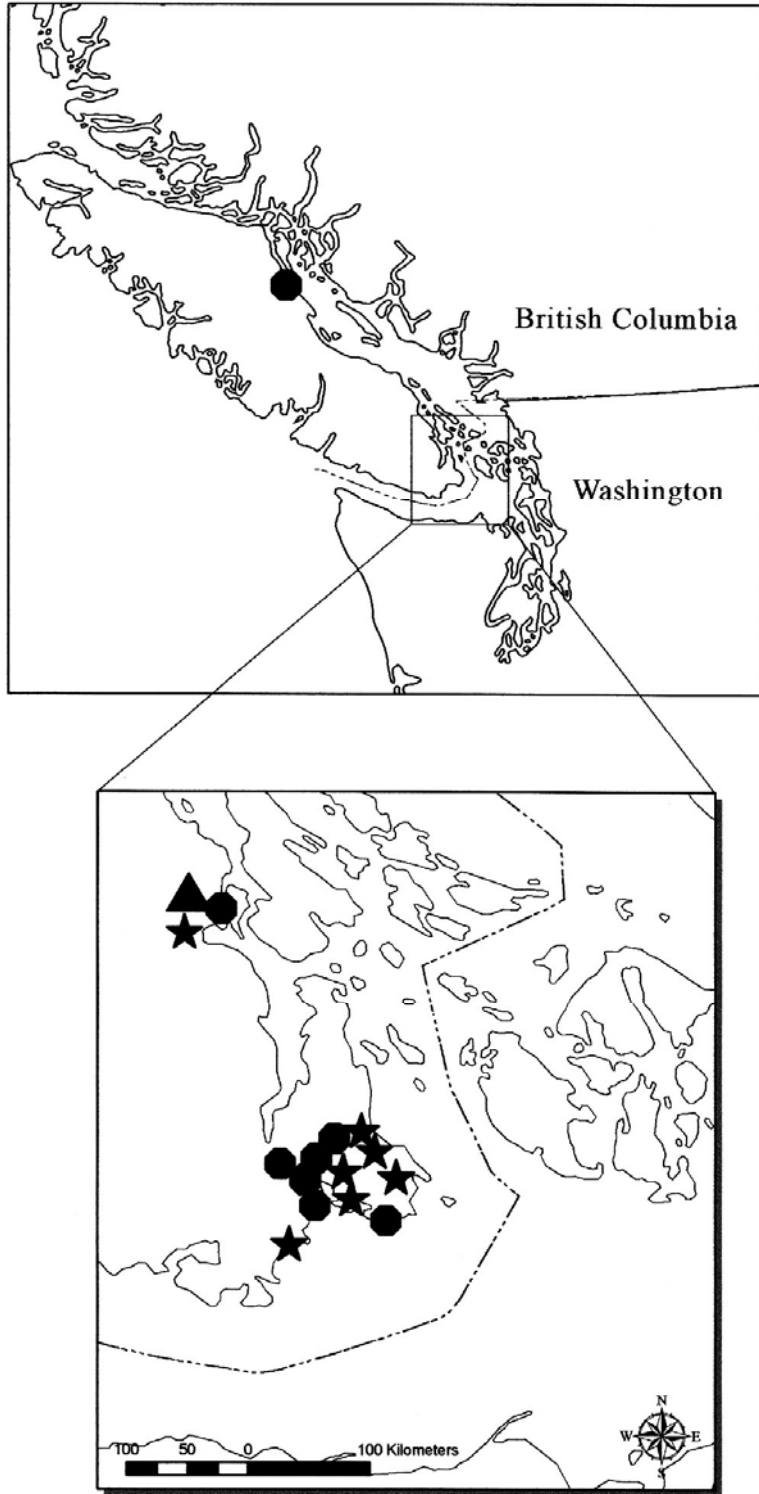


Figure 3. Canadian distribution of Deltoid Balsamroot. (Circles indicate extant populations, stars indicate extirpated populations, triangle indicates an experimental re-introduction.)

From Table 1 it is clear that almost all of the actual area of habitat occupied by the eight populations (about 10.3 ha in total) is comprised of the habitat primarily of three extant populations. These three populations (1, 3, 9) and possibly including #8, likely should be considered to represent viable populations based on having a seemingly adequate number of mature plants for the populations to persist, at least for the near future. Three of these (population 3, currently the largest, as well as 8 and 9) occur in regional parks; the fourth (population 1, currently the second largest but reduced in size by site development) is found on an Indian Reserve. On the basis of area occupied, the populations of Deltoid Balsamroot should not be considered to be severely fragmented based on IUCN criteria.

**Table 1. Localities, population and land ownership for Deltoid Balsamroot.**

	<b>Location and Ownership</b>	<b>Year</b>	<b>Collector/ Observer</b>	<b>Number of Plants/area</b>	<b>Notes</b>
1	Campbell River (Indian Reserve)	1959 1968 1968 1991 1992 2004 2004 2007	Beamish Bednar Krajina Brooks Douglas? Douglas Ennis Fairbarns	unknown unknown unknown unknown 1,600/1,260m <sup>2</sup> 500/1,875m <sup>2</sup> 700-900 plants 345/1,600m <sup>2</sup>	Site variously referred to as south of Campbell River and north of Campbell River but probably all the same site, which is north of the town of Campbell River but on the south shore of the river itself; Fairbarns (2007) counted all individuals large enough to reproduce whether or not they had flowers.
2	Somenos (NGO protected area)	1940s 2007	Watts Polster	unknown	Population consists of 25-30 container-raised plant which were re-introduced in 2004. The plants were still alive in 2007.
3	Mount Tzuhalem (BC Ecological Reserve)	1930 1997 2001 2004 2007	Newcombe Douglas Douglas Douglas Fairbarns	unknown 344 plants no full count 463/137m <sup>2</sup> 1,014/10.2 ha	Fairbarns 2007: 253 plants on private land and 761 plants on crown land (only plants large enough to reproduce were counted). Approximately 35% of plants of reproductive size bore flowers.
4	Koksilah (ownership unknown)	n.d.	Newcombe	unknown	Presumed extirpated.
5	Witty's Lagoon (regional park)	1965	Carl	unknown	Presumed extirpated.
6	Fort Rodd Hill (National Historic Site)	1966 2002 2003 2004 2007	Ashlee Roemer Roemer Roemer Fairbarns	unknown 4/2m <sup>2</sup> 1 plant 4/2m <sup>2</sup> 2/2m <sup>2</sup>	Fairbarns (2007) counted all individuals large enough to reproduce whether or not they had flowers.
7	Skirt Mountain (private)	1896 2003	Anderson Fuller	unknown 1/1m <sup>2</sup>	
8	Mill Hill (regional park)	1963 1998 2003 2004	Hett Douglas Roemer Roemer	unknown 50/100m <sup>2</sup> 55/100m <sup>2</sup> 53/100m <sup>2</sup>	One subpopulation extirpated since first observed in 1963; all subsequent counts have come from the only other subpopulation.

	<b>Location and Ownership</b>	<b>Year</b>	<b>Collector/ Observer</b>	<b>Number of Plants/area</b>	<b>Notes</b>
9	Thetis Lake (regional park)	1940 1954 1957 1993 1999  2005	Eastham Melburn Beamish Ryan Douglas & Fleming Fairbarns	unknown unknown unknown 76/61m <sup>2</sup> ~ 100/100m <sup>2</sup>  166/590m <sup>2</sup>	Fairbarns (2005) counted several previously reported patches and counted all individuals large enough to reproduce whether or not they had flowers.
10	Highland Pacific (private)	1992 1993 1999 2001 2007	Cadrin Ryan Penny Douglas Fairbarns	unknown 70/20m <sup>2</sup> 90/76m <sup>2</sup> 36/30m <sup>2</sup> 7/20m <sup>2</sup>	Fairbarns (2007) counted all individuals large enough to reproduce whether or not they had flowers.
11	Portage Inlet (municipal land)	1976	Brayshaw	unknown	Presumed extirpated (site destroyed in 1997).
12	Esquimalt (ownership unknown)	1896	Anderson	unknown	Presumed extirpated.
13	Beacon Hill (municipal park)	1913 1993 2004 2007	Macoun Ryan Douglas Fairbarns	unknown 5/2m <sup>2</sup> 1/1m <sup>2</sup> 1/1m <sup>2</sup>	Fairbarns (2007) counted all individuals large enough to reproduce whether or not they had flowers.
14	Tolmie Farm (ownership unknown)	n.d.	Newcombe	unknown	Presumed extirpated.
15	Blenkinsop Lake (ownership unknown)	1887 1916 1926	Macoun Newcombe Walker	unknown unknown unknown	Presumed extirpated. Macoun collection labelled Cedar Hill, Newcombe collection labelled Lost Lake, Walker collection labelled Lakehill.
16	Royal Oak (ownership unknown)	1935	Goddard	unknown	Presumed extirpated.
17	Victoria Arm (ownership unknown)	1893	Macoun	unknown	“Victoria Arm” appears to have been an informal name and the location is unknown (perhaps Saanich Peninsula).
18	Dews Harbour (ownership unknown)	1876	Dawson	unknown	“Dews Harbour” appears to have been an informal name and the location is unknown.
19	South Saanich (ownership unknown)	1930	Newcombe	unknown	South Saanich is a large area, which includes locations 10, 11, 15 and 16. Newcombe collection may have been from one of these populations or may have been a different location within South Saanich.
20	Skist Mountain (ownership unknown)	1896	Anderson	unknown	Anderson collection labelled “Skist” Mtn. may have been Skirt Mtn (population #8, above).

n.b. Apart from Fairbarns, investigators did not indicate whether they were counting all plants or just mature individuals

The Canadian populations are approximately 50 km from the nearest historic U.S. population in Islands County, Washington State. The Islands County population, which occurs in a well-studied conservation area, has not been reported since 1934 and is presumed extirpated. The next nearest populations are in South Puget Sound, approximately 150 km from Canada (Arnett pers. comm. 2007). The Canadian EO constitutes less than 1% of the species' global range.

## HABITAT

### Habitat requirements

This section is based on data collected by M. Fairbarns from extant Canadian populations of Deltoid Balsamroot.

In Canada, the species occurs from low to mid-elevations (up to 250 m asl). The slope angle varies from 0-50% and on steeper slopes the populations generally occur on west or south facing aspects. The soils appear to consist of thick ( $\geq 30$  cm deep), medium to coarse-textured deposits, usually with a high component of coarse fragments. The soil tends to be well to rapidly drained. In the early growing season, the soil tends to remain moist. The soil moisture level diminishes as the growing season progresses and by the time the fruits are developing and the plants are senescing the soil experiences significant water deficits for prolonged periods. The surface is characterized by relatively small amounts of exposed mineral soil and fine litter. Coarse woody debris is usually present but rarely abundant. While the roots of deltoid balsamroot appear to require deep soil, rocks frequently outcrop near or within populations.

Deltoid Balsamroot usually occurs in woodlands dominated by Garry Oak and/or Douglas-fir, or in meadow ecosystems. Shrubs are usually sparse although on occasion their cover may be as high as 25%. The most frequent native shrub species are Dull Oregon-grape (*Mahonia aquifolium*) and Common Snowberry (*Symphoricarpos albus*). Invasive shrubs, primarily Scotch Broom (*Cytisus scoparius*\*)<sup>1</sup>, are often present but rarely abundant. Spurge-laurel (*Daphne laureola*\*) is occasionally present and may even dominate the shrub layer in places. In most cases, invasive shrubs appear to have displaced herbaceous species.

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<sup>1</sup> Asterisks indicate species which are not native to the range of Deltoid Balsamroot in BC.



The well-developed herb layer tends to be dominated by a relatively even mix of grasses and forbs. Leading native forbs include Common Yarrow (*Achillea millefolium*), Camas (*Camassia* spp.), Field Chickweed (*Cerastium arvense*), Menzies' Larkspur (*Delphinium menziesii*), Cleavers (*Galium aparine*), Spring Gold (*Lomatium utriculatum*), Western Buttercup (*Ranunculus occidentalis*), Pacific Sanicle (*Sanicula crassicaulis*) and Death-camas (*Zygadenus venenosus*). Invasive forbs are usually present but rarely abundant. The most frequent species are Tiny Vetch (*Vicia hirsuta*\*) and Common Vetch (*V. sativa*\*). Grass Peavine (*Lathyrus sphaericus*\*), an invasive member of the pea family, is rarely present but where it does occur it may be abundant. The only native grass that is frequent and moderately abundant is Blue Wildrye (*Elymus glaucus*). Invasive grasses are inevitably present and often dominate the herb layer. Leading species include Sweet Vernal-grass (*Anthoxanthum odoratum*\*), Soft Brome (*Bromus hordeaceus*\*), Hedgehog Dogtail (*Cynosurus echinatus*\*), Kentucky Bluegrass (*Poa pratensis*\*) and Barren Brome (*Vulpia bromoides*\*). The invasive grasses have probably displaced native grasses and forbs. The bryoid layer, composed of mosses, liverworts and lichens, is rarely well-developed.

Summer droughts cause the herbaceous vegetation to die back in June and July so moisture competition is probably a critical stressor and plant adaptations to moisture stress undoubtedly play a critical role in determining species competition. Mature Deltoid Balsamroot plants possess a long, deep taproot that stores moisture and nutrients, and accesses soil moisture below the rooting zone of most co-occurring herbaceous species. In contrast, seedlings of Deltoid Balsamroot have shallow root systems and probably suffer greatly from competition with other herbaceous species – particularly invasive grasses.

The open tree canopy, where present, probably casts relatively little shade, especially on south-facing slopes. In contrast, low shrubs such as Common Snowberry can cast dense shade, which likely explains the absence of Deltoid Balsamroot on sites where low shrubs are abundant.

Some of the ecosystems where Deltoid Balsamroot occurs were well-suited to burning by First Nations for food plants or other purposes (Turner 1999). Wildfire may have also played a significant role in maintaining ecosystem properties and functions.

## **Habitat trends**

### Habitat loss and fragmentation

The amount of potential habitat on southeast Vancouver Island and the adjacent offshore islands has declined greatly over the past century as suitable woodlands and maritime meadows have been destroyed during the development of land for residential and recreational use. The extent of Garry Oak ecosystems in Victoria decreased 95% from 10,510 ha in 1800 to 512 ha in 1997 (Lea 2002). There is an ongoing decline in the extent of habitat suitable for the establishment of new populations as recommended in the recovery strategy for this species (Parks Canada 2006). This is due to strong

demands for more recreational sites and more intensive housing development within the Canadian range of Deltoid Balsamroot. For example, the population of metropolitan Victoria has increased from approximately 180,000 in 1966 to an estimated 348,467 in 2007 and is projected to increase to 407,600 by 2026 (CRD 2007a,b). The most expensive and sought-after properties are in coastal areas, where most Deltoid Balsamroot habitat is found. As a result, there will be continued pressure to develop woodland and meadow habitats capable of supporting the species.

A significant portion of the habitat supporting the largest Canadian population, near Campbell River, has been converted into parking lots and light industrial developments since the species was last assessed in 2000. The threat of habitat loss is exacerbated by the severe fragmentation of remaining habitat.

### Altered fire regimes

Pre-European fire regimes in the dry coastal belt of southeast Vancouver Island are probably more complex than is generally reported. There is no doubt that First Nations in the area used fire extensively to stimulate the growth of food species – particularly camas bulbs that provided a storable form of starch. Fire may also have been used to improve forage for game species such as elk and deer (Turner and Bell 1971).

Frequent low-intensity burns killed young Red Alder (*Alnus rubra*) and Douglas-fir (*Pseudotsuga menziesii*) and checked the growth of Trembling Aspen and most shrub species – notably Common Snowberry and Nootka Rose (*Rosa nutkana*). The resulting increase in light levels and decrease in competition favoured the growth of herbaceous plants such as Deltoid Balsamroot. Even the composition of the herb layer altered, because many highly competitive plants decrease under a regime of frequent burning.

First Nations' fire management practices also played a significant role in the development (and therefore fertility) of soils. The organic component of the upper mineral horizon was not greatly reduced by low-intensity fires because it accumulated through the *in-situ* decomposition of roots material. In contrast, the surface organic materials did burn rather than accumulate, releasing nutrients. Because the main inputs of organic matter came from herbs rather than coniferous trees, the upper mineral horizon also had a near neutral pH reaction in sharp contrast to the acidic nature of soils under Douglas-fir forests (Broersma 1973). As well, the frequent fires provided a continuous supply of 'safe sites' where the seeds of Deltoid Balsamroot may have been able to germinate and grow without the stifling influences of surface organic horizons.

### Habitat invasion by exotic and native species

Most locations have a significant cover of exotic invaders including shrubs and/or grasses (see above). At some sites, Common Snowberry, a native shrub, appears to have expanded into most of the habitat formerly available to Deltoid Balsamroot.

Scotch Broom and other invasive shrubs are being controlled in five of the eight extant populations but invasive grasses and forbs are not being controlled because of a lack of effective techniques.

### **Protection/ownership**

One very small population (2 plants) occurs in a national historic site managed by Parks Canada Agency. There is a moderately large population (345 plants) in an Indian Reserve but much of the habitat at this site has been lost over the past decade (see Table 1). Another moderately large population (1,017 plants) lies within a provincial ecological reserve, as well as on adjacent private land. Three populations occur in parks managed by municipal or regional governments. The remaining two populations occur completely within private lands. Deltoid Balsamroot present on federal lands are protected as an endangered species under the federal *Species at Risk Act*. Those present in parks under provincial and municipal jurisdictions would potentially receive some protection from habitat loss due to development activities.

## **BIOLOGY**

### **Life cycle and reproduction**

In Canada, shoot dormancy begins to break in April. In average years, flowering peaks in May (Fairbarns pers. obs.). Flowers are pollinated by insects. A close relative, Arrowleaf Balsamroot (*Balsamorhiza sagittata*), does not appear to be capable of self-pollination. Arrowleaf Balsamroot is self-fertile when pollinated by bees but higher rates of seed set are achieved with cross-pollination (Cane 2005).

The dry fruits are shed as the plants begin to wither, usually in late June. The dry fruits lack any structures to aid dispersal by wind, water or animals (Fairbarns pers. obs.) so most seeds are probably dispersed over very short distances.

It is not certain when germination occurs under natural conditions but propagation studies have demonstrated that high germination rates are achieved after seeds are cold-stratified and then sown into outside beds during the spring (when temperature are between 2-6°C). In such conditions, 37% germination was observed over a 6-week period with the first seedlings emerging 18 days after they were sown (Drake and Ewing 1997). This suggests that under natural conditions germination normally occurs in early spring.

Young plants may be quite susceptible to root rot if the soil remains damp during the summer, normally a dormant season (Roemer pers. comm. 2006). In cultivation, plants may flower in their second year (Hook pers. comm. 2005). In nature, plants likely require several years to reach maturity.

## **Herbivory**

In Canada, natural populations of Deltoid Balsamroot may be heavily affected by vertebrate and invertebrate defoliators. Columbia Black-tail Deer and Eastern Cottontails may remove sufficient leaf material to cause a long-term decline in plant vigour (Roemer pers. comm. 2006). The larval stage of a moth (*Eurois occulta*) has been found feeding on the foliage of Deltoid Balsamroot at one site (Roemer 2005) and invertebrate herbivory by unknown agents has been observed in many other locations. Fences may be built to protect the plants from vertebrate herbivores but have no effect on insect defoliators, which cause substantial leaf loss in several populations (Fairbarns pers. obs.). The original population at Somenos appears to have disappeared after the site was subjected to cattle grazing (Watts ex D. Polster pers. comm. 2007).

## **Physiology**

In the largest population, a high proportion of Deltoid Balsamroot seeds have been aborted in most years (Fairbarns pers. obs.), perhaps as a result of the rapid onset of drought conditions in June.

## **Dispersal**

Fruits are small, dry, hairless achenes (Hitchcock *et al.* 1955) with no specialized structures to promote long-distance dispersal.

## **Interspecific interactions**

Taller shrubs and trees appear to suppress growth by limiting the amount of light available to Deltoid Balsamroot. Woody and herbaceous species (particularly robust invasive grasses and forbs) compete for nutrients. No evidence of other, biologically significant interspecific interactions affecting Deltoid Balsamroot has been noted.

# **POPULATION SIZES AND TRENDS**

## **Search effort**

Deltoid Balsamroot has attractive, showy flowers that are not easily overlooked. It has distinctive leaves that easily distinguish it from other plants with bright yellow flowers. Suitable sites have been surveyed repeatedly since the early 1980s in a series of projects designed to document the distribution of rare plants of Garry Oak woodlands and coastal prairies on southeast Vancouver Island and the Gulf Islands. The principal investigators included Adolf and Oldriska Ceska, Matt Fairbarns, Hans Roemer, Jenifer Penny, Harvey Janszen, Frank Lomer and the late George Douglas, all of whom are/were familiar with Deltoid Balsamroot. Fairbarns has conducted a focused search for this species throughout its extent of occurrence since 2002 but found no new populations (Figure 4).

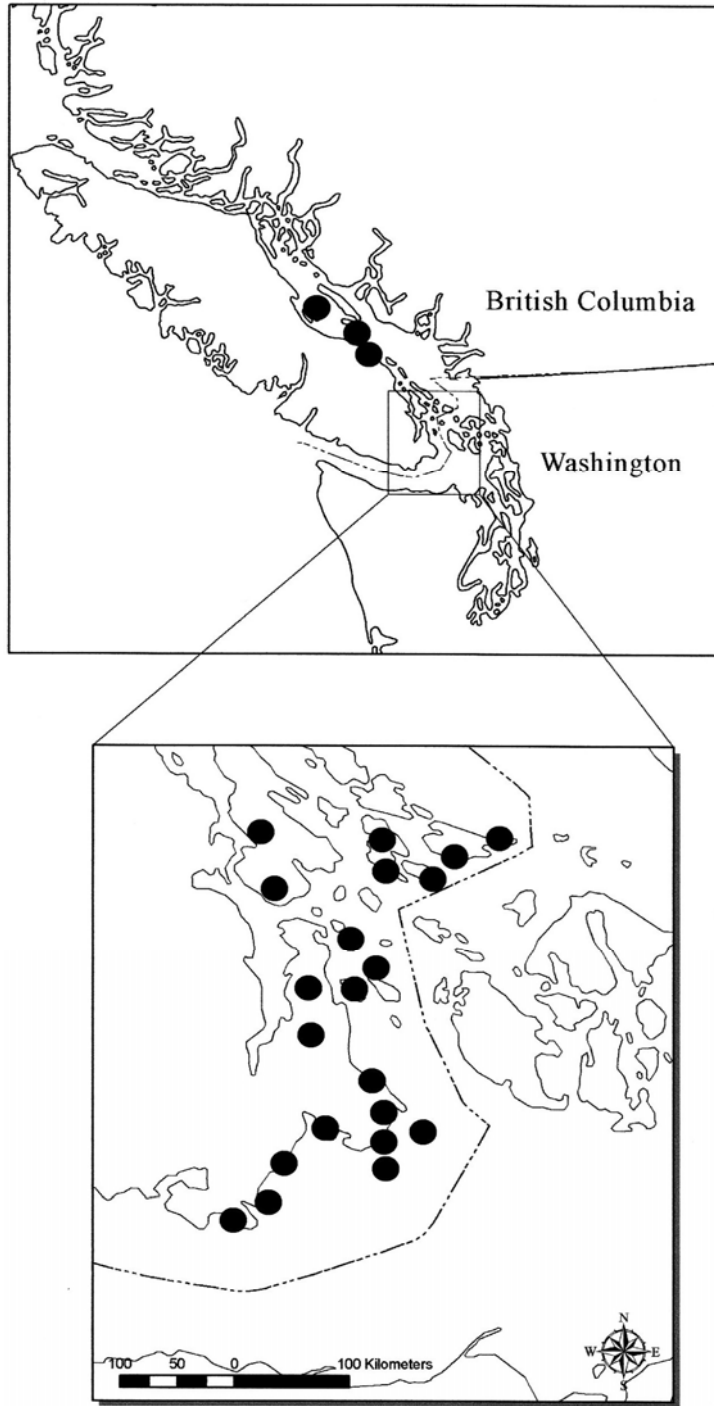


Figure 4. Search effort by Fairbarns.

## **Abundance**

In the absence of species-specific information, NatureServe criteria treat locations of vascular plants such as Deltoid Balsamroot as separate occurrences (populations) if they are separated by over 1,000 m of persistently unsuitable habitat. COSEWIC generally accepts this criterion for vascular plant species. Deltoid Balsamroot has been reported from at least 16, and perhaps as many as 20 locations in Canada (Table 1), only eight of which have extant populations.

Based on the most recent data from each site, there are about 1,589 plants in Canada that are large enough to flower.

An experimental re-introduction project has begun near Somenos, British Columbia, but it is too early to report on results (Polster pers. comm. 2007). The probability of persistence of this population is uncertain, therefore it is not treated as an extant population in this update.

## **Fluctuations and trends**

The original status report (Ryan and Douglas 1994) estimated a total Canadian population size of 1,907 mature individuals from a total of five verified locations. Three populations have subsequently been rediscovered at historic locations not reported by Ryan and Douglas (1994). They described the Fort Rodd Hill and Mill Hill populations as status unknown. These populations were subsequently rediscovered by the original collectors where they had been found originally; it seems quite unlikely the populations had been extirpated and re-established. Ryan and Douglas neglected to mention the 1896 Anderson collection from “Skist” (presumably Skirt) Mountain, nor did they mention conducting surveys in the area so it is quite possible this population has persisted since its original discovery.

The similarity in numbers between those reported in Table 1 and values presented by Ryan and Douglas are misleading. Large new subpopulations have been discovered at sites 3 and 9. Because these subpopulations and populations were presumably present but undetected all along, in 1996, the total Canadian population probably consisted of approximately 2,600 mature individuals. Accordingly, the Canadian population appears to have declined from approximately 2,600 individuals in 1996 to about 1,589 in 2007. Considering uncertainties, particularly with population estimates prior to 2005, the decline is estimated at between 35-40% over the 11-year period.

Where there are comparable records, most subpopulations/populations appear to have been relatively stable since 1996. The single major exception has been a decline in the largest population (1) from a peak of approximately 1,700 plants in 1992 to 345 plants in 2007. This is the result of commercial development of the site in 2003, which now consists of a 1,600 m<sup>2</sup> prairie remnant fenced off and surrounded by roads, a parking lot and light industrial buildings. The sharp decline in this population accounts for most of the decline in the Canadian population since 1996.

## **Rescue effect**

Extensive floristic surveys have been conducted in nearby areas of Washington State, including the Olympic Peninsula (Buckingham *et al.* 1995), the main islands of San Juan County (Atkinson and Sharpe 1993) and small islets in San Juan County (Giblin pers. comm. 2006). From these studies, it appears that Deltoid Balsamroot is absent from the Olympic Peninsula and the San Juan Islands. For these reasons, there is negligible opportunity for unassisted genetic immigration (seed or pollen) from the United States.

## **LIMITING FACTORS AND THREATS**

The impacts of invasive species and herbivory have already been discussed. Trampling and flower-picking threaten populations that occur along trails, as at Mount Tzuhalem, Thetis Lake, Beacon Hill and perhaps Campbell River. Trail maintenance activities, including regrading and mowing, pose a threat to the populations at Thetis Lake and Beacon Hill. Habitat loss and population size reduction due to commercial development has occurred at the Campbell River site.

The very small size of populations at Beacon Hill, Skirt Mountain, Fort Rodd Hill and Highland Pacific (all with 10 or fewer mature plants) predisposes them to stochastic events that could quickly eliminate them and, as well, to inbreeding depression.

### Actions to minimize threats

The recovery strategy for Deltoid Balsamroot does not recommend actions for specific populations. This direction will be provided in an action plan, which has not yet been developed. Nevertheless, the following actions have been taken to protect the remaining populations.

Populations at Campbell River, Fort Rodd Hill, Mill Hill, Mount Tzuhalem, Thetis Lake, Highland Pacific and Beacon Hill have been mapped and the appropriate land owners/managers have been made aware of the locations.

The remnant population at Campbell River was fenced in 2007 to prevent it from being damaged by vehicles using the parking lot that encircles it. Transplant and propagation programs have been established at Campbell River although the transplants appear to have died and there is little or no suitable habitat in which to establish transplants. There is also a program to control invasive shrubs in the Campbell River population.

The Fort Rodd Hill population has been mapped and is being closely monitored. Invasive shrubs are being controlled. The population will be fenced to protect it from vertebrate herbivores.

The Mill Hill population has also been mapped and cages have been built around most of the plants to protect them from vertebrate grazing. Invasive shrubs are being controlled at the site.

The Mount Tzuhalem population has been protected from human activities by fencing much of the area and closing off some trail sections to direct people away from the plants. Unfortunately, flower heads were removed from many of the plants in both 2006 and 2007, apparently by people interested in harvesting the seeds. Invasive shrubs are being controlled in the vicinity of many subpopulations at Mount Tzuhalem.

Although invasive shrub control programs have been established at many sites, little or nothing has been done to control invasive grasses and forbs. As well, the main invasive shrub (Scotch Broom) is capable of quickly recolonizing sites from the long-lived seedbank if invasive shrubs are not removed on a regular basis. If Scotch Broom is allowed to re-establish itself, even small populations may quickly replenish the soil seedbank and reverse the benefits of many years of clearing.

### **SPECIAL SIGNIFICANCE OF THE SPECIES**

Deltoid Balsamroot has many traditional culinary and medicinal uses (Garth 1953, Kunkel 1984, Usher 1974, Yanovsky 1936, Zigmond 1981). Early settlers in the Victoria area used the seeds as chicken feed (MacFie 1972), which suggests that the species may have once been both abundant and fecund in the area.

Deltoid Balsamroot has significant potential as a garden plant because of its showy blooms, although it tends to be susceptible to invertebrate herbivory and more resistant strains would be desirable. Seeds are not readily available in Canada. At least one grower propagates the species for sale as an ornamental but the plants are not widely available in the Canadian retail market.

### **EXISTING PROTECTION OR OTHER STATUS DESIGNATIONS**

NatureServe has ranked deltoid balsamroot as "G5" (globally secure and essentially ineradicable). It is ranked "S2" (imperilled) in Washington. It has not been ranked by NatureServe member programs in California and Oregon, which generally means it is present but secure (NatureServe Explorer 2007).

The British Columbia Ministry of Environment has included Deltoid Balsamroot in the "Red-list" of taxa that are threatened or endangered in British Columbia and has ranked it as "S1" (critically imperilled) in British Columbia (BC Species and Ecosystems Explorer 2007). COSEWIC assessed Deltoid Balsamroot as Endangered in Canada (2000) and it is an endangered species protected under Schedule 1 of the federal Species at Risk Act on federal lands such as Indian Reserves and National Historic Sites.



## TECHNICAL SUMMARY

### ***Balsamorhiza deltoidea***

Deltoid Balsamroot

Balsamorhize à feuilles deltoïdes

Range of Occurrence in Canada: British Columbia

### **Demographic Information**

Generation time (average age of parents in the population)	at least several yrs
Observed percent reduction in total number of mature individuals over the last 10 years.	35-40% over the past 11 years
Projected percent reduction in total number of mature individuals over the next 10 years.	Unknown
Observed percent reduction in total number of mature individuals over any 10 years period, over a time period including both the past and the future.	Unknown
Are the causes of the decline clearly reversible?	Unknown
Are the causes of the decline understood?	Yes
Have the causes of the decline ceased?	No
Observed trend in number of populations Historical decline but stable since last report.	Stable
Are there extreme fluctuations in number of mature individuals?	Unlikely
Are there extreme fluctuations in number of populations?	No
Is the total population severely fragmented? More than one-half of the area is occupied by presumably viable populations and only a small proportion of the total population is in small isolated patches	No

### **Number of mature individuals in each population**

<b>Population</b>	<b>N Mature Individuals</b>
#1. Campbell River:	345
#3. Mount Tzuhalem:	1,014
#6. Fort Rodd Hill:	2
#7. Skirt Mountain:	1
#8. Mill Hill:	53
#9. Thetis Lake:	166
#10. Highland Pacific:	7
#13. Beacon Hill:	1
Total	1589
Number of populations (locations)	8

### **Extent and Area Information**

Estimated extent of occurrence (km <sup>2</sup> )	1000-1200 km <sup>2</sup>
Observed trend in extent of occurrence	Stable
Are there extreme fluctuations in extent of occurrence?	No
Estimated area of occupancy (km <sup>2</sup> )	8 based on a 1x1 km grid and 32 based on a 2x2 km grid km <sup>2</sup>
Observed trend in area of occupancy	Decline
Are there extreme fluctuations in area of occupancy?	No
Is the extent of occurrence or area of occupancy severely fragmented?	No
Number of current locations	8
Trend in number of locations Historical decline but presently stable	Stable
Are there extreme fluctuations in number of locations?	No

Trend in area or quality of habitat	declining in extent and quality
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### Quantitative Analysis

	None available
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### Threats (actual or imminent, to populations or habitats)

Threats to habitat and populations: loss from commercial development, invasive species, herbivory, trampling, trail maintenance, seed collection, flower picking.
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### Rescue Effect (immigration from an outside source)

Status of outside population(s) USA: secure	
Is immigration known or possible?	No
Would immigrants be adapted to survive in Canada?	Unknown
Is there sufficient habitat for immigrants in Canada?	Yes
Is rescue from outside populations likely?	Unlikely

### Current Status

COSEWIC: Endangered (April 2009)
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Additional Sources of Information: None

### Status and Reasons for Designation

<b>Status:</b> Endangered	<b>Alpha-numeric code:</b> Met criteria for Threatened, A2ac; B1ab(ii,iii,iv,v)+2ab(ii,iii,iv,v) but designated Endangered, B1ab(ii,iii,iv,v) +2ab(ii,iii,iv,v), because 4 of the native populations may not be viable.
<b>Reasons for designation:</b> A showy perennial comprising only eight natural populations containing about 1600 mature plants. The largest population has declined greatly due to site development in recent years and accounts for most of the 35-40% decline in the total Canadian population. All populations experience continued habitat degradation from competition with invasive introduced plants. Four of the eight populations are also at risk of extirpation from stochastic events due to the presence of only one to several plants in each.	

### Applicability of Criteria

<b>Criterion A</b> (Decline in Total Number of Mature Individuals): Meets threatened A2ac. A reduction of 35-40% in mature individuals has been observed in the last 10 years with a decline in area of occupancy and in the quality of habitat.
<b>Criterion B</b> (Small Distribution Range and Decline or Fluctuation): Meets Threatened B1ab(ii,iii,iv,v)+2ab(ii,iii,iv,v) with EO and IAO within limits for Threatened and with 8 extant populations, four of which consist of only one to several mature individuals in each and are likely not viable. Habitat has declined in area due to development and in quality due to invasive plants. A decline of 35-40% in mature individuals has been documented based on site development at the largest population (#1).
<b>Criterion C</b> (Small and Declining Number of Mature Individuals): Not applicable.
<b>Criterion D</b> (Very Small Population or Restricted Distribution): Not applicable. Although the index of area of occupancy is small, current threats are unlikely to cause this species to decline rapidly in the near future.
<b>Criterion E</b> (Quantitative Analysis) : None available.

## ACKNOWLEDGEMENTS AND AUTHORITIES CONSULTED

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David Fraser. Endangered Species Specialist. Biodiversity Branch, Conservation Planning Section, Ministry of Environment, Government of British Columbia.

Gloria Goulet. Coordinator, Aboriginal Traditional Knowledge. COSEWIC Secretariat, Canadian Wildlife Service, Environment Canada.

Kevin Fort. Species at Risk Biologist. Pacific Wildlife Research Centre, Canadian Wildlife Service, Environment Canada.

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## **BIOGRAPHICAL SUMMARY OF REPORT WRITER**

Matt Fairbarns has a B.Sc. in Botany from the University of Guelph (1980). He has worked on rare species and ecosystem mapping, inventory and conservation in western Canada for approximately 20 years. He was a botanist with the British Columbia provincial government until 2003 and now manages Aruncus Consulting, an independent biological conservation research company. He has written a number of COSEWIC status reports.

## **COLLECTIONS EXAMINED**

The following collections were examined:

- Royal BC Museum herbarium (V)
- University of Victoria herbarium (UVIC)