

COMMITTEE ON THE
STATUS OF ENDANGERED
WILDLIFE IN CANADA

OTTAWA, ONT. K1A 0H3
(819) 997-4991

COMITÉ SUR LE STATUT
DES ESPÈCES MENACÉES
DE DISPARITION AU
CANADA

OTTAWA (ONT.) K1A 0H3
(819) 997-4991

**STATUS REPORT ON THE YELLOW MONTANE VIOLET
VIOLA PRAEMORSA SSP. *PRAEMORSA***

IN CANADA

BY

MICHAEL RYAN

AND

GEORGE W. DOUGLAS

**STATUS ASSIGNED IN 1995
THREATENED**

**REASON: HIGHLY LOCALIZED SPECIES WITH FEW SITES AND
RESTRICTED TO HABITATS UNDER THREAT FROM
DEVELOPMENT, RECREATIONAL USE AND FROM SPREAD OF
EXOTIC PLANTS.**

OCCURRENCE: BRITISH COLUMBIA

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Canada.**

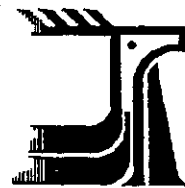
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statut national aux espèces canadiennes en péril.**

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Yellow Montane Violet



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COSEWIC

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IN CANADA

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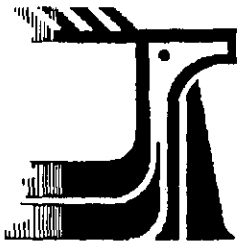
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VICTORIA, B.C.
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JUNE 1994

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DEFINITIONS

SPECIES:	"Species" means an indigenous species, subspecies, variety or geographically defined population of wild fauna and flora.
VULNERABLE: (V)	A species of special concern because of characteristics that make it particularly sensitive to human activities or natural events.
THREATENED: (T)	A species likely to become endangered if limiting factors are not reversed.
ENDANGERED: (E)	A species facing imminent extirpation or extinction.
EXTIRPATED: (XT)	A species no longer existing in the wild in Canada, but occurring elsewhere.
EXTINCT: (X)	A species that no longer exists.
NOT AT RISK: (NAR)	A species that has been evaluated and found to be not at risk.
INDETERMINATE: (I)	A species for which there is insufficient scientific information to support status designation.

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Executive Summary

Description

Viola praemorsa ssp. *praemorsa* (yellow montane violet) is a non-stoloniferous yellow-flowered violet with dark green hirsute ovate leaves with serrate margins. It is distinguished from *V. praemorsa* ssp. *linguaeifolia* and ssp. *flavovirens* by its shorter leaves and well-defined leaf bases.

Distribution

Viola praemorsa ssp. *praemorsa* ranges from southeastern Vancouver Island and Saltspring Island and along the coast to central California. It extends inland along the Columbia River and towards the Sierra Nevada.

Population Size and Trends

Of the fourteen sites in which *V. praemorsa* ssp. *praemorsa* has been collected, populations at seven sites are extant. The status of populations at six sites remains uncertain whereas the population at a single site is believed to be extirpated. No populations have been monitored so it is not possible to identify increases or decreases in the size of specific populations. However, given the extent to which the habitats in which this species occurs have been altered or destroyed, it is likely that the number of populations in Canada have declined over time.

Habitat

Viola praemorsa ssp. *praemorsa* is restricted to *Quercus garryana* vegetation and grass-dominated meadows which are largely restricted to the southeastern side of Vancouver Island and some of the Gulf Islands. These sites typically experience drought conditions during the summer months and are often located in areas that receive the lowest amount of annual rainfall along coastal British Columbia and are characterized by shallow to deep soils with rapid drainage. Associated species include *Symphoricarpos albus*, *Cytisus scoparius*, *Sedum spathifolium*, *Allium cernuum*, *Ranunculus occidentalis*, *Dactylis glomerata*, *Anthoxanthum odoratum*, and several species of *Bromus*.

General Biology

Little information is available on the biology of *Viola praemorsa* ssp. *praemorsa*. Leaves emerge in early spring followed by the appearance of flowers in April and May. By summer, seeds have been discharged and, although most plants have withered and died, some continue to grow until late summer. It is likely that the posterior position of stamens to that of the stigma favours cross-pollination. This species is also known to produce self-pollinated cleistogamous flowers but their relative importance to seed production and the longterm survival of the population is not known. No demographic information is available including the extent to which seeds remain viable in the soil, the survival rates of seedlings and mature plants, and interactions with many associated species.

Limiting Factors

Threats to existing populations vary in type and intensity. Habitat destruction threatens several populations whereas other populations are protected to a certain extent by their location in parks and ecological reserves. Other factors which threaten a number of populations include aggressive introduced species such as *Cytisus scoparius* which is a dominant species at many sites. Furthermore, fire suppression at these sites has also appeared to have resulted in changes to the vegetation at some sites whereby both several native and introduced species have expanded in area at the expense of many other species including *Viola praemorsa* ssp. *praemorsa*.

Protection

There is no specific legislation for the protection of endangered and rare species in British Columbia. However, some *Viola praemorsa* sites are located in parks or ecological reserves which provides them some protection from direct habitat destruction although this does not provide any protection against more aggressive plant species which threaten some of these populations. No efforts have been made to reintroduce this species into new habitats or increase the number of plants located at existing sites.

Conclusions

Populations of *V. praemorsa* ssp. *praemorsa* in Canada have recently been confirmed at a limited number of sites on southeastern Vancouver Island and Saltspring Island. Given the threats posed by agricultural and residential development and other aggressive plant species, it is recommended that *V. praemorsa* ssp. *praemorsa* be considered an endangered species. The prognosis for this species is not good. Although almost half of the populations are somewhat protected from direct habitat destruction, it is possible that these sites may require active management to prevent their elimination by other aggressive plant species. Research on the biology of *V. praemorsa* ssp. *praemorsa* will be required to provide management guidelines for the survival of this species in Canada.

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I. SPECIES INFORMATION

1. Classification and Nomenclature

Scientific name:

Viola praemorsa Dougl. ex Lindl. ssp. *praemorsa*

Bibliographic citation:

Edward's Bot. Reg. 15: plate 1254. 1829.

Pertinent synonyms:

Viola nuttallii Pursh var. *praemorsa* (Dougl. ex Lindl.) S. Wats.

Viola nuttallii Pursh ssp. *praemorsa* (Dougl. ex Lindl.) Piper.

Common Names:

Yellow montane violet

Family Name:

Violaceae

Major Plant Group:

Angiosperm

History of taxon:

The type of *Viola praemorsa* was collected by David Douglas ... "in dry upland soils, under the shade of solitary pine trees on the banks of the Columbia, and the plains above the river Aguilar, in California." Because the original voucher specimens were lost, most researchers accepted the published drawing in place of the voucher specimen. Fabijan *et al.* (1987), however, believed a photograph of the original type specimen to be at Cambridge University because the label read: "North West America, Douglas" "Cambridge Botanical Museum. Forb. J. Lindley, PhD. Purchased 1866."

Viola praemorsa belongs to subsection *Nuttallianae* which has been a source of difficulty to researchers because it is composed of a polyploid complex of intergrading morphologically similar species. Some taxonomists consider *Viola praemorsa* to be a subspecies or variety of *Viola nuttallii* (Hitchcock and Cronquist 1961, Scoggan 1978, Taylor and MacBryde 1977).

Other workers, however, consider *V. praemorsa* to be a distinct species composed of several subspecies (Baker 1957, Clausen 1964, Fabijan *et al.* 1987, Packer 1991).

The most recent investigation of this group by Fabijan *et al.* (1987), based on morphological, cytological, and phytochemical data, was used in numerical and statistical analyses to distinguish between species, subspecies and varieties. They concluded that *V. praemorsa* encompasses a diverse range of chemical and morphological characteristics of which the extremes characterize three subspecies: ssp. *praemorsa*, ssp. *linguaeifolia*, and ssp. *flavovirens*.

2. Description

Taxonomic Description

Viola praemorsa ssp. *praemorsa*

(Description based on Fabijan *et al.* (1987)).

- General:** Perennial from a short, occasionally coarsely erose rootstock, appearing stemless at first but stem elongating during the growing season, 6 to 22 cm high; glabrous or conspicuously hirsute throughout.
- Leaves:** Basal ones mostly broadly ovate-lanceolate, cuneate at the base, margins slightly serrate, usually conspicuously pubescent.
- Flowers:** Petals yellow, upper ones usually brownish-backed, lower ones up to 20 mm long including the short spur; style 2.5 mm long with the capitate head retrorsely bearded on the sides.
- Fruits:** Capsule glabrous to puberulent; seeds glabrous, yellow to dark brown.

Illustrations

1) see *Viola nuttallii* var. *praemorsa* p. 449 in Hitchcock, C.L. and A. Cronquist. 1961. Vascular Plants of the Pacific Northwest Part 3: Saxifragaceae to Ericaceae. University of Washington Press, Seattle. 614 pp.

2) see *Viola praemorsa* ssp. *praemorsa* p. 1095 in Little, R.J. 1993. *Violaceae*. In, Hickman, J.C. (ed.). The Jepson Manual. Higher Plants of California. University of California Press, Berkeley. 1400 pp.

- drawings of a whole plant and flower of *V. praemorsa* ssp. *linguaeifolia* and a single leaf of *V. praemorsa* ssp. *praemorsa*.

Diagnostic Features

Among the yellow violets which occur in western British Columbia, *V. praemorsa* ssp. *praemorsa* is distinguished primarily by slightly serrate, ovate-lanceolate, pubescent leaves. The only other plant, occupying similar habitats, which superficially resembles flowerless *V. praemorsa* ssp. *praemorsa* is the introduced *Plantago lanceolata*. The latter has leaves which are similar in colour and shape to those of *Viola praemorsa* ssp. *praemorsa*, but they lack hairs and gradually taper to the petiole.

V. praemorsa ssp. *praemorsa* is distinguished from subspecies *linguaefolia* and *flavovirens* by short cauline leaves (23-40 mm long), with a length to width ratio of 1:4, and sharply defined serrate-margined leaf bases. Furthermore, it has dark brown seeds with a length to width ratio of 1:5. The caruncle is relatively short. Subspecies *linguaefolia* and *flavovirens* have longer (33 to 88 mm) and narrower leaves (length to width ratio of 1:4), with less sharply defined basal margins which are subserrate to serrate. The seeds are medium brown and slightly narrower than those of ssp. *praemorsa* (length to width ratio of 1:5 - 1:7). The caruncle is 1.8 to 3.2 mm long (see Fabijan *et al.* 1987).

3. Distribution

The subspecies *praemorsa* is the only subspecies of *V. praemorsa* known to occur in British Columbia. It is restricted to the southeastern side of Vancouver Island and Saltspring Island and is not found elsewhere in Canada. Subspecies *linguaefolia* is known from the southwestern corner of Alberta and may possibly occur in the extreme southeastern corner of British Columbia although its presence here has not yet been recorded (Packer 1991).

In the United States, ssp. *praemorsa* extends south along the coast to California, inland along the Columbia River in Washington and towards the Sierra Nevada in California (Figure 1). It is commonly found between elevations of 100 to 2500 m except at several inland locations where it is found at elevations up to 7000 m (Fabijan *et al.* 1987). In Canada, populations occur below 100 m in the lowlands and at higher elevations (up to 650 m) on rocky slopes along the east coast of Vancouver Island and on Saltspring Island.

4. Climate

The climate on the southeastern side of Vancouver Island and Saltspring Island is characterized by mild wet winters and warm dry summers in which the bulk of the rainfall (95%) occurs during the winter months. Annual rainfall is particularly low in the southeastern corner of Victoria. This area receives about one-third of the rainfall to that west of Victoria (Figure 2).

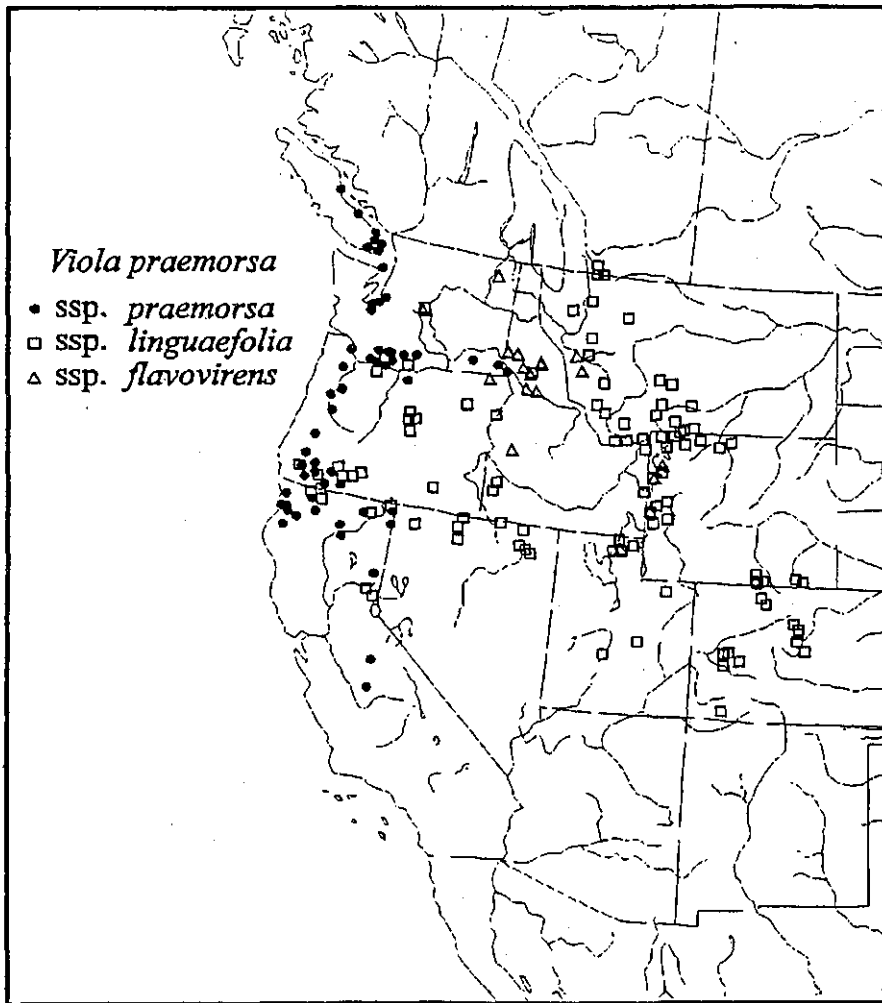


Figure 1. The distribution of *Viola praemorsa*. Redrawn from Fabijan *et al.* (1987).

5. Habitat

Viola praemorsa ssp. *praemorsa* occupies a number of different habitats in *Quercus garryana* communities and grass-dominated meadows on Vancouver Island and Salt Spring Island. Many populations occur on sites dominated by *Quercus garryana*-*Bromus* vegetation. The *Quercus garryana*-*Bromus* vegetation occurs predominantly on deeper soils with less exposed bedrock. These sites also contain a substantial number of forbs including *Triteleia hyacinthina* and *Ranunculus occidentalis* but tend to be dominated by grasses such as *Dactylis glomerata*, *Anthoxanthum odoratum*, and several species of *Bromus*. Some stands are dominated in the understorey by shrubs, in particular, *Symphoricarpos albus* and *Cytisus scoparius*, which effectively shade out many herbaceous species. Soils are usually orthic sombric brunisols (Roemer 1972).

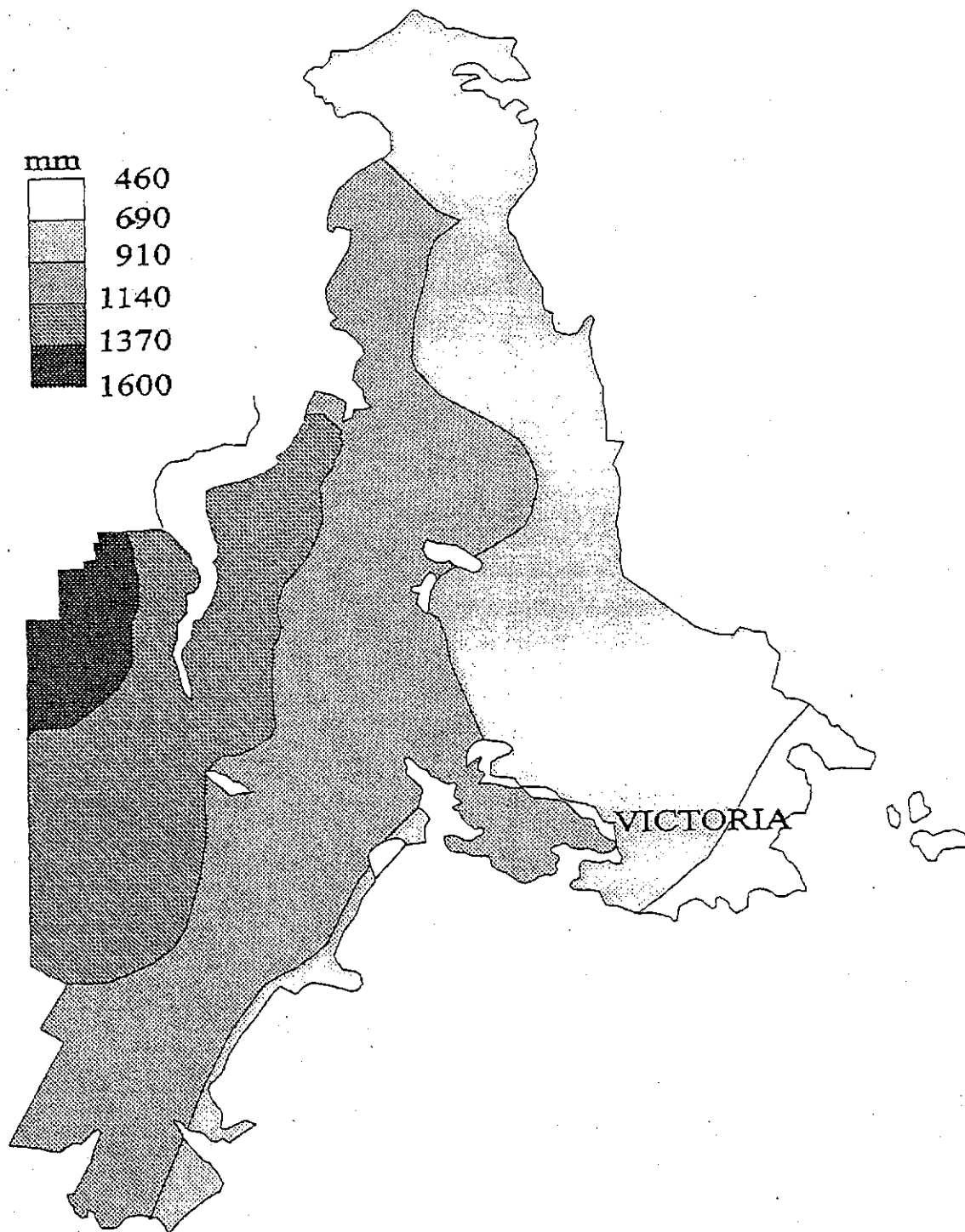


Figure 2. Average annual rainfall in the Victoria region. Redrawn from McMinn et al. (1976).

Some populations also occur on relatively steep rocky slopes where *Quercus garryana*-*Holodiscus discolor* is the dominant vegetation type. On these sites they are usually located in pockets of deep soil partially shaded by *Quercus garryana*.

Viola praemorsa ssp. *praemorsa* may also be found, less often, in open grass-dominated meadows where soils are relatively deep and which likely retain some moisture during summer drought conditions.

It is apparent that, as with other spring-flowering forbs found in *Quercus garryana* and associated meadow communities, *Viola praemorsa* ssp. *praemorsa* is a shade-intolerant species that takes advantage of the high light levels, warm temperatures, and moist conditions which occur in early spring when leaves have not yet appeared on *Quercus garryana* and most shrubs. By the time *Quercus* leaves emerge in late spring, most plants have already flowered and set seed. *Viola praemorsa* ssp. *praemorsa* rarely occurs where dense shrub thickets of *Symphoricarpos albus* and *Cytisus scoparius* dominate the vegetation and strongly shade the forest floor.

6. Population Size and Trends

Table 1 identifies those locations in which *Viola praemorsa* ssp. *praemorsa* has been collected in Canada. All populations have been found on Vancouver Island and Salt Spring Island. Of the 15 sites, 13 are post-1949; seven of these were recently verified (Fig. 3). The remaining populations could not be relocated. While some of these latter populations may be extirpated, it is also possible that they were overlooked because *V. praemorsa* ssp. *praemorsa*, when not in flower, may be very difficult to locate among the tall grass which often dominates the herbaceous vegetation. Most plants are only visible above ground for a short period of time in the spring and die back to the rhizome during the dry, warm summer months. For example, 300 plants were counted in Beacon Hill during spring, 1993, but when this site was revisited during July, 1993, less than 100 plants were found after a careful search. Future revisitation of sites at which *V. praemorsa* ssp. *praemorsa* has been collected, but not observed, will be required before their status can be confirmed.

Table 1. Populations of *Viola praemorsa* ssp. *praemorsa* in Canada.

Collection Site	Last Observation	Collector/ Observer	Population (no./area)
Cedar Hill (Victoria)	1887	Macoun	extirpated
Quamichan Lake (Duncan)	1933	Newcombe	
Holmes Point (Comox)	1961	Beamish	
Mount Tolmie (Victoria)	1963	Young	
Christmas Hill (Victoria)	1971	Roemer	
Nanoose Hill (Nanaimo)	1976	Douglas	
Mount Maxwell (Salt Spring Island)	1985	Roemer	
Mount Tuam (Salt Spring Island)	1985	Chatwin	> 300/400m ²
Royal Oak (Victoria)	1991	MacGillivray	3-5/?m ²
Beacon Hill (Victoria)	1994	Douglas	400-450/ 1100m ²
Smith Hill (Victoria)	1994	Douglas	500/435m ²
Uplands Park (Victoria)	1994	Douglas	125/18m ²
Mount Tzuhalem (Duncan)	1994	Douglas	25/100m ²
Somenos Lake (Duncan)	1994	Douglas	45,000/5700m ²
Falaise Park (Victoria)	1994	Ryan	40/27m ²

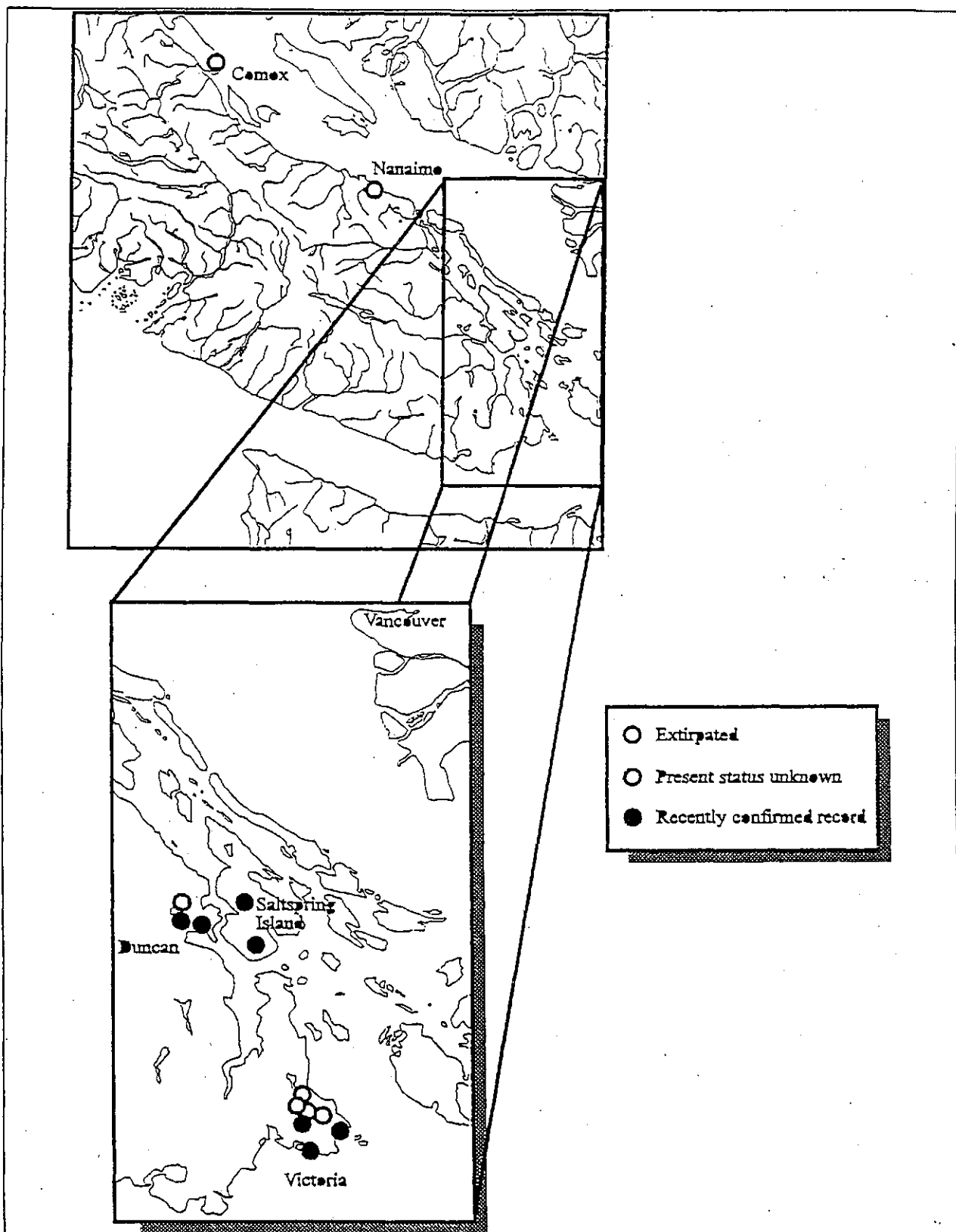


Figure 3. The location of *Viola praemorsa ssp. praemorsa* populations in Canada.

Recently Verified Populations

Beacon Hill (Victoria)

Approximately 400-450 plants are known from three sites in Beacon Hill Park. One group is located in a grass-dominated meadow on an open, dry, exposed gentle slope (5%) with a NW aspect. Associated species include *Anthoxanthum odoratum*, *Lomatium nudicaule*, *Taraxacum officinale*, *Plantago lanceolata*, *Lupinus bicolor*, *Hypochoeris radicata* and *Dactylis glomerata*.

A second group of *Viola* plants are located beneath, and adjacent to, a small stand of *Quercus garryana* on a west-facing slope of 10%. Associated species include *Dactylis glomerata*, *Sanicula crassicaulis*, *Bromus* sp., *Lolium perenne*, *Poa pratense*, *Lathyrus nevadensis* var. *pilosellus*, *Anthoxanthum odoratum* and *Allium acuminatum*. Soils lack a distinct humus layer and are porous with good structure and little or no clay.

A third population occurs in an open *Quercus garryana* stand with an understorey dominated by *Camassia quamash*, *Ranunculus occidentalis* and *Poa* sp. The level site is characterized by deep soils.

Smith Hill (Victoria)

Two groups of *Viola praemorsa* ssp. *praemorsa*, composed of 300 and 200 plants respectively, occur on Smith Hill. Both populations are located in *Quercus garryana*-*Bromus* vegetation on relatively deep soil.

Uplands Park (Victoria)

Approximately 125 plants were found in the central portion of this municipal park. The site is dominated by *Quercus garryana*-*Bromus* stands and grass-dominated meadows on relatively deep brunisol soils.

Mount Tuam (Saltspring Island)

Over 300 plants were located in a 400 m² band below the summit of Mount Tuam near the southwestern corner of the island. They occur in a meadow consisting of *Cerastium arvense*, *Anthoxanthum odoratum*, *Zygadenus elegans*, and *Camassia quamash* (T. Chatwin pers. comm). The meadow was surrounded by scattered *Pseudotsuga menziesii* and rock outcrops. More *Viola praemorsa* ssp. *praemorsa* have been reported to occur in adjacent *Quercus garryana* groves (H. Roemer pers. comm.).

Mount Maxwell (Saltspring Island)

Viola praemorsa ssp. *praemorsa* was located on Mount Maxwell in a *Quercus garryana*-*Bromus* stand dominated in the understorey by grasses, forbs, and mosses (H. Roemer pers. comm.).

Mount Tzuhalem (Duncan)

Mount Tzuhalem is located adjacent to the Strait of Georgia on the east side of Vancouver Island. Twenty-five plants are known from a 100 m² area in gullies dominated by *Quercus garryana* and shrubs.

Somenos Lake (Duncan)

The largest population of *Viola praemorsa* ssp. *praemorsa* in Canada is located at Somenos Lake. Two groups of plants are located on either side of an open, shallow-soil meadow. Although much of the *Quercus garryana* forest has been converted to agricultural land with introduced species dominating the herbaceous vegetation, two stands remain relatively intact. A number of native species persist in these two stands and include *Viola praemorsa* ssp. *praemorsa*, *Osmorhiza chilensis*, *Cardamine pulcherrima*, *Dodecatheon hendersonii*, and *Erythronium oregonum*. Based on increment cores, both stands are composed of pure mature *Quercus garryana*, approximately 20 m in height, ranging in age between 100 and 200 years old (Chislett Lattey Manson Architecture and Engineering Inc. 1993). The contours of the boundary of the *Viola* populations mirror those of the *Quercus garryana* - *Bromus* stands. The open meadow, which lies between the two stands, is devoid of *Viola praemorsa* ssp. *praemorsa*. Adjacent areas also support *Quercus garryana* but these stands are either dominated by *Symphoricarpos albus* in the understorey or have been so heavily disturbed in the past that the understorey vegetation is composed entirely of introduced species.

Falaise Park (Victoria)

A small population (40 plants) of *Viola praemorsa* ssp. *praemorsa* occurs in this municipal park. The site is dominated by *Camassia quamash*, *Lithophragma parviflora*, *Sanicula crassicaulis* and *Taraxacum officinale*.

Non-verified Populations

Viola praemorsa ssp. *praemorsa* has been collected in the past from the following sites but their existence in recent years has not been confirmed.

Christmas Hill (Victoria)

The occurrence of *V. praemorsa* ssp. *praemorsa* at Christmas Hill was reported by Dr. Hans Roemer. The exact location of the population is unknown and substantial residential development has occurred since this species was observed in 1971, particularly in areas once dominated by *Quercus garryana*-*Bromus* vegetation. This area must be searched before the status of this population can be confirmed.

Mount Tolmie (Victoria)

Located in the northeastern part of the Victoria area, the lower portion of this hill is primarily dominated by residential development. The upper steeper portion of the hill is largely composed of exposed bedrock with scattered shrub-like *Quercus garryana* trees. Only the northern and eastern portion of the hill supports *Quercus garryana* - *Bromus* vegetation, typical of the habitat in which *Viola praemorsa* ssp. *praemorsa* is found. Most of

the vegetation at this site is now dominated by *Cytisus scoparius*. It is possible that *Viola praemorsa* ssp. *praemorsa*, first collected in 1963 but not found during a 1993 survey, may be present at this site but given the extensive domination of the *Quercus garryana*-*Bromus* vegetation by *Cytisus scoparius*, it is unlikely.

Royal Oak (Victoria)

Viola praemorsa ssp. *praemorsa* was thought to have been extirpated when a residential development was built at this site. It was predominantly a *Quercus garryana*-*Holodiscus discolor* stand located on a small hill. It was discovered recently that at least one of the sites, where *Viola praemorsa* ssp. *praemorsa* was collected in 1991, has not been destroyed. This area will have to be visited next spring to determine if the few plants known from this site are extant.

Quamichan Lake (Duncan)

Recently, a herbarium specimen of *V. praemorsa* ssp. *praemorsa*, collected from Quamichan Lake in 1933, was found at the Royal British Columbia Museum. Although some development of the land surrounding this lake has occurred since the time of collection, many *Quercus garryana*-*Bromus* stands are extant at this site but the status of *Viola praemorsa* ssp. *praemorsa* remains to be verified.

Nanoose Hill (Nanaimo)

Initially found in 1976, a recent visit to this site in 1993 failed to locate any specimens despite an intensive search. A portion of the property has been blasted and two roads have been constructed since the collection was made in 1976. It is possible that *V. praemorsa* ssp. *praemorsa* was located in these disturbed areas and is now extirpated.

Holmes Point (Comox)

A collection was made at this site in 1961 but according to the Gazetteer of Canada (Geographical Services Division 1985) there is no Holmes Point located at Comox. The only listing is in Nugent Sound (51°06' lat. 127°28' long.) on the coastal mainland just north of Vancouver Island which lies far outside the range of *Quercus garryana*, the habitat in which *Viola praemorsa* ssp. *praemorsa* is found. Local Comox residents, however, refer to the area at Cape Lazo (49°42' lat. 124°52' long.) as Point Holmes (J. Manson pers. comm.). This is the only area at Comox which supports *Quercus garryana* vegetation. No *Viola praemorsa* ssp. *praemorsa* was found when this area was visited in 1993 (C. Cadrin pers. comm.). Although some *Quercus* trees and meadows were found, some changes have occurred in this area since this species was last collected, including residential development and the construction of the Comox Canadian Air Forces Base.

Extirpated Populations

Cedar Hill (Victoria)

The Cedar Hill region has experienced extensive residential development since *Viola praemorsa* ssp. *praemorsa* was collected in 1887 by Macoun. Although many *Quercus garryana* trees are found in this area, the understorey vegetation has almost been completely eliminated. It is very unlikely that *Viola praemorsa* ssp. *praemorsa* has survived given the extensive residential development and the lack of records of this species in over 100 years.

7. General Biology

Little direct information is available on the ecology of *V. praemorsa* ssp. *praemorsa*. To date, almost all research has concentrated on taxonomic investigations regarding the separation and delineation of species comprising subsection *Chamaemelianum*.

Viola praemorsa ssp. *praemorsa* is a perennial species that overwinters as a short vertical rhizome. In British Columbia, *V. praemorsa* ssp. *praemorsa*, as with many other forbs located in *Quercus garryana* communities, appears to take advantage of the warm temperatures, ample moisture, and high light levels found during spring. In early spring (March) the leaves emerge, followed by the appearance of flowers in April and May. This usually occurs before the *Quercus garryana* leaves have fully emerged and before grasses, which usually dominate the understorey, have grown to a sufficient size where they shade or smother *Viola praemorsa* ssp. *praemorsa* and other forbs. Seeds are explosively ejected from the capsules during early to mid-summer and most plants then die back to the perennating rhizome. Some plants retain their leaves and produce elongated decumbent stems which may exceed 25 cm in length. Eventually these plants will also wither and die back to the perennating rhizome.

V. praemorsa ssp. *praemorsa* does not appear to spread by either stolons or rhizomes, hence, seed production appears to be very important in the maintenance and spread of this species into new habitats. Unfortunately, there is little direct information on the importance of insect pollinators, the proportion of flowers that are self- and cross-pollinated, and the average number of viable seeds produced by individual plants. In a discussion of the floral structure of *V. praemorsa* ssp. *praemorsa*, Baker (1935) stated that the style and stigma were pressed closely to the groove formed by the lower petal. This produced such a close fit that small insects could not force an entrance underneath, or on either side, of the style and were required to crawl over the stigma to reach the stamens and nectaries. On many occasions he observed thrips crawling along the groove formed by the lower petal until they were stopped by the close fitting head of the style. To reach the pollen and nectaries, the thrips had to crawl over the stigma before they could reach the pollen behind the broad appendages connected to the stamens. Hence, because the order in which insects contact the floral structures are stigma, stamens, and nectaries, pollen deposited on the stigma is likely to have come from another flower thus favouring the likelihood of cross-pollination. Further evidence suggesting that cross-pollination is common in *Viola* is provided by Beattie (1969).

He found that when insects were excluded from 30 flowers, only two of the flowers showed signs of ovule development which suggested that self-pollination is an uncommon event. Alternatively, when the stamens of 30 flowers were removed, but not excluded from contact with insects, 27 of the flowers showed ovule development suggesting these flowers were pollinated by pollen transported from other flowers.

Pollination of the closely related species, *Viola nuttallii*, is by solitary bees and occasionally butterflies. Despite its broad distribution, there is no indication that pollinators differ between ecogeographical regions (Beattie 1974). Beattie (1974) believed that *Viola* flowers were pollinated by a wide variety of both medium- and long-tongued pollinators. These insects must push the stigma and style upwards before they can reach the stamens and nectaries. Hence, any pollen carried by the insect upon arrival at the flower would be deposited on the stigma followed by the deposition of pollen from the stamens onto the insect as it attempted to reach the nectaries.

Davidse (1976) observed flies of the genera *Eristalis* and *Bombylius* frequently and indiscriminantly visiting the yellow-flowered species *Viola vallicola*, *V. utahensis* and *V. praemorsa* ssp. *major* (= *V. praemorsa* ssp. *linguaeifolia*). He believed hybrids observed among these species were likely produced as a result of interspecific pollination.

Like other *Viola* species, *Viola praemorsa* ssp. *praemorsa* may also produce seeds by cleistogamous flowers. These are apetalous flowers containing both stamens and ovules which do not open but produce seeds by self-pollination. They emerge after the petalous flowers have completed flowering. The extent to which *V. praemorsa* ssp. *praemorsa* produces cleistogamous flowers, and the importance of their contribution to seed production, is not known.

Beattie (1971) believed both types of flowers contributed to the success of *Viola* species by balancing the promotion of seeds with new genetic recombinants with potentially adaptive characteristics in new or changing habitats (produced by petalous flowers) with seeds produced by self-pollination (cleistogamous flowers) which are suited to the same habitat conditions as their parents.

8. Limiting Factors

Specific Threats

There are numerous threats to the survival of *Viola praemorsa* ssp. *praemorsa* populations although the intensity of these threats varies between populations. The most direct and immediate threat to several existing populations is that of habitat destruction. In British Columbia, *V. praemorsa* ssp. *praemorsa* is restricted to *Quercus garryana* communities and associated meadows which are themselves limited to a very small geographic area in southwestern British Columbia and predominantly occur in the Victoria region on southeastern Vancouver Island. Although few records are available indicating the extent of

Quercus garryana communities in the Victoria area prior to, and during, colonization by European settlers, it is likely these communities once dominated much of the area now presently occupied by residential and urban developments (see map pp. 9-10 in McMinn *et al.* 1976). The continued destruction of *Quercus garryana* communities has resulted in the elimination of almost all sites inhabited by *Quercus garryana*-*Bromus* vegetation, in which *Viola praemorsa* ssp. *praemorsa* appears to be particularly abundant.

The Conservation Data Centre (B.C. Ministry of Environment, Lands, and Parks) has ranked *Quercus garryana*-*Bromus* vegetation as S1 indicating a critically imperiled community because of extreme rarity (5 or fewer extant occurrences or very few remaining individuals) or because some factor(s) making it especially vulnerable to extirpation or extinction (C. Cadrin pers. comm.).

Today, the suppression of both natural and human-induced fires appear to have resulted in changes to many *Quercus garryana* communities in which shrub species, particularly *Symphoricarpos albus*, seem to be expanding at the expense of native forbs. This is evident at the Somenos site where *Symphoricarpos albus* dominates the understorey vegetation in a portion of the *Quercus garryana*-*Bromus* vegetation. It appears to be spreading into areas dominated by herbaceous species, including *Viola praemorsa*, as suggested by the emergence of new shoots along the edges of *Symphoricarpos albus* colonies. This shrub then effectively shades out, and eliminates, most herbaceous species. It is possible, therefore, that at one time, the *Viola praemorsa* ssp. *praemorsa* populations were larger in area but have since been reduced by encroaching *Symphoricarpos albus*.

The herbaceous vegetation observed today in *Quercus garryana*-*Bromus*, *Quercus garryana*-*Holodiscus discolor* vegetation, and grass-dominated meadows has been drastically altered with the introduction of European species. Although a large number of native forbs occur in these areas, much of the vegetation is dominated to a large extent by introduced species, particularly grasses, including *Dactylis glomerata*, *Anthoxanthum odoratum*, *Cynosurus echinatus*, and a number of species of *Bromus*. It is likely that introduced species now account for greater than 90% of the herbaceous vegetation biomass. Because these stands are composed primarily of introduced species, with no existing examples of "pre-European" vegetation, it is not possible to determine the type of species displaced, or the extent of the displacement (Roemer, 1972).

The degree that introduced species may have had on *Viola praemorsa* ssp. *praemorsa* remains unclear. Most grass species, except *Dactylis glomerata*, grow slowly in the spring and do not appear to compete with *Viola praemorsa* ssp. *praemorsa* for light until the latter has completed flowering and set seed. However, the dense turf formed by grasses at these sites may effectively prevent the successful germination and establishment of *Viola* seeds.

The shrub, *Cytisus scoparius*, has become a dominant species in almost all *Quercus garryana* stands and appears to negatively impact all herbaceous species. It is very resilient and invades open areas (particularly after fire and other types of disturbance) where it 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 which contribute nitrogen to the soil.

Changes in Populations

None of the British Columbian locations in which *Viola praemorsa* ssp. *praemorsa* is known to occur have been monitored over time. It is therefore difficult to determine, with much certainty, the decline or increase in specific populations. An examination of the pollen in soil cores sampled on southeastern Vancouver, however, suggest that *Quercus garryana* stands were much more extensive several thousand years ago (R. Hebda pers. comm.). Since this is the type of habitat where *Viola praemorsa* ssp. *praemorsa* is found, existing populations may be remnants of a more contiguous distribution of *V. praemorsa* ssp. *praemorsa* along the southeastern portion of Vancouver Island.

Since *Quercus garryana* stands have been extensively altered or destroyed in British Columbia, it is almost certain that the size and number of *Viola praemorsa* ssp. *praemorsa* populations has also declined in recent years. The introduction of aggressive competitive species has also aided in this decline.

9. Protection

Regulatory Measures

There is no specific legislation for the protection of rare and endangered vascular plants in British Columbia. Some populations of *V. praemorsa* ssp. *praemorsa*, however, are protected to a certain extent by their location on public property.

Populations on Public Land

Beacon Hill (Victoria)

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. Many of the natural areas have been converted to managed gardens and ponds. Unlike other areas within the park boundaries where the grass-dominated vegetation is often mowed, the three sites in which *V. praemorsa* ssp. *praemorsa* are found are less actively managed. Populations of *V. praemorsa* ssp. *praemorsa* and other rare species are not provided any protection, however, from habitat destruction in the park. The focus of park management is mainly on recreational activities rather than on the preservation of natural vegetation. Unfortunately, this lack of concern has resulted in the elimination of several rare species by direct habitat destruction (A. Ceska pers. comm.). 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 but this has yet to be taken seriously by park management.

Mount Tolmie (Victoria)

If *V. praemorsa* ssp. *praemorsa* is still extant at this site, it is most likely to be found in the municipal park located near the summit of Mount Tolmie where the native vegetation remains relatively intact. Unlike the lower slopes of Mount Tolmie, which are dominated by residential developments where the native herbaceous vegetation has been destroyed, the summit is not actively managed by the municipality. There are a large number of paths throughout the park and a road intersects the summit of the hill. It appears to be heavily used by pedestrians and cyclists which may have had some impact on *V. praemorsa* ssp. *praemorsa*. Unfortunately, *Cytisus scoparius* has become a dominant species throughout much of the park which may have caused the elimination of any pre-existing populations of *Viola praemorsa* ssp. *praemorsa*.

Smith Hill (Victoria)

This *V. praemorsa* ssp. *praemorsa* population is located in a small municipal park located in a residential area of Greater Victoria. This site has remained relatively undisturbed and probably does not experience the same degree of human impacts and disturbances as those located at Beacon Hill Park.

Uplands Park (Victoria)

Uplands Park is a municipal park located along the eastern shoreline of Victoria and is surrounded by residential development. It is a mixture of rock outcrops, *Quercus garryana* stands, and seasonally flooded meadows which support a number of rare species including *Ranunculus alismaefolius*, *Psilocarphus elatior*, *Aster curtus*, and *Centaureum muhlenbergii*. Almost all of the park receives little active management, hence, the vegetation has not been altered to the same extent as that seen in Beacon Hill Park. However, the park is heavily utilized by pedestrian traffic and cyclists so that trampling and disturbance of the vegetation has occurred. Much of the park is also heavily infested with *Cytisus scoparius* and other introduced species which have eliminated much of the native vegetation.

Mount Tzuhalem (Duncan)

The *Viola praemorsa* ssp. *praemorsa* populations known on Mount Tzuhalem receive the greatest degree of available legal protection due to their location within an ecological reserve. It encompasses 18 ha. of *Quercus garryana* stands, meadows, and rock outcrops which have been preserved as a representative example of *Quercus garryana* vegetation type and associated spring-flowering forbs meadows. In addition to *Viola praemorsa* ssp. *praemorsa*, this reserve includes several other rare species including *Balsamorhiza deltoidea*, *Aster curtus*, and *Isoetes nuttallii*. (B.C. Ecological Reserves Program 1992). Unfortunately, because the reserve is adjacent to a residential area, some human disturbance has occurred in the form of trampling by hikers and mountain bikes. Another threat to herbaceous species

on this site is the presence of *Cytisus scoparius* which has become a dominant species on the site in recent years.

Mount Maxwell (Saltspring Island)

The Mount Maxwell population is located in an ecological reserve which encompasses 65 ha. of *Quercus garryana* stands, rock outcrops, and *Pseudotsuga menziesii* forests. It includes the largest protected stand of *Quercus garryana* in British Columbia. Unfortunately, sheep grazing has eliminated many of the native understorey forbs commonly associated with *Quercus garryana* stands (B.C. Ecological Reserves Program 1992) although *Viola praemorsa* ssp. *praemorsa* appears to be resilient to grazing.

Falaise Park (Victoria)

This is a small park located in the Municipality of Saanich, just north of Victoria. The main threats in this park are due to human disturbance from trampling.

Populations on Private Land

Christmas Hill (Victoria)

Much of Christmas Hill has been extensively developed, particularly within the past twenty years. If *V. praemorsa* ssp. *praemorsa* is extant at this site it likely occurs near the summit of the hill on property located in the Swan Lake Nature Sanctuary. Although this property is protected from direct habitat destruction, high usage of the property by the general public and the extensive domination of the site by *Cytisus scoparius* likely threatens any extant populations.

Royal Oak (Victoria)

Until recently, *Viola praemorsa* ssp. *praemorsa* was thought to have disappeared from Royal Oak, a residential area in the northern part of Victoria. Much of the area has seen rapid residential development over the past 20 years which is continuing at the last remaining *Quercus garryana* sites. In 1991, volunteers and members of the Swan Lake Nature Sanctuary, led by W. MacGillivray, received permission to remove sections of sod in a *Quercus garryana* community that was slated for residential development. Approximately eight *Viola praemorsa* ssp. *praemorsa* plants were located within this area of which two were transplanted, along with sod, to the Swan Lake Nature Sanctuary. Unfortunately the plants were destroyed after they were transplanted. However, in a recent communication, MacGillivray states that the area in which the *V. praemorsa* ssp. *praemorsa* was collected was subsequently set aside and not destroyed with the construction of townhouses. This property is now designated as a municipal park.

Quamichan Lake (Duncan)

The land surrounding Quamichan Lake is privately owned by multiple landowners, hence, if *V. praemorsa* ssp. *praemorsa* still exists, it is not legally protected.

Somenos Lake (Duncan)

The largest population of *V. praemorsa* ssp. *praemorsa* located in British Columbia occurs on a 37 ha. parcel of land owned by Timbercrest Developments Ltd. In the past, the property was partially logged and was used for cattle grazing. Twenty-four hectares on the eastern side of the property was developed as single family residential housing. The undeveloped portion of the property is currently being considered for rezoning. Part of this area, containing the *Quercus garryana* stands with the *Viola* populations, has yet to receive protective status although recommendations have noted it's value. Currently, this area is frequented by the general public with several paths intersecting the areas in which *Viola praemorsa* ssp. *praemorsa* is located. It is likely that some plants have been eliminated with trampling, but on the whole, these areas appear to remain relatively undisturbed.

Mount Tuam (Saltspring Island)

At present, *V. praemorsa* ssp. *praemorsa* is not legally protected but is located adjacent to an ecological reserve also located on Mt Tuam. It is hoped that this land will eventually be incorporated into the ecological reserve.

Nanoose Hill (Nanaimo)

V. praemorsa ssp. *praemorsa*, if it is still present at this site, is located on private property and has no legal protection.

Holmes Point (Comox)

It is not possible to identify the degree of protection afforded *V. praemorsa* ssp. *praemorsa* populations at Holmes Point because their specific location is not known.

Rehabilitation Efforts

No attempts have been made to introduce *V. praemorsa* ssp. *praemorsa* into suitable habitats or to increase the number of individuals at current locations. Unfortunately, any effort to do so would be through trial and error because so little is known regarding the ecology and management of this species.

Fire, as it was used by native aboriginal people before European settlers arrived in coastal British Columbia, may have benefited the habitats in which *V. praemorsa* ssp. *praemorsa* occurred by eliminating dense thickets of shrubs and maintaining a forb-rich understorey in *Quercus garryana* stands. Unfortunately, today, fire does not appear to be a viable management option in this region.

Although most forms of disturbance will likely have a negative impact on *Viola praemorsa* ssp. *praemorsa*, this species appears to withstand grazing. The largest Canadian population at Somenos Lake was subjected to cattle grazing during the summer for many years. Likewise, the population on Mount Maxwell is grazed by domestic sheep. It is possible that these animals may benefit *V. praemorsa* ssp. *praemorsa* by keeping potentially competitive

species in check. However, more intense grazing may negatively impact *V. praemorsa* ssp. *praemorsa*. In a study of grazing intensity in grasslands and adjacent *Quercus garryana* stands in northern California, *Viola praemorsa* ssp. *praemorsa* was reported to occur in grasslands which were grazed for four months of the year but were absent from adjacent areas that were grazed for eight months of the year (Saenz and Sawyer 1986).

II. ASSESSMENT OF STATUS

10. Comments on Status

Globally, *Viola praemorsa* ssp. *praemorsa*, is ranked as a G5 species by the Conservation Data Centre (B.C. Ministry of Environment, Lands, Parks). This ranking indicates that, on a global scale, it is considered to be "common to very common; demonstrably secure and essentially ineradicable under present conditions". This ranking is based on the occurrence of all three subspecies of *Viola praemorsa*, including ssp. *linguaefolia*, an abundant species in the United States. When ssp. *praemorsa* is considered separately, it is ranked as a T3 species which is defined as "rare or uncommon (typically 21-100 occurrences); may be susceptible to large-scale disturbances; e.g. may have lost extensive peripheral populations."

Provincially, *V. praemorsa* ssp. *praemorsa* is ranked as an S2 species, "imperiled because of rarity (typically 6-20 extant occurrences or few remaining individuals) or because of some factor(s) making it vulnerable to extirpation or extinction.". It has been placed on the red list which encompasses 231 taxa that are listed as threatened or endangered and usually occur in threatened or endangered habitats. The species on this list are considered to be most at risk in British Columbia.

11. Status Recommendation

Viola praemorsa ssp. *praemorsa* should be ranked as a threatened species for the following reasons:

- 1) The number of *V. praemorsa* ssp. *praemorsa* populations in Canada are few in number and, in some instances, populations only comprise a few individual plants.
- 2) All populations appear to be threatened to a certain extent by introduced species which have invaded and dominated many *Quercus garryana* stands.
- 3) *Viola praemorsa* ssp. *praemorsa* in British Columbia represents the northern limits of this taxa at both the species and subspecies level and may represent genetically distinct populations to those found elsewhere (see p. IV-122, Forest Ecosystem Management Assessment Team 1993).

12. Prognosis

The prognosis for this species is uncertain. Although almost half of the populations are somewhat protected on public land, it is doubtful that this species will continue to persist at these sites without some form of active management. Some assurance would be provided if the stands in which these populations occur were considered stable natural ecosystems. However, with the introduction and domination of these stands by many non-native species, and the suppression of fire, it is apparent that the composition and structure of some stands are changing. It is difficult to predict what impact these changes will have on the success or failure of *V. praemorsa* ssp. *praemorsa* populations. In some *Quercus garryana* stands, *Symphoricarpos albus* and *Cytisus scoparius* seem to be increasing in area at the expense of native herbaceous species. Unfortunately, there appears to be few management options available to successfully control these species. Likewise, there are no existing *Quercus garryana* stands 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.

Management of *Viola praemorsa* ssp. *praemorsa* is further hampered because very little is known regarding the ecology of this species and its relationship to the environment and other species. In particular, demographic information is lacking and it is not known if existing populations are decreasing or increasing in numbers.

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