Species at Risk Act
Recovery Strategy Series

Recovery Strategy for Multi-Species at Risk in Garry Oak Woodlands in Canada

Deltoid balsamroot
White top aster
Small-flowered tonella
Howell's triteleia
Yellow montane violet

July 2006

Parks Canada Parcs Canada

Canada

About the Species at Risk Act Recovery Strategy Series

What is the *Species at Risk Act* (SARA)?

SARA is the Act developed by the federal government as a key contribution to the common national effort to protect and conserve species at risk in Canada. SARA came into force in 2003 and one of its purposes is "*to provide for the recovery of wildlife species that are extirpated, endangered or threatened as a result of human activity*."

What is recovery?

In the context of species at risk conservation, **recovery** is the process by which the decline of an endangered, threatened or extirpated species is arrested or reversed, and threats are removed or reduced to improve the likelihood of the species' persistence in the wild. A species will be considered **recovered** when its long-term persistence in the wild has been secured.

What is a recovery strategy?

A recovery strategy is a planning document that identifies what needs to be done to arrest or reverse the decline of a species. It sets goals and objectives and identifies the main areas of activities to be undertaken. Detailed planning is done at the action plan stage.

Recovery strategy development is a commitment of all provinces and territories and of three federal agencies — Environment Canada, Parks Canada Agency and Fisheries and Oceans Canada — under the Accord for the Protection of Species at Risk. Sections 37–46 of SARA (http://www.sararegistry.gc.ca/the_act/default_e.cfm) spell out both the required content and the process for developing recovery strategies published in this series.

Depending on the status of the species and when it was assessed, a recovery strategy has to be developed within one to two years after the species is added to the List of Wildlife Species at Risk. Three to four years is allowed for those species that were automatically listed when SARA came into force.

What's next?

In most cases, one or more action plans will be developed to define and guide implementation of the recovery strategy. Nevertheless, directions set in the recovery strategy are sufficient to begin involving communities, land users, and conservationists in recovery implementation. Cost-effective measures to prevent the reduction or loss of the species should not be postponed for lack of full scientific certainty.

The series

This series presents the recovery strategies prepared or adopted by the federal government under SARA. New documents will be added regularly as species get listed and as strategies are updated.

To learn more

To learn more about the Species at Risk Act and recovery initiatives, please consult the SARA Public Registry (http://www.sararegistry.gc.ca/) and the web site of the Recovery Secretariat (http://www.speciesatrisk.gc.ca/recovery/default_e.cfm).

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RESPONSIBLE JURISDICTIONS

The species addressed within the Garry Oak Woodlands Recovery Strategy occur exclusively within the Province of British Columbia in Canada. The Garry Oak Woodlands Recovery Strategy was developed by the Parks Canada Agency on behalf of the Competent Minister (the Minister of the Environment) in partnership with the Government of British Columbia.

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PREFACE

This national multi-species strategy addresses the recovery of five endangered or threatened species at risk in Garry oak (*Quercus garryana*) woodlands: deltoid balsamroot (*Balsamorhiza deltoidea*), white-top aster (*Sericocarpus rigidus*), small-flowered tonella (*Tonella tenella*), Howell's triteleia (*Triteleia howellii*), and yellow montane violet (*Viola praemorsa* ssp. *praemorsa*). The range of all species in this strategy is primarily in the United States, with only a small percentage extending north into Canada along southeastern Vancouver Island and through the adjacent Gulf Islands.

The *Species at Risk Act* (SARA, Section 37) requires the competent minister to prepare recovery strategies for listed extirpated, endangered or threatened species. The Garry Oak Ecosystems Recovery Team, Province of British Columbia and the Parks Canada Agency led the development of this *Recovery Strategy*.The proposed strategy meets SARA requirements in terms of content and process (Sections 39-41). It was developed in cooperation or consultation with numerous individuals and agencies: the Garry Oak Ecosystems Recovery Team, Province of British Columbia, Environment Canada; numerous aboriginal groups within the range of the species were informed of the strategy and opportunity for involvement; numerous environmental non-government groups such as The Land Conservancy and Nature Conservancy of Canada; industry stakeholders such as Weyerhaeuser, and BC Hydro; and landowners such as the Department of National Defence. Almost 1700 individuals and agencies were contacted directly and informed about this recovery program and the opportunity for involvement.

In accordance with the *Cabinet Directive on the Environmental Assessment of Policy, Plan and Program Proposals* (the Directive), a strategic environmental assessment (SEA) was conducted on this Recovery Strategy. The purpose of an SEA is to incorporate environmental considerations into the development of public policies, plans, and program proposals to support environmentally-sound decision making. The strategy has no significant adverse effects, and presents an overall benefit to the environment.

STRATEGIC ENVIRONMENTAL ASSESSMENT

In accordance with the *Cabinet Directive on the Environmental Assessment of Policy, Plan and Program Proposals*, a strategic environmental assessment (SEA) is conducted on all SARA recovery planning documents. The purpose of a SEA is to incorporate environmental considerations into the development of public policies, plans, and program proposals to support environmentally sound decision-making.

Recovery planning is intended to benefit species at risk and biodiversity in general. However, it is recognized that strategies may also inadvertently lead to environmental effects beyond the intended benefits. The planning process based on national guidelines directly incorporates consideration of all environmental effects, with a particular focus on possible impacts on non-target species or habitats. The results of the SEA are incorporated directly in the strategy itself, but are also summarized below.

There are no obvious adverse environmental effects of the proposed recovery strategy. Implementation of direction contained within this recovery strategy should result in positive environmental effects. In this strategy, the appropriate species (i.e. those in greatest danger of irreversible damage) are targeted for action. Threats to species and habitat are identified to the degree possible and related knowledge gaps are acknowledged. The state of knowledge of habitat critical for the survival and recovery of these species is provided and a specific course of action for definition of these spaces is outlined. Recovery objectives relate back to the specified threats and information gaps. It follows that acting upon the objectives will help to mitigate the effects of threats and improve upon knowledge gaps, thereby resulting in positive impacts to the subject species populations.

The compatibility of this recovery strategy and other plans is facilitated through the multi-stakeholder committee structure of the Garry Oak Ecosystems Recovery Team. It is reasonable to assume that successful stakeholder participation allows for this recovery strategy and relevant plans to be mutually influenced, thereby resulting in some degree of compatibility and positive cumulative effects.

EXECUTIVE SUMMARY

This national multi-species strategy addresses the recovery of five species at risk in Garry oak (*Quercus garryana*) woodlands: deltoid balsamroot (*Balsamorhiza deltoidea*), white-top aster (*Sericocarpus rigidus*), small-flowered tonella (*Tonella tenella*), Howell's triteleia (*Triteleia howellii*), and yellow montane violet (*Viola praemorsa* ssp. *praemorsa*). The Recovery Strategy comprises one component of the recovery program for Garry oak and associated ecosystems as outlined in the *Recovery Strategy for Garry Oak and Associated Ecosystems and their Associated Species at Risk in Canada: 2001-2006.*

The range of all species in this strategy is primarily in the United States, with only a small percentage extending north into Canada along southeastern Vancouver Island and through the adjacent Gulf Islands. The climate in this area is sub-Mediterranean, with cool, moist winters followed by warm summers with a prolonged drought. The woodland habitats range from open parkland with few scattered oaks to woodlands with a closed canopy and a patchy mix of shrubs and meadows. Very little of these woodlands remain and these remnants are fragmented by urbanization and at risk from a number of threats.

Stewardship Approach

For successful implementation in protecting species at risk there will be a strong need to engage in stewardship on a variety of land tenures, and in particular on private land and on Indian Reserves. Stewardship involves the voluntary cooperation of landowners to protect Species at Risk and the ecosystems they rely on. It is recognized in the Preamble to the federal *Species at Risk Act* (SARA) that "stewardship activities contributing to the conservation of wildlife species and their habitat should be supported" and that "all Canadians have a role to play in the conservation of wildlife in this country, including the prevention of wildlife species from becoming extirpated or extinct." It is recognized in the Bilateral Agreement on Species at Risk, between British Columbia and Canada that:

"Stewardship by land and water owners and users is fundamental to preventing species from becoming at risk and in protecting and recovering species that are at risk" and that "Cooperative, voluntary measures are the first approach to securing the protection and recovery of species at risk."

Very little Garry oak woodland remains (less than 5%), mostly due to land development. The remaining habitat is highly fragmented, and threatened by further urban development and recreational pressures. The invasion of exotic grasses and shrubs is a pervasive threat to all habitats and species in this strategy. Fire suppression is changing Garry oak stand structure and associated plant community composition, resulting in increased shading, thatch accumulation, and encroachment of shrubs and trees. Herbivory by exotic species and by livestock or deer may also be a potential threat.

- Information that is pertinent to the ultimate identification of critical habitat is provided for single occurrences, occurrences of the species on federal land, and occurrences under imminent threat. Critical habitat for deltoid balsamroot, white-top aster, small-flowered tonella, yellow montane violet, and Howell's triteleia will be proposed in the Recovery Action Plan, after a schedule of studies has been completed.

Occupied habitat is discussed in this strategy. Potential habitat remains to be identified and prioritized. Potential habitat should have an open tree canopy, well-drained or seasonally dry soils, and a relatively low amount of invasive species.

Recovery actions will improve the probability of long-term persistence in the wild for all species in this strategy. Further studies are required to determine any insurmountable barriers to restoration or reestablishment.

Long-term recovery goals for all species in this strategy are to: maintain existing populations at current levels of abundance or greater; restore species to their approximate historical area of occupancy and extent occurrence through reintroductions or translocations; and ensure long-term population viability.

The short-term objectives toward meeting these goals are:

1. Establish protection[1] for existing populations through stewardship and other mechanisms.

2. Involve landowners in habitation protection and species recovery.

3. Monitor populations and habitat to determine population trends and demography, and assess threats and habitat conditions.

4. Identify and define habitat attributes of populations including: soil depth and texture, slope and aspect, and associated plant communities.

5. Conduct biological and ecological research to better understand species at risk biology and ecological requirements and effects of exotic species and fire suppression.

6. Establish site-specific, adaptive management plans for habitat restoration.

7. Identify and rank recovery (translocation) sites for each species.

8. Augment population numbers where required as per recovery goals.

9. Establish new populations or subpopulations of each species as per recovery goals.

Four broad strategies have been designed to address threats and meet recovery objectives:

- Habitat protection and stewardship
- Site Management
- Information collection: inventory, monitoring and research
- Population Augmentation and Establishment

[1] This may involve protection in any form including stewardship agreements and conservation covenants on private lands, land use designations on crown lands, and protection in federal, provincial and local government protected areas.

By taking a multi-species, habitat-based approach to recovery, this strategy recognizes the importance of maintaining Garry oak ecosystems. It is expected that the recommended approaches will benefit not only the individual species at risk but the wider ecological community as well. A program of research to identify specific impacts on associated species at risk will be provided in the Recovery Action Plan.

Social and economic considerations

Recovery of species at risk and restoration of imperiled habitats associated with Garry oak ecosystems will contribute to biodiversity, health and functioning of the environment and enhance opportunities for appreciation of such special places and species thereby contributing to overall social value in southwestern British Columbia. The natural beauty of Garry oak ecosystems in the lower mainland, Gulf Islands and Vancouver Island are an important resource for British Columbians that provide for a robust tourism and recreation industry. Protecting these natural spaces, biodiversity and recreation values has enormous value to the local economy.

Recovery actions could potentially affect the following socioeconomic sectors: recreational activities, private land development, parks operations and maintenance. The expected magnitude of these affects is expected to be low in almost all cases.

There are a number of knowledge gaps that need to be addressed, regarding individual species as well as habitats. Information gaps include: species distribution and population status, species demography, effects of fire suppression, exotic species and restoration activities on species and habitats.

Recovery of the species in this strategy is likely to have minimal socio-economic impact, however, some land use options may be incompatible with recovery goals outlined in this recovery strategy.

The draft Recovery Action Plan for Garry oak woodland species at risk will be completed by March 2010.

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1. INTRODUCTION

This strategy has been developed under the broader Recovery Strategy for Garry Oak and Associated Ecosystems and their Associated Species at Risk in Canada: 2001-2006 (GOERT 2002) to address the recovery of five plant species at risk that occur within Garry oak (*Quercus garryana*) woodland habitat: deltoid balsamroot (*Balsamorhiza deltoidea*), white-top aster (*Sericocarpus rigidus*), small-flowered tonella (*Tonella tenella*), Howell's triteleia (*Triteleia howellii*), and yellow montane violet (*Viola praemorsa* ssp. *praemorsa*). In particular, this strategy comprises components of Strategic Approach D: "Protection and recovery of species at risk" of the GOERT strategy. This strategy covers all locations of all five of these species within Canada.

General background information that is common to all species is provided in Section A of the GOERT 2002 strategy and includes common habitat elements and background on Garry oak and associated ecosystems recovery.

The Garry Oak Woodlands Recovery Strategy provides two components of the three tiers of recovery identified by the Garry Oak Ecosystems Recovery Team (GOERT). In Section 2, key characteristics of the species, importance to people, threats to the species and habitat, critical habitat and recovery of the species are discussed. Section 3 provides detail on each species' biological needs and habitat requirements.

Table 1. Species addressed in this Recovery Strategy[2]

Species Name	COSEWIC Status	Provincial Rank and Listing	Global Rank	SARA Status (Schedule 1)	Estimated Population	Percent Range in Canada
deltoid balsamroot *(Balsamorhiza deltoidea)*	Endangered	S1 - Red	G5	Endangered	~ 1160 plants	< 1%
white-top aster *(Sericocarpus rigidus)*	Threatened	S2 - Red	G3	Threatened	~ 54,800 – 94,800 stems	~ 15%
small-flowered tonella *(Tonella tenella)*	Endangered	S1 - Red	G5	Endangered	~ 236-316 plants	< 1%
Howell's triteleia *(Triteleia howellii)*	Endangered	S2 - Red	G5	Endangered	~ 1000 plants	< 1%
yellow montane violet *(Viola praemorsa* ssp. *praemorsa)*	Threatened	S2 - Red	G5T3T5	Threatened	~ 45,000 plants	< 1%

See Appendix 2 of the *Recovery Strategy for Garry Oak and Associated Ecosystems* for definitions of ranks and listings used in this table.

[2] Taxonomy and nomenclature follows Douglas et al. (1998a, 1998b, 1999a, 1999b and 2001).

1.1 Stewardship Approach

For successful implementation in protecting species at risk there will be a strong need to engage in stewardship on a variety of land tenures, and in particular on private land and on Indian Reserves. Stewardship involves the voluntary cooperation of landowners to protect Species at Risk and the ecosystems they rely on. It is recognized in the Preamble to the federal *Species at Risk Act* (SARA) that "stewardship activities contributing to the conservation of wildlife species and their habitat should be supported" and that "all Canadians have a role to play in the conservation of wildlife in this country, including the prevention of wildlife species from becoming extirpated or extinct." It is recognized in the Bilateral Agreement on Species at Risk, between British Columbia and Canada that:

> "Stewardship by land and water owners and users is fundamental to preventing species from becoming at risk and in protecting and recovering species that are at risk" and that "Cooperative, voluntary measures are the first approach to securing the protection and recovery of species at risk."

1.2 Stewardship Approach for Private Lands

Since many species of risk occur only or predominantly on private lands, including some of the species in this strategy, stewardship efforts will be the key to their conservation and recovery. It is recognized that to successfully protect many species at risk in British Columbia there will have to be voluntary initiatives by landowners to help maintain areas of natural ecosystems that support these species of risk. This stewardship approach will cover many different kinds of activities, such as: following guidelines or best management practices to support species at risk; voluntarily protecting important areas of habitat on private property; conservation covenants on property titles; ecogifting part or all of their property to protect certain ecosystems or species at risk; or to sell their property for conservation. For example, both government and non-governmental organizations have had good success in conserving lands in the Province. This could be aided by the B.C. Trust for Public Lands.

1.3 Description of the Habitat Area Covered by the Recovery Strategy

The species covered in this strategy mostly occur in association with Garry oak woodlands in Canada. Garry oak woodlands, for the purposes of this strategy, range from open parkland with scattered Garry oak trees, a sparse shrub layer and a diverse herb layer, to closed Garry oak woodlands, sometimes including arbutus (*Arbutus menziesii)* and Douglas-fir *(Pseudotsuga menziesii*) trees, with a patchy mix of shrub thickets and meadow openings. These woodlands occur as patches within the Coastal Douglas-fir biogeoclimatic zone as a result of climatic, edaphic, and cultural factors (see Fuchs 2001).

Annual precipitation in Victoria, the centre of historical Garry oak woodland distribution in Canada, is approximately 600 mm (based on climate normals 1971-2000, Environment Canada 2004). Annual precipitation increases toward the periphery of Garry oak woodlands, approaching 1000 mm in Metchosin and up to 1500 mm in Duncan. The majority of this rainfall occurs in winter, with only approximately 45-65 mm per month falling in May-August in Duncan and 20 mm or less during this period in Victoria.

Soils supporting Garry oaks on southeastern Vancouver Island are often gravelly loams or gravelly sandy loams (Stein 1990). These soils are often shallow (i.e. <30 cm), with depths ranging from a few to over 100 cm, with deeper soils typically being very well-drained (Fuchs 2001, Roemer 1993). Soils can also be nitrogen poor, resulting in less competition from other native species.

It is likely that Garry oak woodlands had a more extensive range in Canada several thousand years ago as suggested by pollen in soil cores sampled on southern Vancouver Island and the adjacent mainland (R. Hebda pers. comm.; Brown and Hebda 2002, Pellat *et al.* 2001). The use of fire by First Nations is thought to have allowed the oak woodlands to persist and perhaps expand on southeastern Vancouver Island, particularly in areas with deeper soil, by preventing conifer encroachment as the climate became wetter (Pellat *et al.* 2001, Fuchs 2001, Turner 1999, Thilenius 1968).

There is little intact Garry oak woodland ecosystem left and most of the remaining stands contain an abundance of invasive, often introduced, species (MacDougall *et al.* 2004). In urban areas, veteran oaks remain, however, the understory has mostly been replaced by cultivated lawns and pavement. Remaining woodland patches are highly disjunct, typically small, and are most often dominated by invasive plant species. In addition, ecosystem processes (such as fire, herbivory, and hydrology) are often altered.

The remnants of Garry oak woodland habitats in which the species in this strategy are found vary between sites and do not necessarily represent typical or historical habitat conditions. Historically, Garry oak woodlands have been described as occurring in two major forms: oak parklands typified by richer, deeper soils with an understory mosaic of shrubs and herbaceous meadows, and drier scrub oak ecosystems on rocky hillsides and shorelines with poorer, shallower soils and a sparser understory (MacDougall *et al.* 2004). The species within this strategy typically occur in one of these woodland types, however, the majority of the habitat has been heavily invaded by exotic species, and community structure and composition has been altered by fire suppression. One deltoid balsamroot population (Tyee Spit) does not have a Garry oak overstory. One common factor in all of the sites is that they experience seasonal drought and/or have well-drained soils.

1.4 Rationale for Multi-species Approach to Recovery

Habitat protection plays an essential role in the conservation of wildlife species, as noted in the federal *Species At Risk Act* (SARA). GOERT has recognized this in their broad and fine filter approach to recovery planning, as discussed in the umbrella strategy (GOERT, 2002). A number of other important considerations identified by the National Recovery Working Group (2001) also indicate a need to approach species-specific recovery of Garry oak woodland species from a habitat perspective:

- These species at risk occupy a limited geographical area and their recovery actions must be integrated at some point in the planning process.

- These species may have conflicting needs which can be identified and addressed proactively with ecosystem and habitat approaches.
- Some threats to these species, such as invasive species, operate at an ecosystem scale and are therefore more effectively tackled with an ecosystem or habitat-wide approach.

Populations of species at risk in Garry oak woodlands are at the northern limit of their range (Ceska 1992, Pojar 1980) and may face similar important genetic and other recovery issues as a result.

Finally, due to the large number of species at risk (approximately 100 species) that occupy Garry oak ecosystems, recovery planning at the ecosystem and habitat levels enables a highly integrated and efficient planning process.

2. RECOVERY

2.1 Key Characteristics of the Group of Species

The species included within this recovery strategy have some common biological characteristics and requirements, aside from sharing similar habitat (see section I. above for characteristics of Garry oak woodland habitat).

Key characteristics include:

- The species in this strategy all occur over a similar range (California through Oregon to Washington and into southern British Columbia), with the populations in Canada being at the northernmost extent of this range.
- When mature, all species appear to be well adapted to drought conditions.
- The species are all relatively shade intolerant and are poor competitors.
- These species all tend to have either poor germination or poor seedling survival rates.
- All species have relatively limited dispersal, and the habitat is highly fragmented, making genetic exchange unlikely and limiting the opportunity for unoccupied habitat to be colonized.

2.2 Threats to Populations and Habitat

Threats to Garry oak woodland species have been identified in four major categories: direct human impact, exotic species, grazing and herbivory, and fire suppression. These threats are listed in Table 2 along with the degree to which they affect each species and its habitat. These categories are broad and interrelated, with threats likely having complex and cumulative effects on species at risk and their habitats.

Table 2. Present threats to populations of Garry oak woodland species at risk (P) and their habitat (H). The extent of the threat is described as Low, Moderate, High, or Unknown.

Threat	Impact	deltoid balsamroot	white-top aster	small-flowered tonella	Howell's triteleia	yellow montane violet
1. Direct human impact on habitat						
a) Habitat loss (e.g., urbanization and agricultural development)	P, H	High	High	High	High	High
b) Habitat fragmentation and demographic collapse	P	High	High	High	High	High
c) Habitat degradation (e.g., recreation, land use/maintenance)	P, H	High	Moderate	Moderate	High	Moderate
d) Restoration activities (e.g., mowing, pulling/cutting of shrubs, pesticide application)	P, H	Low	High	Low	High	Moderate
2. Fire suppression						
Changes to stand structure and plant community composition (shading, accumulation of thatch and woody debris, forest and shrub encroachment)	P, H	High	High	High	High	High
3. Invasion of exotic plant species						
a) Exotic shrubs (shading, competition and habitat alteration)	P, H	High	High	Low	High	High

b) Exotic grasses and forbs (shading, competition and habitat alteration)	P, H	Low	High	Moderate	High	High
4. Grazing and herbivory						
a) Herbivory or seed/bulb predation by exotic species (e.g., slugs, squirrels, rabbits, feral sheep)	P	High	Moderate	Unknown	Unknown	Unknown
b) Grazing by deer	P, H	High	High	Unknown	Unknown	Unknown

2.2.1 Direct human impact on habitat

The current extent of Garry oak ecosystems is estimated to be to less than 5% of their historical extent in the Victoria area (MacDougall *et al.* 2004, Lea 2002, Fuchs 2001). In addition, many sites continue to have no legal protection against future development since they occur on private land. Of the eight extant deltoid balsamroot sites in British Columbia, two are known to occur on private land. A significant portion of the deltoid balsamroot population at Tyee Spit was affected by residential development in 2003 (Ennis pers. comm. 2003). Of the 21 extant white-top aster sites, eight occur on private land. The single small-flowered tonella site occurs on private land on Salt Spring Island and could easily be extirpated by house construction on the waterfront property. Previous owners had plans for a residence on the site but these plans did not materialize. In recent years, Salt Spring Island has shown a marked increase in housing development with waterfront property at a premium. The population of the Island has increased by 78% between 1986 and 2001 and future projections indicate a further increase of 43% by 2026 (Adams pers. comm. 2003). Of the 13 extant Howell's triteleia sites, five occur on private land. Of the 13 extant yellow montane violet sites, one occurs on private land.

Historical habitat loss has resulted in a matrix of highly fragmented sites, with limited or no dispersal between populations of all species within this strategy. Such small, isolated populations are at risk of inbreeding depression (Primack 1998). Loss of habitat and habitat fragmentation can also lead to pollinator limitation, as has been noted as a concern for white-top aster populations at Fort Lewis in Washington (Bigger 1999). In addition, habitat fragmentation can result in an increased invasion of exotic species, as well as alteration of ecosystem processes such as disturbance, nutrient, and hydrological regimes, due to edge effects.

Habitat loss can also threaten survival in protected areas where management plans have not been implemented, or where management plans do not include specific provisions for rare vascular plants. Road, trail, or other facility construction or maintenance in some municipal parks have had adverse effects on rare vascular plant populations in the recent past, such as at Uplands and

Saxe Point Parks (Douglas pers. observ., Penny pers. comm. 2005). In addition, recreational use can result in trampling and removal of plants and/or flowers.

Degradation of habitat and direct damage to individual plants can also unintentionally result from restoration activities. Mowing, even in late summer, could negatively affect white-top aster since it is not dormant in mid-late summer, like most other forbs associated with Garry oak woodlands. Trampling of vegetation, accidental removal or disturbance of at-risk plants, exposure of soil, and inappropriate application of pesticides may all negatively affect the species in this strategy. The largest subpopulation of white-top aster at Mt. Tzuhalem was destroyed when a pile of pulled exotic shrubs were burned on the site. Carefully developed restoration plans and routine monitoring can ensure that restoration activities do not negatively impact plant species at risk in Garry oak woodlands.

2.2.2 Fire suppression

Suppression of both natural and human-induced fires following European settlement threatens all species in this strategy. The most noticeable threat is the expansion of shrub species, particularly common snowberry *(Symphoricarpos albus*), which effectively shade out native forbs, including those in this strategy. In the past, First Nations regularly burned much of southeastern Vancouver Island to maintain important wildlife and food-producing habitat (Roemer 1972, Turner 1999). Paleoecological evidence indicates that this burning by First Nations allowed for the persistence of Garry oak woodlands over the last several thousand years, by preventing the successional development of coniferous forest (Pellatt *et al.* 2001). Historical records indicate that the resulting landscape was a matrix of open prairies, rich meadows and shrub thickets (MacDougall *et al.* 2004). Many Garry oak woodland ecosystems (particularly the more mesic, deeper soil sites) are therefore dependant on fire as a disturbance mechanism to maintain the open canopy and understory, and remove thatch accumulation. Fire suppression also changes hydrological and nutrient regimes, and could negatively affect the species within this strategy.

The expansion of shrubs is evident at the Cowichan Garry Oak Preserve and at Somenos Lake, where snowberry dominates the understory vegetation in portions of these Garry oak woodlands. Snowberry appears to effectively shade out and eliminate most herbaceous species so it is possible that, historically, the white-top aster, Howell's triteleia, and yellow montane violet populations were larger at these sites, but have been reduced by shrub encroachment. Yellow montane violet is particularly shade-intolerant and takes advantage of the high light levels, warm temperatures, and moist conditions which occur in early spring when leaves have not yet appeared on Garry oak and most shrubs. Yellow montane violet rarely occurs where dense shrub thickets of snowberry and broom dominate the vegetation and strongly shade the forest floor.

The reintroduction of fire could potentially threaten the populations and habitat of woodland species. With the accumulation of thatch and woody debris that has resulted from fire suppression, any fire that does occur will most likely burn at much higher temperatures than did historic fires. This would likely result in increased invasion of exotic plants, particularly common velvet-grass (*Holcus lanatus*) and/or orchard-grass (*Dactylis glomerata*). Any reintroduction of fire will need to be carefully conducted, and alternative methods of addressing this threat may be required (such as mowing and hand removal of shrubs, trees and debris). Fire suppression poses a particular problem for small-flowered tonella survival. The vegetation in the area would have naturally been maintained by fires, however, in their absence, high fuel loads have developed and a catastrophic, high-temperature fire could occur, which could completely destroy the entire small-flowered tonella population.

Public safety and potential for damage to property is a major concern in regards to bringing fire back to these ecosystems. Therefore, this will have to be addressed if fire reintroduction is proposed.

2.2.3 Invasion of exotic plant species

Habitat and populations of all five species at risk are threatened by invasive exotic species: the grasses early hairgrass (*Aira praecox*), sweet vernalgrass *(Anthoxanthum odoratum*), hedgehog dogtail *(Cynosurus echinatus*), a number of brome species (*Bromus* spp.) and orchard-grass are of special concern and, at most Garry oak woodland sites make up over 80% of the vegetative cover. These grasses compete with native plants for nutrients and water and may also alter habitat conditions, such as by increasing the litter layer. Competition from exotic grasses may also inhibit seedling establishment. In addition, shading and crowding by the invasive shrub, Scotch broom *(Cytisus scoparius*), is a threat to deltoid balsamroot, white-top aster, Howell's triteleia, and yellow montane violet populations at several sites.

The small-flowered tonella habitat has been significantly altered by the presence of introduced species which now dominate the vegetation in the area. There is a particularly high cover of introduced grasses, especially bromes, at the site.

The extent of the impact that introduced plant species may have had on yellow montane violet remains unclear. Most grass species in the violet's habitat, except orchard-grass, grow slowly in the spring and do not appear to compete with the violet for light until it has completed flowering and set seed. However, the dense turf formed by grasses may still effectively prevent the successful germination and establishment of the violet's seedlings and may also compete for nutrients and water.

2.2.4 Grazing and herbivory

The effects of grazing and seed or bulb predation are largely unknown for the species addressed in this strategy, particularly for small-flowered tonella, Howell's triteleia, and yellow montane violet, but may have a considerable impact on regeneration and survival, particularly of young plants. An unstudied potential threat to Howell's triteleia is the increasing numbers of the introduced eastern grey squirrel (*Sciurus carolinensis)*, since lily bulbs are known food sources for squirrels.

Grazing by invertebrates and mammals has been observed on deltoid balsamroot, particularly in more disturbed sites, and may threaten the survival of younger balsamroot individuals (Roemer 2005). Some populations of white-top aster in parks have also been observed to be heavily grazed by deer as well as rabbits (Roemer 2005). Grazing may not always be a significant threat, however, since little grazing of white-top aster has been observed at Little Saanich Mountain, despite its high deer population (Fairbarns 2005). Yellow montane violet on Mt. Tuam appears to be heavily browsed by feral sheep, and also likely by deer.

Seed predators may threaten both deltoid balsamroot and white-top aster. Only a few intact seeds are often found in each of the many-flowered balsamroot seed heads. At Fort Lewis, Washington, Bigger (1999) found that two-thirds of the white-top aster ramets (essentially clonal stems) in his study were attacked by seed predators, mostly larvae of a coleopteran (beetle) species. This seed predation was also found to be correlated with patch size, with twice as many seeds damaged in large patches as in small. In Canada, seed predation of white-top aster is currently only a moderate threat, since a recent study indicates that few stems appear to flower, apparently due to summer drought (Fairbarns 2005).

2.3 Critical Habitat

No critical habitat, as defined under the federal *Species at Risk Act* [s2], is proposed for identification at this time in the 'Woodlands Recovery Strategy'.

While much is known about the habitat needs for survival and recovery of the species included within this recovery strategy, more definitive work must be completed before any specific sites can be proposed for protection as critical habitat. It is expected that critical habitat will be proposed within one or more recovery action plans following: (1) consultation and development of stewardship options with affected landowners and organizations and (2) completion of outstanding work required to quantify specific habitat and area requirements for these species.

A schedule of studies outlining work necessary to identify critical habitat is found below (Section 2.3.4). Notwithstanding the above, information on the current state of knowledge on the habitat needs and sites of occupation of the species included in this recovery strategy are provided below.

This section describes, to the extent possible, the occupied and potential habitat for each species, examples of activities which are likely to destroy critical habitat, and a schedule of studies required to define critical habitat.

Occupied habitat is described for four of the five species included in this strategy. Critical habitat will be proposed in the Recovery Action Plan stage after consultation with land owners and land managers.

2.3.1 Occupied habitat

All currently occupied habitat on federal, municipal lands as well as any sites that are under imminent threat, and are described below.

Deltoid balsamroot

Occupied habitat for deltoid balsamroot is found on the southeast coast of Vancouver Island, in Garry oak woodlands from Langford and Colwood to Victoria, as well as at Duncan and

Campbell River. These sites (see “Description of the needs of the species” section for details) are typically dry in summer and well-drained in winter, and exposed or only partially shaded by shrubs or trees.

Occupied habitat for Deltoid balsamroot occurs in eight locations in Canada; one location atis Fort Rodd Hill National Historic Site has the species’ only population on federal land (other than Indian Reserve land). Of the seven remaining balsamroot sites, two are on private land and therefore lack any sort of protection, one occurrence is on an Indian Reserve (Tyee Spit) where active protection and restoration of the species occurs, and the others are within protected areas.

White-top aster

Occupied habitat for white-top aster is found on the southeast coast of Vancouver Island and on Trial Island and Hornby Island. It occurs in Garry oak woodlands, or in meadows from Trial Island and Victoria, west to Colwood, Langford and Sooke, and north to Duncan, and Nanaimo. In addition, one population is known from the Port Alberni area. These sites (see “Description of the needs of the species” section for details) are dry in summer and well-drained in winter, and exposed or only partially shaded by shrubs or scattered trees. Soils are typically shallow (i.e. < 30 cm).

White-top aster is currently known from 21 extant sites. Sites with strong potential for protection or that have inordinately high value for the survival of the species in Canada include the federally-owned land on Trial Island and on Little Saanich Mtn. The percentage of the white-top aster population that is on the federally-owned land at these sites is unknown, therefore, mapping and inventory will be required to ensure that sufficient critical habitat can be designated at these sites. Important occupied habitat also occurs on private land in the Harmac area southeast of Nanaimo. This property is slated for development (Christy 2005, Fairbarns 2005) and contains the largest population of white-top aster in Canada.

Small-flowered tonella

Small-flowered tonella only occurs on one steep talus slope near Sansom Narrows, Salt Spring Island. This site (see “Description of the needs of the species” section for details) occurs on talus in open bigleaf maple-arbutus (*Acer macrophyllum-Arbutus menziesii*) forests, is dry in summer, well-drained in winter, and exposed. Additional habitat may be required for this species, and will be identified in the Recovery Action Plan after consultation with relevant landowners.

Howell’s triteleia

Occupied habitat for Howell’s triteleia is found along the southeast coast of Vancouver Island, between Victoria and Metchosin, including Langford and Saanich, north to Duncan. Howell’s triteleia occurs on moderately deep soils and rock outcrops in Garry oak woodlands. These sites (see “Description of the needs of the species” section for details) are dry in summer and well-drained in winter, and may be shaded by shrubs and scattered trees.

Of the 13 extant Howell's triteleia sites, seven occur within parks or other protected areas. One occurs on an Indian Reserve, and five are found on private property. There are no known development plans for the sites on private properties.

Yellow montane violet

Occupied habitat for yellow montane violet is found along the southeast coast of Vancouver Island, between Victoria and Metchosin, including Langford and Saanich, north to Duncan and Nanaimo, as well as on Salt Spring Island. One historical location was reported from the Comox area. Yellow montane violet habitat occurs in Garry oak woodland and meadows with deeper soils and less exposed bedrock (see "Description of the needs of the species" section for details). Habitat also includes some relatively steep rocky slopes, with pockets of soil, as well as some open (very little or no Garry oak or other tree cover) grass-dominated meadows where soils are relatively deep and likely retain some moisture during summer drought conditions.

Yellow montane violet is known from 13 sites in Canada: one site federal land on Little Saanich Mountain, nine are in parks or other protected areas, and three are on private land.

2.3.2 Potential habitat

The previously discussed occupied habitat is insufficient for the full recovery of the species within this strategy as defined under the species-specific recovery goals. Additional habitat will be required to meet these goals. However, further research is required before appropriate additional habitat can be proposed as critical habitat, and to determine feasibility of translocations including re-introductions. Selected potential habitat will also likely require restoration actions before recovery is attempted.

Ideally, all remaining Garry oak woodlands should be considered as potential habitat for one or more of deltoid balsamroot, white-top aster, Howell's triteleia, and yellow montane violet throughout their known historical range (see Section 3 for details on historical sites). Quality habitat should have an open tree canopy, well drained or seasonally dry soils, and a relatively low amount of invasive exotic species (particularly grasses and Scotch broom). Since these four species at risk sometimes occur together and require similar habitat, recovery actions for all four could be implemented simultaneously. In addition, populations of Howell's triteleia and yellow montane violet at extant sites could be increased dramatically, with the removal or reduction of threats to the populations and habitat.

Since small-flowered tonella is only known from one site in Canada, additional habitat on Salt Spring Island may need to be identified in order to increase the potential for this species' recovery.

2.3.3 Examples of activities likely to destroy any critical habitat identified in the future

Habitat loss through urbanization or agricultural development and other land use change is the most obvious activity that can destroy critical habitat. However, this threat can be effectively eliminated through habitat protection including stewardship. Maintenance activities (e.g., trail building and repair) and recreational use (e.g., hiking, mountain biking, ATV's) also can destroy critical habitat, and protection of critical habitat will require the cooperation of land owners or land managers.

Protection of critical habitat will involve restoration activities at most sites following guidelines provided by the Garry Oak Ecosystems Recovery Team to support land owner stewardship. Invasive exotic species are a serious threat to critical habitat, changing the plant community composition and structure and nutrient and water cycling regimes, essentially making the habitat unsuitable for the species at risk addressed in this strategy. Fire suppression is also resulting in a loss of critical habitat, by allowing conifers and shrubs to invade the open understory that was previously maintained by natural fires and by First Nations burning. However, restoration activities such as invasive plant removal (weeding or pesticide use), thatch removal (mowing or fire) and shrub and conifer removal (cutting or prescribed burning) can trample or otherwise destroy critical habitat, particularly if such activities are conducted during the growing season. Restoration activities may also be unsuccessful and therefore may have an overall deleterious effect on critical habitat (e.g., removal of shrubs resulting in erosion or invasion by exotic grass species).

2.3.4 Schedule of studies to identify critical habitat

Currently known important habitat attributes are discussed in detail in Section 3 of this strategy. A table of Garry oak woodland sites occupied by one or more of the species in this strategy has been compiled (Table 3) as a starting point for identification of critical habitat. The known population size, quality of habitat, and level of protection, were used to qualitatively assess each site's potential for recovery.

Further research is required to define proposed critical habitat for the five species in this recovery strategy. Research projects include:

- Use established mapping techniques (applied during phenologically appropriate periods), to delimit the boundaries of all occupied habitats and to confirm and consult with landowners. Suggested completion date: 2008
- Conduct detailed surveys of occupied habitats to better understand habitat attributes of critical habitat, including: soil depth and texture, slope and aspect, and plant community composition. Suggested completion date: 2009.
- Identify, map, and classify unoccupied Garry oak woodlands on southeastern Vancouver Island and the adjacent Gulf Islands. Suggested completion date: 2010.
    - Identified potentially suitable habitat for Garry oak woodland species at risk should be assessed both for possible unknown extant populations of species at risk and for suitability of establishing new populations if necessary.
- Compile information and research to propose critical habitat. Suggested completion date: 2010.

Table 3. Garry oak woodland species land tenure, population size, and qualitative assessment of site potential for recovery (Excellent, Good, Moderate, Poor or Unknown).

Site	Land Tenure	Population Size (# of stems)	Assessment of Site Potential for Recovery

		deltoid balsamroot	white-top aster	small-flowered tonella	Howell's triteleia	yellow montane violet	Excel.	Good	Mod.	Poor	Unkn.
Albert Head	Regional Park				9						X
Beacon Hill	Municipal Park	1			200	465			X		
Bear Hill	Regional Park		300			78					X
Camas Hill	Private		30								X
Canoe Cove	Private				2					X	
Christmas Hill	Private?					86				X	
Cordova Bay	Private		560							X	
Cowichan Garry Oak Preserve	Nature Conservancy of Canada		858		450	3200	X				
Cowichan River Estuary	Private				62					X	
Darnley Rd.	Private		Not recorded								X
Downes Pt.	Private		7,300						X		
Falaise Park	Municipal Park					59				X	
Fort Rodd Hill	National Historic Site	5								X	
Francis-King Park	Regional Park		438-478						X		
Francis-King Park, SW of	Private	36	Unknown							X	
Gordon Head	Private				51						X
Harmac	Private		24,000						X		
Holmes Point	Private?					Unknown					X
Horth Hill	Regional Park				3					X	
Island View Beach	Indian Reserve				1					X	
Kangaroo Rd.	Private		Unknown								X
Little Saanich Mtn.	Federal		12,000-45,000			25		X			

Site	Land Tenure	Population Size (# of stems)					Assessment of Site Potential for Recovery				
		deltoid balsamroot	white-top aster	small-flowered tonella	Howell's triteleia	yellow montane violet	Excel.	Good	Mod.	Poor	Unkn.
Maple Mtn.	Municipal Park		20								
Mary Hill	DND					Unknown					X
Mill Hill	Regional Park	55	3,990					X			
Mt. Finlayson	Provincial Park		200						X		
Mt. Maxwell	Provincial Park & Ecological Reserve					Possibly extirpated		X			
Mt. Tolmie	Municipal Park		30			Unknown				X	
Mt. Tuam	Private (Federal lease?)					53+				X	
Mt. Tzuhalem	Ecological Reserve	463	850			55	X				
Mt. Tzuhalem, base of	Private				6				X		
Mt. Wells	Regional Park		158					X			
Playfair Park	Municipal Park					282			X		
Sansom Narrows	Private			236-316				X			
Skirt Mountain	Private	1								X	
Smith Hill	City Park					490			X		
Somenos Lake	Provincial Park				126	40,000+	X				
St. Peter's Church	Private					5				X	
Thetis Lake	Regional Park	100			1				X		
Trial Island	Federal & Provincial		3000-8000						X		
Tyee Spit	Indian Reserve	500						X			

Site	Land Tenure	Population Size (# of stems)					Assessment of Site Potential for Recovery				
		deltoid balsamroot	**white-top aster**	**small-flowered tonella**	**Howell's triteleia**	**yellow montane violet**	**Excel.**	**Good**	**Mod.**	**Poor**	**Unkn.**
Uplands Park	Municipal Park		600			95			X		
White Rapids Rd.	Private		15							X	
William Head Rd.	Private				14					X	
Witty's Lagoon	Regional Park				43				X		
Woodley Range	Ecological Reserve		500								X

2.4 Recovery Feasibility

Recovery is broadly defined as "any improvement in a species' probability of long-term persistence in the wild" (Environment Canada *et al*. 2004). Recovery of species at risk to historical extent may not be feasible due to habitat loss, or inability to completely eliminate all threats or other limitations. Further study will be required to determine whether there are barriers to restoration of specific populations of the species, or to reintroduction of new populations. The premise of this strategy is that recovery is technically and biologically feasible (Table 4).

Table 4. Recovery feasibility for all species

Criteria	deltoid balsamroot	white-top aster	small-flowered tonella	Howell's triteleia	yellow montane violet
1. Are individuals capable of reproduction available to support recovery?	Yes	Yes	Yes	Yes	Yes
2. Is habitat available for recovery or could it be made available through recovery actions?	Yes	Yes	Yes	Yes	Yes
3. Can significant threats to the species or its habitat be avoided or mitigated through recovery actions?	Yes	Yes	Yes	Yes	Yes
4. Do the necessary recovery techniques exist and are they demonstrated to be effective?	Yes	Yes	Yes	Yes	Yes

2.5 Goals, Objectives and Broad Approaches/Strategies

2.5.1 Goals

Recovery goals are presented in Table 5 for all five species included in this strategy. Although these species differ in some respects of life history and microhabitat requirements, the overlying goals remain relatively constant for all. Since persistence of species at risk is the basic goal of recovery (see "Recovery feasibility" above), the first goal for all species is to maintain existing populations at existing or greater numbers. This ensures short-term persistence of the species in the strategy and provides a baseline standard for Goal 3 (see description of Goal 3 below). In most cases, removal of threats should allow populations to stabilize or increase in size. However, if monitoring indicates a population decline, augmentation may be required to increase population numbers.

Population viability analyses (PVA) have not been conducted for the species within this strategy. Until these analyses are conducted, specific recovery targets are instead based on historical records and the best available knowledge on the species. Goal 2 aims to restore or maintain the area of occurrence and area of occupancy of the species, based on estimations of historical abundance and distribution, to provide a greater likelihood of long-term persistence.
The aim of Goal 3 is to achieve viable populations of all species, with either a high or moderate (in the case of small-flowered tonella) probability of persistence. Probability of persistence can be predicted through demographic models which integrate birth and death rates that determine changes to population size (Caswell 2001 in Miller 2004). The discrete population growth rate, λ, is the most critical demographic parameter for species at risk management. When $\lambda < 1$, the population is projected to decline; when $\lambda = 1$, the population is stable; and when $\lambda > 1$, the population is projected to grow. Due to variation in λ, a single estimate is not usually a reliable predictor of long-term population dynamics. Stochastic simulations are used to provide more accurate indicators of long-term trends, by accounting for yearly variation in λ (indicated by log λ_s) (Caswell 2001 and Caswell and Kaye 2001 in Miller 2004).

Table 5. Recovery goals for all species.

Species	Recovery goals
deltoid balsamroot	1. To maintain extant populations of deltoid balsamroot at current levels of abundance or greater. 2. To restore deltoid balsamroot to its estimated approximate historical extent of occurrence and area of occupancy [establish a minimum of two new self-sustaining populations (in the Victoria and Metchosin area)]. 3. Attain, with a high probability of persistence[3], a fully viable Canadian population of deltoid

[3] After 10 years, population size at four protected localities is stable or increasing, with the combined population exhibiting a projected stochastic population growth rate (log λ_s) ≥ 1.0. (Population trends will be estimated using data collected from annual monitoring. Prior to the initiation of detailed monitoring surveys and/or demographic study, a pilot study should be undertaken to determine if 10 years represents an appropriate time scale to measure population changes for individual species at risk and to guide the development of sampling designs with the statistical rigor to detect such changes.)

Species	Recovery goals
	balsamroot.
white-top aster	1. To maintain extant populations of white-top aster at current levels of abundance or greater. 2. To restore white-top aster to its estimated approximate historical extent of occurrence and area of occupancy (establish a minimum of two new self-sustaining populations in the Victoria area). 3. Attain, with a high probability of persistence[4], a fully viable Canadian population of white-top aster.
small-flowered tonella	1. To maintain the extant population of small-flowered tonella at the current level of abundance or greater. 2. To maintain the approximate current extent of occurrence and increase the area of occupancy (at least two additional subpopulations on Salt Spring Island). 3. Attain, with a moderate probability of persistence[5], a fully viable Canadian population of small-flowered tonella.
Howell’s triteleia	1. To maintain extant populations of Howell’s triteleia at current levels of abundance or greater. 2. To restore Howell’s triteleia to its estimated approximate historical extent of occurrence and area of occupancy [establish a minimum of two new populations (in the Victoria and Metchosin area)]. 3. Attain, with a high probability of persistence[4], a fully viable Canadian population of Howell’s triteleia.
yellow montane violet	1. To maintain extant populations of yellow montane violet at current levels of abundance or greater. 2. To restore yellow montane violet to its estimated approximate historical extent of occurrence and area of occupancy [establish a minimum of two new populations (in the Victoria and Metchosin area)]. 3. Attain, with a high probability of persistence[5], a fully viable Canadian population of yellow montane violet.

2.5.2 Objectives

The short-term recovery objectives outlined in Table 6 apply to all species in this strategy and contribute to achieving the recovery goals. The first objectives are clearly focused on protecting species and habitat, acquiring information, and monitoring extant sites. These first steps are important requirements for appropriate recovery implementation over the long term, especially in regard to habitat restoration and augmentation of current populations and establishment of additional populations.

Table 6. Common recovery objectives for Garry oak woodland species at risk.

Objective	Suggested Time to Completion

[4] After 10 years, population size at 10 protected localities is stable or increasing, with the combined population exhibiting a projected stochastic population growth rate (log λ_s) ≥1.0. (Population trends will be estimated using data collected from annual monitoring. Prior to the initiation of detailed monitoring surveys and/or demographic study, a pilot study should be undertaken to determine if 10 years represents an appropriate time scale to measure population changes for individual species at risk and to guide the development of sampling designs with the statistical rigor to detect such changes.)

[5] After 10 years, total population size at Salt Spring Island is at least 1000 individuals, with the population exhibiting a projected stochastic population growth rate (log λs) ≥1.0.

1) Establish protection for existing populations through stewardship and other mechanisms..	5 years
2) Involve landowners in habitation protection and species recovery.	5 years
3) Monitor populations and habitat to determine population trends and demography, and assess threats and habitat conditions.	ongoing
4) Identify and define habitat attributes of populations including: soil depth and texture, slope and aspect, and associated plant communities.	5 years
5) Conduct biological and ecological research to better understand species at risk biology and ecological requirements and effects of exotic species and fire suppression.	ongoing
6) Establish site-specific, adaptive management plans for habitat restoration.	5 years
7) Identify and rank recovery (translocation) sites for each species.	5 years
8) Augment population numbers where required as per recovery goals.	5-10 years
9) Establish new populations or subpopulations of each species as per recovery goals.	5-10 years

Effective protection of existing populations

Long-term protection for extant populations of species at risk needs to be secured whenever possible. This may be conducted through a variety of mechanisms, including land acquisition by public agencies or private conservation organizations, development of formal stewardship agreements or conservation covenants with landowners, or legislative protection through the *Wildlife Act*.

Landowner participation

Landowner cooperation and participation in habitat protection and species recovery is crucial for effective recovery. This will require proactive communication between recovery teams and stewards, including land managers and property owners. Stewards should also be involved in the recovery process, and encouraged to participate in restoration projects and species monitoring and collaborate with researchers.

Monitoring of populations and habitat

A monitoring program for all species at risk in this strategy will be required in order to determine population trends, and identify new and ongoing threats to species and habitats. Monitoring programs should be developed in conjunction with land managers and owners and should focus on habitat condition, threats, and associated population responses, as well as on providing detailed assessments of population size and demography. Monitoring should be conducted on an annual basis, at a minimum. Information gathered through monitoring should be forwarded to relevant stakeholders and agencies, and incorporated into site management plans.

Identification of habitat attributes

A detailed inventory and survey, including mapping, of Garry oak woodland species at risk habitat on southern Vancouver Island and the adjacent Gulf Islands is necessary to understand habitat requirements of the species. The information gathered should be utilized in conjunction with monitoring information to aid in identifying appropriate critical habitat and establishing research priorities. Data collected should include:

- numbers of plants, including general age classes
- area of occupancy (m^2)
- substrate type (e.g., soil texture, depth, presence of organics)
- site, slope and aspect
- stand structure and age
- plant community composition including vegetative cover and/or numbers of community associates, especially exotics

Biological and ecological research

In addition to investigating population trends and habitat attributes, research on the biology and community ecology of the species in this strategy is necessary for effective site management and recovery. Permanent study plots should be established at one or more sites for each species at risk in this strategy, for use in addressing research questions.

Information on demographics (including seedling and juvenile survival, individual plant longevity, and seed bank longevity), genetics, germination characteristics, pollination, and dispersal is required to better understand population dynamics. To address threats posed by exotic species, research on exotic species biology, eradication, and effects on species at risk is necessary. Effects of fire suppression, and impacts of fire reintroduction or other disturbances or maintenance methods (such as mowing and cutting of shrubs and/or trees), should also be studied.

Habitat restoration and management plans

Habitat restoration is required at all sites to address threats from exotic and native shrubs, including thatch accumulation as a result of invasion by exotic grasses and fire suppression. This may require various treatments including cutting of trees and/or shrubs, weeding, mowing, and/or controlled burning to restore habitat and enhance germination and seedling survival and reduce competition. Restoration activities should be based on site-specific management plans, and should be adapted as required (from information provided by monitoring and research).

Identification and ranking of recovery sites

Upon completion of Objective #4, in conjunction with information gathered through Objective #5, additional habitat for the species at risk in this strategy should be identified and ranked in order of priority and feasibility.

Population augmentation and establishment

Population monitoring may indicate a decline in individuals at extant sites, despite recovery action to reduce threats. In order to meet recovery goals, planting of seedlings or cuttings at extant sites may therefore be required to augment existing populations. Additional populations may also need to be established at formerly occupied sites in order to restore the species to an approximation of its historical extent of occurrence. Prior to any population augmentation or establishment, site restoration will likely need to be conducted and any potential or actual threats to the species and/or habitat will need to be addressed.

The Recovery Action Plan will include augmentation and translocation plans for the species in this strategy. These plans will further outline the specific conditions under which augmentation translocations should be implemented, and will provide guidance based on the "Guidelines for Translocation of Plant Species at Risk in British Columbia" (BC Ministry of Environment, in draft.)

2.5.3 Broad Approaches to Address Threats

The similar goals and objectives for the species included in this strategy can be addressed through four broad approaches that can be applied to all species: habitat protection/stewardship, site management, information collection, and population augmentation/establishment. The use of these broad approaches can increase efficiency and cost-effectiveness of recovery actions. The approaches to effect recovery of the species included in this strategy are listed in Table 7 and are linked to the objectives and threats of the species. In addition, examples of specific steps and outcomes or deliverables are identified.

Table 7. Broad approaches to effect recovery for all species within the strategy.

Priority	Obj. No.	Broad Approach	Threat(s) addressed	Specific Steps	Outcomes or Deliverables (identify measurable targets)
High	1,2	Habitat Protection and Steward-ship	1 - 4	• Prioritize sites for urgency (see Table 3) of attention • Identify and contact private owners • Determine and implement ideal protection strategies for individual sites (acquisition, easement, stewardship, etc.) when feasible • Establish communication and cooperation with land owners and stewards and engage in recovery	• Prioritized list of private sites for potential securement • Contact established with landowners and protection measures in place where feasible • Where protection of private land not feasible, stewardship roles established when possible • All protected areas implement specific provisions for species at risk management
High	2, 3, 4, 5, 6, 8	Site Manage-ment	1b, 1c, 1d, 2, 3, 4	• Implement actions to reduce impact of invasive exotic species on habitat and individual plants (based on research) • Minimize damage to individual plants through application of netting and/or diatomaceous earth or other means when necessary • Implement and adaptively manage a mowing, weeding and/or controlled burning regime where determined appropriate	• Increased health of extant individuals and populations • No decrease in population sizes over 5-10 year period
High	3,4,5, 6,7	Information collection - inventory - monitoring - research	1b, 1c, 1d, 2, 3, 4	• Conduct baseline inventory of sites and habitat attributes • Map sites accurately for long term monitoring • Conduct research to better understand demographic patterns • Conduct research on non-native species biology, eradication, and interaction with species at risk • *In situ* and *ex situ* experiments to address knowledge gaps regarding competition, germination, survival etc.	• GIS database of accurate baseline site information • Completion of basic research on habitat attributes, phenology, seed bank longevity, germination characteristics, seedling and juvenile survival, and individual plant longevity • Basic understanding of threat from non-native species at sites
Medium	3,4,5, 7, 8, 9	Population Augmentation and Additional Population Establishment	1a, 1b, 1c, 3b, 4a	• Apply experimental data from research to create recovery strategies for extant populations • Implement population recovery actions at extant sites by enhancing recruitment and survival • Apply knowledge gained from research, experiments, and population recovery to create strategies for additional population establishment • Implement establishment of new populations at suitable sites if required and feasible	• Increased health of extant individuals and populations • No decrease in population sizes over 5-10 year period • Experimental populations established

Habitat Protection and Stewardship

Habitat loss and fragmentation has historically been the most serious threat affecting the species in this strategy. Habitat protection and stewardship agreements can be used to effectively address this threat. Sites should be prioritized by urgency of attention, after mapping and surveying of populations and habitats. Landowners should be identified and contacted to discuss feasible protection strategies, and to establish open communication and cooperation in protecting species at risk in Garry oak woodlands.

Site Management

Site maintenance and restoration activities need to be implemented to reduce the impact of invasive exotic species on habitat and individual plants. Caution must be used to minimize damage from herbivores and detrivores to individual plants (particularly younger deltoid balsamroot plants) through application of netting and/or diatomaceous earth or other means when necessary. An adaptive management approach may be implemented to design the most effective site management approach for each location.

Information collection: inventory, monitory and research

Baseline inventory, monitoring and research on populations and habitats is required to better understand species at risk in Garry oak woodlands. Necessary studies include:

- an accurate assessment of current populations to establish baseline population numbers for long term monitoring
- research to better understand species at risk biology, population dynamics and demographic patterns, and ecological requirements
- research on exotic species biology, eradication, and interaction with species at risk
- *In situ* and *ex situ* experiments to address knowledge gaps regarding competition, germination, survival etc.

Population Augmentation and Establishment

The first priority for recovery of the species in this strategy is the protection and management of currently occupied habitats. The Canadian Botanical Association (2004) recommends that existing populations should not be moved to more convenient locations as compensatory mitigation planting. Translocations and reintroductions should be used as a tool for augmenting the number of individuals at existing sites and increasing the number of existing populations (as well as the extent and area of species occurrence). In addition, populations used as source material should be carefully monitored to ensure that collection does not damage donor populations. Reintroduction of plants at extirpated sites should not replace protection and management of existing populations.

Successful introductions/reintroductions require the active participation of the GOERT Plants at Risk RIG and must follow augmentation and translocation plans to be provided in the Action Plan (see “Objectives” section above). It must be ensured that appropriate habitat exists at reintroduction sites and that threats to new populations have been adequately managed or eliminated. (e.g., through site preparation and restoration, control of competition, watering, fencing, etc.).

2.6 Effects on Other Species

Garry oak woodland species are inherently tied to ecosystem processes which have been significantly altered since the arrival of European settlers (e.g., changes to fire regime and stand dynamics and spread of invasive exotic species). As a result, most of the activities suggested in this strategy will also benefit other species within the ecosystem. However, this assumption should not necessarily be accepted, and specific recovery activities should always consider effects on other species, particularly other species at risk. Because of the large number of species at risk and the high concentrations of rare species at some locations, it is not possible to describe all possible positive and negative impacts associated with recovery. These management impacts must be addressed at a later stage either in the Recovery Action Plan (RAP), or during on-site evaluations.

To avoid potential conflicts with other recovery actions planned or underway, open communication should be maintained with the following GOERT Recovery Implementation Groups (RIGs) and Steering Committees:

- Inventory, Mapping & Plant Communities RIG
- Conservation Planning & Site Protection RIG
- Restoration and Management RIG
- Invertebrates at Risk RIG
- Vertebrates at Risk RIG
- Research RIG
- Communication, Coordination & Public Involvement RIG
- Invasive Species Steering Committee
- Native Plant Propagation Steering Committee
- Fire & Stand Dynamics Steering Committee

2.7 Knowledge gaps common to all or most species

The strategic approaches outlined in the umbrella Garry oak and associated ecosystem strategy (GOERT 2002) identify and discuss knowledge gaps that pertain to Garry oak ecosystems. Particular information gaps that may inhibit recovery of the species included in this strategy will be addressed through research activities as discussed in the objectives and broad approaches sections. The most pressing concerns regarding recovery of woodland species are the lack of information on species distribution and population status, species demography, and effects of fire suppression, exotic species and restoration activities on species and habitats.

Species-specific biological information gaps common to all species within the report include: understanding of competition (especially with exotic species), and demographic patterns (e.g., seed bank longevity, germination characteristics, seedling and juvenile survival, individual plant longevity). Little or no information is available regarding the population dynamics of these species including the extent to which seed remains viable in the soil, the frequency with which recruitment occurs from established seedlings, and the longevity of mature plants (for perennials).

In addition, research on white-top aster in the U.S. has been unable to find a correlation between the species' reproductive biology and its rarity since seed production has been found to be within the normal range for Asteraceae (Clampitt 1987, Giblin and Hamiliton 1999). Douglas and Illingworth (1996) report a relatively high percentage of flowering stems (30-50%), though Fairbarns (2005) found very few flowering stems. There is little known about Howell's triteleia in terms of biology or ecology throughout its range. No information is available regarding the population dynamics of this species including the extent to which seed remains viable in the soil, the frequency with which recruitment occurs from established seedlings, and the longevity of mature plants.

2.8 Actions already completed or underway

This section describes some of the relevant recovery actions already completed or underway that directly apply to one or more of the species at risk. Some actions listed have been adapted from Maslovat and Fairbarns (2005) and Miller (2005). Several actions are from a list of active research compiled by Mike Meagher of the GOERT Research RIG (Meagher pers.comm. 2004). In addition to these local actions, research and management or restoration techniques in the United States should be considered, such as those outlined by Fitzpatrick (2004).

2.8.1 Other recovery strategies

- GOERT (Garry Oak Ecosystems Recovery Team). 2002. Recovery Strategy for Garry Oak and Associated Ecosystems and their Associated Species at Risk in Canada: 2001-2006. Draft 20 February 2002. (website: http://www.goert.ca).
- Maslovat, C., and M. Fairbarns. 2005. National Recovery Strategy for Maritime Meadow Species at Risk. Draft report to the Garry Oak Ecosystems Recovery Team.
- Miller, M.T. 2005. National Recovery Strategy for Species at Risk in Vernal Pools and Other Ephemeral Wetlands. Draft report to the Garry Oak Ecosystems Recovery Team.

2.8.2 Public outreach and education

- Preparation and distribution of Fact Sheets for Species at Risk in Garry Oak and Associated Ecosystems in British Columbia (GOERT 2003).
- Public education, including workshops, hosted by GOERT
- Mount Tzuhalem stewardship co-ordinator hired by Cowichan tribes for off-reserve outreach and public education on species at risk.
- CRD Parks has developed a draft communications plan for the Sooke Hills Wilderness Area and Mount Wells Regional Park which calls for installation of interpretive signs at Mount Wells explaining the presence of rare species and the need for park users to stay on trails. This information will also be posted at their website: www.crd.bc.ca/parks.

2.8.3 Landowner contact

- Oak Bay Parks has been contacted regarding protection of species at risk in Uplands Park.

2.8.4 Habitat protection

- GOERT has inventoried and compiled a list of priority unprotected Garry oak woodland sites and sponsored and facilitated workshops with potential partners to discuss their protection and securement.

2.8.5 Habitat mapping, surveying, and inventory

- Numerous surveys of Garry oak woodlands have been conducted on behalf of the BC Conservation Data Centre, Interdepartmental Recovery Fund, GOERT, and other agencies by experienced botanists.
- A Sensitive Ecosystem Inventory has been completed for east Vancouver Island and the Gulf Islands (Ward *et al.* 1998).
- A rare plant inventory and mapping has been completed at Uplands Park/Cattle Point, Oak Bay (Collier *et al.* 2004) and rare plant inventory and mapping has been conducted in Beacon Hill Park, Victoria.

2.8.6 Plant Species at Risk Research

- GOERT has supported, initiated and/or continued research on:
  - restoration strategies
  - effects of mammalian herbivores and exotic plants on plant diversity
  - indigenous ecological management
  - fire history
- Staff from the Pacific Agri-Food Research Centre have tested propagation techniques for deltoid balsamroot, white-top aster, and yellow montane violet (Ehret *et al.* 2004).
- Deltoid balsamroot seeds from Mt. Tzuhalem have been propagated by Sylvan Vale Nursery, and planted at Somenos.

2.8.7 Invasive Species Research and Removal

- GOERT has compiled an annotated bibliography of invasive species in Garry oak ecosystems, as well as developed and piloted a Decision Support Tool for invasive species management.
- GOERT has supported, initiated and/or continued research on Scotch broom and common snowberry encroachment, regeneration and management.
- Research at the Pacific Forestry Centre has been conducted on impact and management of the exotic invasives: Scotch broom, gorse (*Ulex europaeus)*, daphne *(Daphne laureola*), and English ivy *(Hedera helix*), as well as monitoring spread of Scotch broom and gorse in British Columbia.

- Removal of invasive species at Fort Rodd Hill National Historic Site, including at the deltoid balsamroot site (Reader, pers. comm.), invasive species removal at Mt. Tzuhalem Ecological Reserve, removal of Scotch broom and gorse from Trial Island.

2.8.8 Management Plans

- Somenos Marsh Management Plan (Williams and Radcliffe 2001). Website: http://www.northcowichan.bc.ca/pdf/somenos_mgt_plan.pdf
- CRD Parks Master Plan (Capital Regional District Parks 2000) and associated management plans for invasives, rare plant monitoring, and individual park issues. Website: http://www.crd.bc.ca/parks/documents/master_plan.pdf
- Uplands Park/Cattle Point Rare Species Management Plan (in progress).
- Mount Tzuhalem Ecological Reserve: Purpose statement (BC Parks 2003a).
- Trial Islands Ecological Reserve: Purpose statement (BC Parks 2003b).
- In 2003-4 and 2004-5 the municipality of Oak Bay and HSP are developing guidelines for the long-term management of all rare species at Uplands Park and Cattle Point.

2.8.9 Habitat Restoration

- Mill Hill Regional Park Restoration Plan: pilot project for future restoration in CRD Parks by removing Scotch broom and daphne from Garry oak ecosystems, and monitoring and restoring species at risk plant populations (CRD Parks 2003).
- The Nature Conservancy of Canada (NCC) has conducted shrub removal (Scotch broom and common snowberry) and established experimental plots at the Cowichan Garry Oak Preserve and at the deltoid balsamroot site in Campbell River (Ennis pers comm).

2.9 Socioeconomic Considerations

The species addressed in this recovery strategy do not have specific economic or social values, other than the historical, cultural and aesthetic values associated with intact Garry oak woodlands. The effects of implementing this recovery strategy are therefore low except on particular sites, and the extent of the affect will have a minimal area involved.

Recovery of species at risk and restoration of imperiled habitats associated with Garry oak ecosystems will contribute to biodiversity, health and functioning of the environment and enhance opportunities for appreciation of such special places and species thereby contributing to overall social value in southwestern British Columbia. The natural beauty of Garry oak ecosystems in the lower mainland, Gulf Islands and Vancouver Island are an important resource for British Columbians that provide for a robust tourism and recreation industry. Protecting these natural spaces, biodiversity and recreation values has enormous value to the local economy.

Some activities occurring in and around Garry oak woodlands can impact sensitive species at risk. Deleterious impacts on species at risk and the integrity of these spaces may occur through activities that:

- modify or damage ecological processes important for maintenance of these sites,

- directly or indirectly introduce species, native or non-native, that alter the biotic or abiotic environment in a manner detrimental to processes important for the perpetuation of Garry oak woodlands,
- directly damage or destroy an individual species at risk (such as through trampling or wheeled activities), or
- modify or destroy Garry oak woodlands (such as through complete terra-forming).

Recovery actions could potentially affect the following socioeconomic sectors: recreational activities, private land development, parks operations and maintenance. The expected magnitude of these effects is expected to be low in almost all cases.

Garry oak woodlands are rare on the landscape and the overall land area required for physical protection of these sites is relatively small. Effective mitigation of potentially detrimental activities can be accomplished through careful planning and environmental assessment of proposed developments and site activities and sensitive routing of travel corridors and recreational activities.

Recovery of Garry oak woodlands and their associated species at risk will require intelligent planning for any development, and determination of appropriate uses for sensitive locations. Managers of public lands such as parks may need to consider access and facilities management in order to maintain and improve Garry oak woodlands under their stewardship.

2.10 Statement of when Recovery Action Plan (RAP) will be completed

A Recovery Action Plan for Garry oak woodland species at risk has not yet been initiated. A draft recovery action plan will be completed by March 2010.

2.11 Evaluation and measures of success

Evaluation of the recovery objectives and approaches will largely be accomplished through routine monitoring of populations and habitat trends, with maintenance or increase in current population sizes, and extent and area of occurrences, being a minimum requirement for acceptable progress toward recovery goals. The Recovery Strategy will be reviewed after five years to evaluate the progress on recovery objectives and to identify additional approaches and other changes that may be required.

Additional performance measures that may be used to evaluate recovery progress include:

- Formalization of critical habitat designations in the Recovery Action Plan
- Knowledge gaps addressed
- Level of proposed critical habitat protection achieved
- Percentage of protected areas with species-specific management practices included in their management plans
- Number of additional populations protected through land acquisition or stewardship agreements

- Establishment of a research strategy to better understand invasive species biology and eradication
- Number of sites with effective habitat restoration actions completed, including non-native species removal, and removal of shrubs and conifers where appropriate
- Completed analysis of population sizes and trends at existing sites to determine whether augmentation is necessary
- Completion of surveying and ranking of potential Garry oak woodland recovery sites
- Designation of the five species under the provincial *Wildlife Act* as Species at Risk

3. SINGLE SPECIES BACKGROUND

3.1 Deltoid Balsamroot

Common Name: balsamroot, deltoid

Scientific Name: *Balsamorhiza deltoidea*

Status: Endangered

Last Examination and Change: May 2000 (No Change)

Canadian Occurrence: BC

Reason for designation: Few highly reduced populations mainly in threatened Garry oak habitats. At risk from development and competition from exotics.

Status history: Designated in April 1996 as Endangered. Status re-examined and confirmed Endangered in May 2000.

3.1.1 Description of the species

The species

Deltoid balsamroot is a member of a genus of about 12 Asteraceae species restricted to western North America (Cronquist 1955). Two species of *Balsamorhiza* occur in British Columbia (Douglas *et al.* 1998a). The genus is characterized by yellow ray and disk flowers on scaly receptacles (Bailey and Bailey 1976). Deltoid balsamroot is a perennial with a deep taproot and a woody stem-base. Its leaf blades are usually triangular, prominently nerved, and 10-50 cm long and 10-20 cm wide (Ryan and Douglas 1994, Douglas and Ryan 2001, Douglas *et al*. 1998a). The involucral bracts are sword-shaped and the 13 to 21 ray flowers are bright yellow. Juvenile plants have smaller, elliptic leaves that are fewer in number than mature plants.

Genetic barriers between the 12 species of *Balsamorhiza* in western North America appear to be few or absent so that hybrids are usually present where two species come into contact with one another. This has caused some confusion in the delineation of species (Cronquist 1955) although specimens collected along the west coast of British Columbia and the United States are easily identified as deltoid balsamroot.

The ecological role of deltoid balsamroot remains unstudied. This species was a source of food by Coast Salish Indians (Turner 1978). There is also a report of this species being used as chicken feed by early settlers in the Victoria area MacFie (1972).There is no record of the plant being used for other cultural resources (clothing, medicine, ceremonial or symbolic purposes) or ecotourism.

Populations and Distribution

Deltoid balsamroot occurs on the west coast of North America from southwestern British Columbia along the western slopes of the Cascade Mountains in Washington and Oregon to the western slopes of the Sierra Nevada in California (Figure 1, Cronquist 1955, Douglas *et al.* 1998a). In Canada, deltoid balsamroot is restricted to southeastern Vancouver Island (Figure 1; Douglas *et al*. 1998a, 2002). The Canadian populations are about 75 km from the nearest populations in Island County (probably Whidbey Island) in Washington (WTU Herbarium Database 2003).

Globally, deltoid balsamroot has a rank of G5, indicating that in most of its range the plant is "apparently common, demonstrably secure and essentially ineradicable under present conditions"(NatureServe 2004). In the U.S. the species is ranked S2 In Washington and SNR (= unranked) in Oregon and California. In Canada, the species has a national rank of N1. Provincially, deltoid balsamroot has been ranked by the Conservation Data Centre as S1 and appears on the British Columbia Ministry of Sustainable Resource Management red list (Douglas *et al*. 2002). The S1 rank is the most critical rank that can be applied to species at the provincial level and indicates that the species is "critically imperiled because of extreme rarity (typically five or fewer occurrences or very few remaining individuals) or because of some factor(s) making it especially vulnerable to extirpation or extinction."

Less than 1% of the current global range of deltoid balsamroot occurs in Canada. The historical range of the species is unknown, although it is possible that the historical range and/or population size was larger than estimates of Garry oak woodland habitat loss suggest since MacFie (1972) mentions the species being used for chicken feed by early settlers. To warrant mention as food for chickens suggests a large supply of seeds.

Deltoid balsamroot is known at eight extant (post-1976) sites in British Columbia, with all populations located on southeastern Vancouver Island (Table 8). Seven other historic sites have been extirpated. This represents a loss of 47% of all sites since 1981. The total number of plants currently known in Canada is approximately 1070. Two of the sites contain 90% of all the plants.

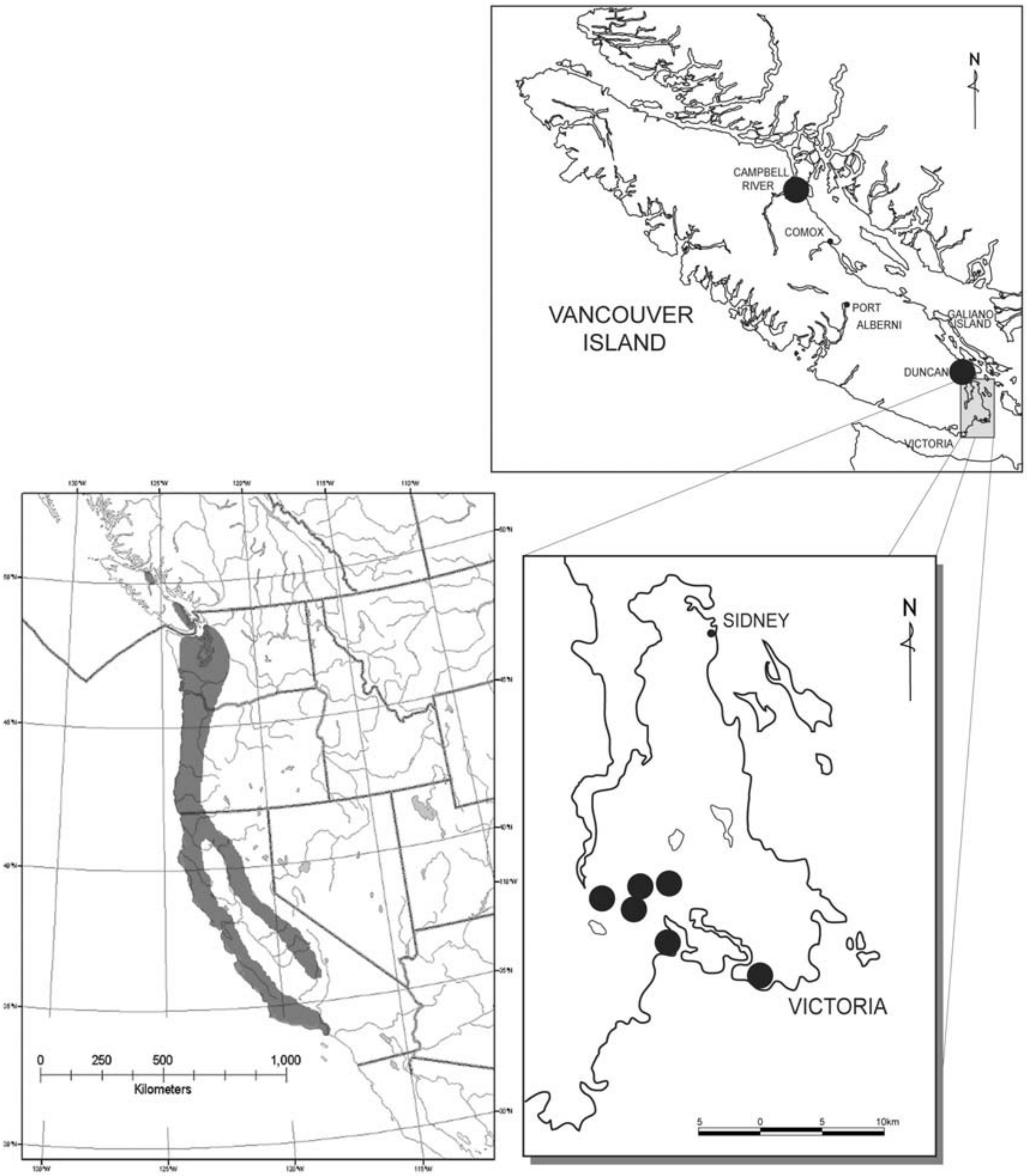

Figure 1. Deltoid balsamroot distribution in North America and British Columbia

Population trends are known from only two deltoid balsamroot populations. The site at the Campbell River Indian Reserve was first inventoried in 1992 and then again in 1997, and most recently, in 2004. Over this 12 year period at this site plant numbers have declined from 1700 to approximately 500 (however other observers in 2004 reported 700-900 plants). This decline in the population was mainly due to ongoing degradation of the site by recreational vehicles, invasion by exotic species, and most recently by residential land development (in 2003). A second population, at the Mt. Tzuhalem Ecological Reserve, has remained relatively stable with counts ranging from about 300 in 1991 to 463 in 2004. The increase at the latter site is due to the finding of small additional subpopulations. Annual observations of one Mt. Tzuhalem subpopulation (65-70 plants) over a period of 19 years of have found little change in the population size (Douglas pers. obs.).

The current area of occurrence for deltoid balsamroot is about 1100 km². This area is most likely be overstated since there is no evidence that the species ever occurred in the area between Campbell River and Mt. Tzuhalem, a distance of approximately 200 km. It is possible that the Campbell River population was established by native peoples from seed collected to the south. The current area of occupancy is 2156 m². The Tyee Spit site at Campbell River accounts for 87% of this area.

Table 8. Deltoid balsamroot locations and population sizes and locations in Canada.

Collection Site	Last Observation	Collector or Observer	Population (no./area)
Tolmie Farm (Victoria)	1891	Newcombe	Extirpated
Lost Lake (Victoria)	1916	Newcombe	Extirpated
Lake Hill (Victoria)	1926	Walker	Extirpated
Royal Oak (Victoria)	1935	Goddard	Extirpated
Campbell River, South of	1959	Beamish	Extirpated
Witty's Lagoon (Victoria)	1965	Carl	Extirpated
Portage Inlet (Victoria)	1976	Brayshaw	Extirpated
Thetis Lake (Victoria)	1999	Douglas & Fleming	ca. 100/100 m²
Francis-King Park, SW of	2001	Douglas	36/30 m²
Fort Rodd Hill (Victoria)	2004	Roemer & Turner	4/2 m^2
Mill Hill, Victoria	2004	Roemer	55/100 m²
Beacon Hill Park (Victoria)	2004	Douglas	1/1 m^2
Tyee Spit, Campbell River[6]	2004	Douglas & Douglas	500/1875 m^2
Mount Tzuhalem (Duncan)	2004	Douglas & Richards	463/137 m²
Skirt Mountain (Victoria)	2005	Fuller	1/1 m^2

[6] B. Brooks, T. Ennis and S. Simpson also surveyed this population in 2004 and reported 700-900 plants (Penny pers. comm.. 2005)

3.1.2 Description of the species' needs

Biological needs

Deltoid balsamroot emerges in the spring from its perennial taproot, grows on and flowers by early summer (Douglas and Ryan 2001). By mid-summer, when drought conditions are prevalent, seed set has occurred and the leaves wither and turn brown. By the end of August, the plants have died back to the perennial taproots. Seedlings are not commonly seen in the field. Although seeds are usually relatively easy to germinate, the cultivation of young plants (at least in the garden) in the Victoria area sometimes appears to be difficult (H. Roemer, pers. comm. 2003). Young plants seem to be sensitive to soil moisture conditions and predators (mainly slugs) during the growing season (H. Roemer, pers. comm. 2003). However, in the dry, more typical, deltoid balsamroot habitats, slugs are uncommon.

No information is available regarding the population dynamics of this species in the wild, including the extent to which seed remains viable in the soil, the frequency with which recruitment occurs from established seedlings, and the longevity of mature plants. The identity of pollinators and their importance are not known. Germination rates in both field and laboratory experiments are 70-90%, although seedling development is slow (Ehret *et al*. 2004, Bailey and Bailey 1997). Seedling survival, in a controlled experiment in the Victoria area, was relatively high, with only a 15% overwinter mortality rate when dormant seedlings were transplanted outdoors (Ehret *et al*. 2004).

Habitat needs

Deltoid balsamroot currently occurs in a range of Garry oak woodland/ rock outcrop habitats in Canada although it is typically associated with very dry, exposed or partially shaded sites with shallow soils (Douglas and Ryan 2001). A Garry oak overstory is often, but not always, present. The essentially open Tyee Spit site in Campbell River has only a single Douglas-fir tree in the meadow, and no Garry oak trees. This site also has different soils than the other sites, as it occurs on coarse, well-drained marine sediments adjacent to the ocean. In contrast, the Mt. Tzuhalem site near Duncan occurs in a relatively moist (at least in spring) ravine with common snowberry, purple sanicle *(Sanicula bipinnatifida)* and yellow montane violet. Seasonal drought or very well-drained soils seem to be key habitat requirements for deltoid balsamroot.

Associated shrubs include the native common snowberry, and introduced Scotch broom. Herbaceous native associates include: broad-leaved stonecrop *(Sedum spathifolium),* nodding onion *(Allium cernuum)* and Menzies' larkspur (*Delphinium menziesii),* as well as native and introduced brome species and the introduced sweet vernalgrass (*Anthoxanthum ordoratum*).

3.2 White Top Aster

Common Name: aster, white-top

Scientific Name: *Sericocarpus rigidus*

Status: Threatened

Last Examination and Change: May 2000 (No Change)

Canadian Occurrence: BC

Reason for designation: Perennial herb occupying very small patches of habitat at few sites on southeastern Vancouver Island within the threatened Garry Oak Ecosystem where it is at continued risk from development pressures and exotic species.

Status history: Designated Threatened in April 1996. Status re-examined and confirmed in May 2000. Last assessment based on an existing status report with an addendum.

3.2.1 Description of the species

The species

White-top aster is a member of a genus of about 250 species, most of which occur in North America (Cronquist 1955). Twenty-three of these *Aster* species occur in British Columbia (Douglas 1995, 1998a). White-top aster is a rhizomatous, leafy, erect, herbaceous perennial ranging from 10-30 cm tall with broadly lanceolate, alternate leaves 2.5-3.5 cm long (Douglas and Illingworth 1996,1997). Both the lower and upper leaves are reduced. The 5-20 flower heads are borne on short stalks in a terminal inflorescence. The involucres are narrow while the ray flowers are white, few and inconspicuous. The disk flowers are pale yellow with purple anthers. The fruit consists of smooth, densely grey-hairy achenes. White-top aster is easily distinguished from other members of the A*ster* genus in British Columbia by its few (1-3), short (1-3 mm), white ray flowers that are obscured by the taller pappus.

Populations and Distribution

White-top aster is restricted to the Pacific Northwest in North America, occurring from the southeasternn Vancouver Island area in British Columbia to west-central Washington and north-western Oregon (Figure 2, Cronquist 1955, Douglas *et al.* 1998a). In Canada, white-top aster is known at 21 extant (post-1982) sites in British Columbia with all but two of these populations (Trial Island and Hornby Island) located on southeasternn Vancouver Island (Figure 2). Similarly to deltoid balsamroot, the Canadian populations of white-top aster are about 75 km from the nearest populations in Island County, Washington (WTU Herbarium Database 2003). Approximately 15% of the current global range of white-top aster occurs in Canada.

Globally, white-top aster has a rank of G3, indicating that in most of its range the plant is “rare and local, found only in a restricted range, or because of some other factors making it susceptible to extirpation or extinction” (NatureServe 2004). In the U.S., the species is ranked S2 in Oregon and S3 in Washington. The species has a national rank in Canada of N1. Provincially, white-top aster has been ranked by the BC Conservation Data Centre as S1 and appears on the British Columbia Ministry of Environment red list (Douglas *et al*. 2002).

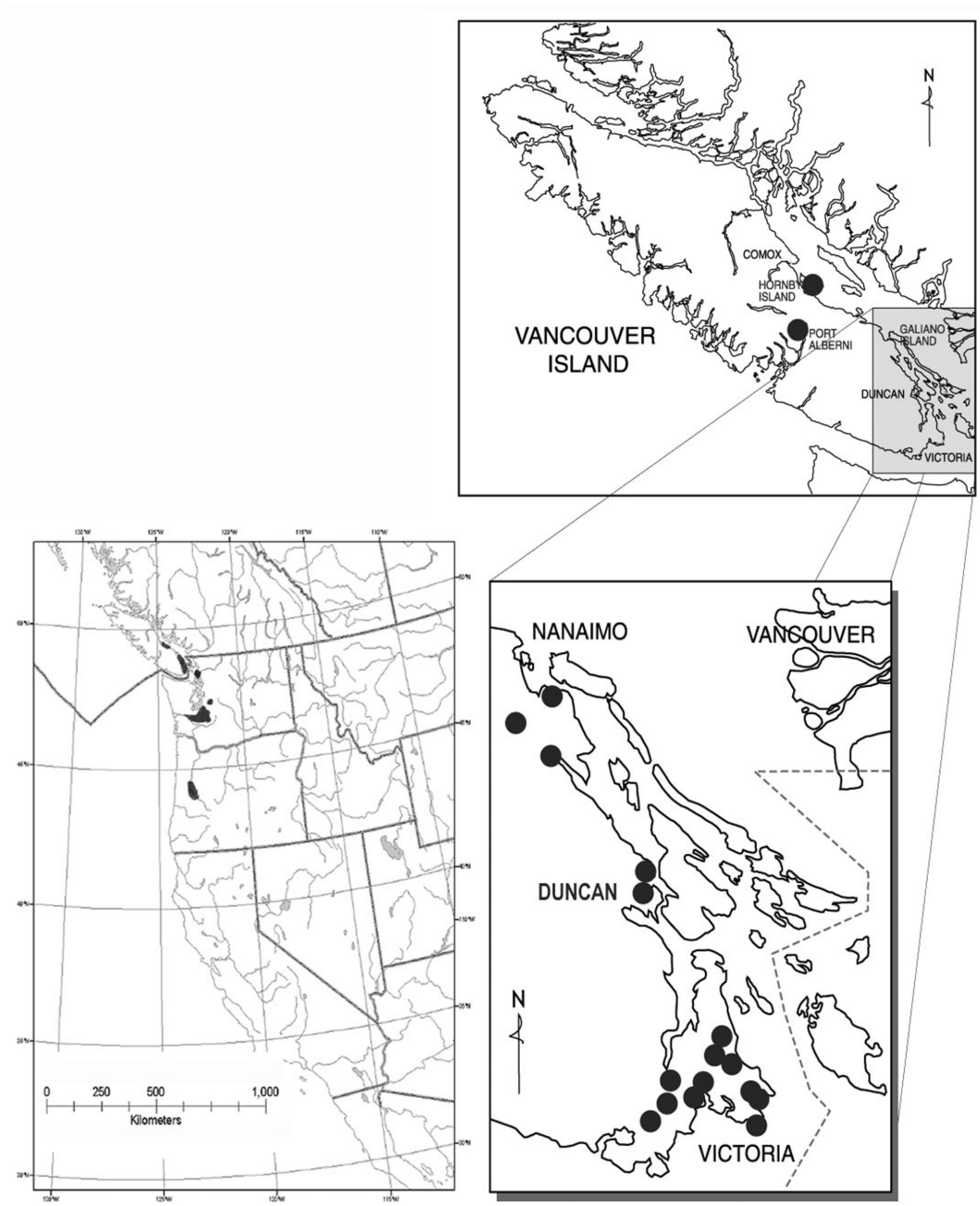

Figure 2. White aster distribution in North America and British Columbia

The S1 rank is the most critical rank that can be applied to species at the provincial level and indicates that the species is "critically imperilled because of extreme rarity (typically five or fewer occurrences or very few remaining individuals) or because of some factor(s) making it especially vulnerable to extirpation or extinction."

White-top aster is known at 21 extant (post-1981) sites in British Columbia with all but two of these populations (Trial Island and Hornby Island) located on southeastern Vancouver Island (Table 9). Seven other historic sites have been extirpated. The latter represents a loss of 25% of the known sites since 1887. There are currently 54,800-94,800[7] stems occurring in Canada. Over 90% of the stems occur at the five locations that each have greater than 3000 stems. The current area of occurrence for white-top aster is approximately 1100 km². The current area of occupancy is approximately 8020 m².

Long term population trends are known from only one white-top aster population, at Mt. Tzuhalem. This site has been monitored for eleven years and has decreased from a high of 1350 stems in 1994 to 850 stems in 2004. Part of this decrease is due to the destruction of the largest subpopulation while burning piles of pulled Scotch broom on the ecological reserve.

Table 9. White-top aster locations and population sizes in Canada.

Collection Site	Last Observation	Collector	Population (stems/area)
Nanaimo	1887	Macoun	Extirpated
Cedar Hill (Victoria)	1897	Anderson	Extirpated
Foul Bay (Victoria)	1914	Macoun	Extirpated
Wellington	1916	Carter	Extirpated
Gonzales (Victoria)	1924	Hardy	Extirpated
Lost Lake (Victoria)	1945	Hardy	Extirpated
Knockan Hill Park, west of (Victoria)	1968	Roemer	Extirpated
White Rapids Rd. (Wellington)	1982	Ceska	15/5 m²
Camas Hill (Sooke)	1985	Ceska	30/4 m²
Kangaroo Rd. (Sooke)	1985	Ceska	Not recorded
Woodley Range (Ladysmith)	1992	Cadrin	500+/300 m²
Francis-King Park, south of (Victoria)	1993	Ryan	Not recorded
Mt. Finlayson (Victoria)	1993	Ryan	200/4 m²

[7] Abundance estimates of white-top aster populations are problematic. The numerous stems appear at regular intervals along one to two m, or more, rhizomes and individual plants are impossible to estimate without excavating. Stem counts therefore give only an approximate estimate of relative abundance between populations. In addition, some observers of large populations (e.g., Fairbarns, see Table 10) have recorded broad ranges only, likely due to practical time considerations.

Collection Site	Last Observation	Collector	Population (stems/area)
Uplands Park (Victoria)	1994	Douglas	600/42 m²
Harmac (Nanaimo)	1998	Douglas	24,000+/134 m²

Collection Site	Last Observation	Collector	Population (stems/area)
Francis-King Park (Victoria)	1999	Douglas	438-478/7 m²
Bear Hill Regional Park (Saanich)	1996	Illingworth	300/40 m²
Cowichan Garry Oak Preserve (Duncan)	1998	Douglas	858/17 m²
Downes Pt. (Hornby Island)	1998	Douglas	7,300/10 m²
Cordova Bay (Victoria)	2001	Douglas	560/34 m²
Port Alberni	2003	Ceska	Not recorded
Mt. Tolmie (Victoria)	2003	Ceska	Not recorded
Little Saanich Mountain (Saanich)	2003	Fairbarns	12,000-45,000/3700 m²
Mill Hill (Victoria)	2004	Roemer	3,990+/ca 600 m²
Mt. Tzuhalem Ecological Reserve (Duncan)	2004	Douglas & Richards	850/120 m²
Mt. Wells	2004	Ansell	158/4.5 m²
Maple Mountain	2004	Douglas & Richards	20/3 m²
Trial Island	2004	Fairbarns	3,000-8000/3000 m²

3.2.2 Description of the species' needs

Biological needs

Each year in April, white-top aster shoots emerge from the rhizomes. Flowering occurs in August, with seeds dispersing a month later (Clampitt 1987). Due to the plant's rhizomatous habit, white-top aster always occurs in clumps, or colonies. In Washington, colonies average 1-10 m² and 5-30% of stems bear flowers (Gamon and Salstrom 1992, Thomas and Carey 1996, Bigger 1999). Populations surveyed by Douglas in the 1990's in BC had higher counts of 30-50% flowering stems, although no seedlings were observed (Douglas and Illingworth 1997). A recent study by Fairbarns at two sites, over two seasons, found very few flowering plants, with only 1-2% of fully developed plants flowering (Fairbarns 2005).

White-top aster is pollinated by a variety of bees and wasps (Giblin and Hamilton 1999, Bigger 1999), as well as a ringlet butterfly (*Coenonympha* sp.: in the Family Satyridae) (Bigger 1999). Research on white-top aster has been unable to find a correlation between the species' reproductive biology and its rarity since seed production has been found to be within the normal range for Asteraceae (Clampitt 1987, Giblin and Hamilton 1999, Bigger 1999).

A range of seed viability has been recorded, with results of 13% (Drake and Ewing 1997), 20% (Clampitt 1987), 22% (Ehret *et al.* 2004) and 39% (Bigger 1999). This range is likely a result of variation among sites and/or years (Bigger 1999). Although white-top aster germination does not appear to be a major problem, seedlings are rarely observed (Clampitt 1987), and have not been observed in BC (Henderson 2005). The plant probably reproduces primarily by vegetative means since seedlings require light to germinate, and also grow extremely slowly in the presence of competitors (Clampitt 1987, Bigger 1999, Giblin and Hamilton 1999). Most research on white-top aster reproduction has supported the hypothesis that the species is an outbreeder, with self-pollination being highly unlikely (Clampitt 1987, Bigger 1999). However, a study by Giblin and Hamilton (1999) has indicated that, although primarily an outbreeder, white-top aster is actually partially self-compatible.

White-top aster is highly stress-tolerant, and is able to persist for long periods once established, even when no seedlings are produced. Clampitt (1987) found that white-top aster exhibited less wilting under droughty conditions, than its exotic competitors [hairy cat's-ear (*Hypochaeris radicata), Scouler's hawkweed (Hieracium cynoglossoides* or *H. scouleri)*, and colonial bentgrass (*Agrostis tenuis* or *A. capillaris)*.

The species' ability to withstand abiotic stress indicates that once established, white-top aster is likely to persist and Giblin and Hamilton (1999) suggest that white-top aster is an excellent candidate for successful reintroduction to existing and restored prairie habitat. A recent capped landfill restoration in Washington used white-top aster along with other native prairie species and found a 60% white-top aster survival rate after three years (Ewing 2002). However, Clampitt (1993) indicates that the aster is eventually extirpated in moderately or heavily disturbed areas and in areas with a higher percentage of exotics. Clampitt (1987) also speculated that since the aster seedlings grow very slowly, it is possible that they lack the stored resources to grow through soil or plant debris before they unfurl their leaves in the light. White-top aster seeds are more likely to germinate in the spring, rather than the fall (Clampitt 1987), which may be one factor limiting the ability of the plant to reinvade an area, since some of the competing exotic species germinate throughout the winter.

Habitat needs

Throughout its range in the U.S., white-top aster is restricted to open or partially open low elevation grasslands. In Washington, the species is found almost exclusively on well-drained, gravely glacial outwash prairies. At the southern limit of the species' range, in southern Oregon, white-top aster is found in wet tufted hairgrass (*Deschampsia cespitosa)* grasslands.

White-top aster habitat in Washington has been relatively well studied. Clampitt (1993) noted that the prairies were sparsely vegetated, with a mean vascular plant cover of approximately 81%, in the plots studied. Clampitt (1993) also analysed major associated species to determine that white-top aster was present where Roemer's fescue (*Festuca idahoensis* ssp. *roemeri)* constituted more than 32% cover. The additional presence of four other species [bracken (*Pteridium aquilinum),* streambank lupine (*Lupinus rivularis),* sweet vernalgrass, and spikelike goldenrod (*Solidago spathulata*)] further increased the likelihood of white-top aster presence.

This study suggests that white-top aster is a community subordinate that occurs in the gaps between clumps of the bunchgrass, Roemer's fescue. Another study, at Fort Lewis, Washington, found white-top aster occurring primarily on mounds, small rises and swales of open to partially wooded prairies with greater than 50% cover of native species. The most common native associates were Roemer's fescue, woolly eriophyllum *(Eriophyllum lanatum)*, spikelike goldenrod and kinnikinnick (*Arctostaphylos uva-ursi)*. Ponderosa pine (*Pinus ponderosa)* and Garry oak were overstory associates, although white-top aster cover was less abundant under the tree canopy, since it is shade intolerant. White-top aster was also found growing with exotics [Scotch broom, colonial bentgrass, hairy cat's-ear, oxeye daisy *(Leucanthemum vulgare)*, common St. John's-wort *(Hypericum perforatum)* and ribwort plantain (*Plantago lanceolata*)], although with lower cover and frequency (Thomas and Carey 1996).

In British Columbia, white-top aster habitat is somewhat different than in the United States. White-top aster in Canada is usually only associated with Garry oak woodlands and is often found on very dry sites. It is not a good competitor, likely partly because of its late flowering, however, white-top aster can withstand extreme conditions including drought and shallow soils. It also requires a southerly or southwesterly exposure. Soils have been described as shallow over bedrock, and vary from shallow dark brown brunisols to brownish-red brunisols (Douglas and Illingworth 1996,1997). Major associates include sweet vernalgrass, Scotch broom, orchard-grass, oceanspray *(Holodiscus discolor*), common snowberry, and Pacific sanicle *(Sanicula crassicaulis*).

The Garry oak woodland in the Cowichan Garry Oaks Preserve is an example of a good white-top aster population. The habitat at this site has been described in detail by Douglas *et al*. (2001), who classified the site as a Garry oak/orchard-grass plant community with sombric brunisol soils up to a metre in depth that are well aerated, with a high organic carbon content. It is likely that prior to understory dominance by orchard-grass, in this and other Garry oak stands of the region, this plant community would have fallen within the Garry oak/ California brome *(Bromus carinatus)* community type (Roemer 1972).

In the Cowichan Garry Oaks Preserve, an extremely rich low shrub and herb stratum is present during the spring. The most prominent species are Pacific sanicle and orchard-grass. Other species with moderate to high constancies associated with white-top aster include common camas and great camas (*Camassia quamash* and *C. leichtlinii*), brome species *(Bromus* spp.), broad-leaved shootingstar *(Dodecatheon hendersonii* ssp. *hendersonii)*, cleavers *(Galium aparine*) and common snowberry. A marked change in composition takes place by mid-summer. Many of the conspicuous native plants at the site (e.g., common and great camas, broad-leaved shooting star, and yellow montane violet) have completed their yearly life cycle and have essentially disappeared. Perennial grasses that were not recognizable or had not initiated growth in the spring and numerous introduced annuals, well adapted to the drier soils, dominate the understory. At this time, orchard-grass and vetch *(Vicia spp.)* species are the most prominent, with greatly increased mean covers. Other prominent species include the native grasses, California brome and Alaska oniongrass *(Melica subulata*) and the introduced grasses: barren brome *(Bromus sterilis)* and Kentucky bluegrass *(Poa pratensis)*.

3.3 Small-flowered tonella

Common Name: tonella, small-flowered

Scientific Name: *Tonella tenella*

Status: Endangered

Last Examination and Change: November 2003 (New)

Canadian Occurrence: BC

Reason for designation: A small annual herb known from a single site in the Gulf Islands, British Columbia. At risk to potential development, exotic species and fire management.

Status history: Designated Endangered in November 2003. Assessment based on a new status report.

3.3.1 Description of the species

The species

The small-flowered tonella [*Tonella tenella* (Benth.) Heller], is a member of a genus of only two species occurring in western North America (Hitchcock *et al*. 1959). Small-flowered tonella is a slender, ascending to prostrate herb from a delicate taproot (Douglas and Penny 2003a and b, Pojar 2000). The smooth, often branched stems are 5-25 cm tall with 1-2 cm long opposite leaves. The blue or white flowers are small and long-stalked. Fruits are egg to globe-shaped capsules containing 2 to 4, 1-1.5 mm long, wingless seeds.

The ecological role of small-flowered tonella remains unstudied and there is no record of the plant being used for cultural resources (food, clothing, medicine, ceremonial or symbolic purposes) or ecotourism.

Populations and distributions

Small-flowered tonella ranges disjunctly from British Columbia to the species' main range in southern Washington (Columbia River gorge), through Oregon to central California (Figure 3, Hitchcock *et al.* 1959, Wetherwax 1993, Pojar 2000. In Canada, small-flowered tonella is known only from a single privately-owned site in on Salt Spring Island in south-western British Columbia (Figure 3). The Canadian populations are about 295 km from the nearest populations in the Columbia River Gorge, south-western Washington (Hitchcock *et al.* 1959). Less than 1% of the current global range of small-flowered tonella occurs in Canada.

Globally, small-flowered tonella has a rank of G5, indicating that in most of its range the plant is "apparently common, demonstrably secure and essentially ineradicable under present conditions" (NatureServe 2004). In the U.S. the species is ranked SNR (= unranked) in Washington, Oregon and California. The species has a national rank in Canada of N1. Provincially, small-flowered tonella has been ranked by the BC Conservation Data Centre as S1 and appears on the British

Columbia Ministry of Environment red list (Douglas *et al.* 2002). The S1 rank is the most critical rank that can be applied to species at the provincial level and indicates that the species is "critically imperilled because of extreme rarity (typically five or fewer occurrences or very few remaining individuals) or because of some factor(s) making it especially vulnerable to extirpation or extinction."

Four small subpopulations of small-flowered tonella were recently confirmed in 2002 at the Salt Spring Island site (Table 10). These subpopulations, plus an earlier (1976) collection record, occur in a narrow band extending up a mountainside for approximately 425 m, thus the area of occurrence is about 2 ha. The subpopulations consist of 30 to 150 plants with areas of 1 to approximately 120 m^2, respectively. The area of occupancy is 62 m^2. Since the plant is inconspicuous and extremely difficult to detect, it is likely other subpopulations occur on the slope.

Table 10. Locations and size of small-flowered tonella subpopulations on Salt Spring Island, British Columbia.

Collection site	Last Observation	Collector	Number of plants/area (m^2)
#1. Upper slope, south	1976	Douglas	Not recorded
#2. Upper slope, north	2002	Lomer	56+ /40
#3. Mid-slope	2002	Lomer	100-150/15
#4. Lower slope	2002	Douglas	50-80/6
#5. Ca. 10 m uphill from beach	2002	Lomer	30 /1

Figure 3. Small-flowered tonella distribution in North America and British Columbia

3.3.2 Description of the species' needs

Biological needs

Species of *Tonella*, along with its sister genus, *Collinsia*, of the tribe Collinsieae, are self-compatible annuals (Armbruster *et al*. 2002). Their persistence at the site in British Columbia indicates that at this time the seeds are viable and germinate readily. Low elevation pollinators for the tribe include bees (*Bombus, Anthophora, Emphoropsis, Synhalonia* and *Osmia spp.)* (Armbruster *et al*. 2002). The phenology of the species has yet to be recorded.

Habitat needs

Small-flowered tonella typically occurs on woodland slopes in the U.S., and in Canada is found on a west-facing slope on stable talus. This talus occurs in open bigleaf maple–arbutus forest, where associates include cleavers, little western bitter-cress *(Cardamine oligosperma),* miner's-lettuce *(Claytonia perfoliata),* barren brome, and large-flowered collomia *(Collinsia grandiflora)* or in open Douglas-fir–arbutus–Garry oak forests with Oregon beaked moss (*Kindbergia oregana)*, dicranum moss (*Dicranum* spp.), Harford's melic (*Melica harfordii)*, upright hedge-parsley *(Torilis japonica)* and barren brome.

3.4 Howell's triteleia

Common Name: triteleia, Howell's

Scientific Name: *Triteleia howellii*

Status: Endangered

Last Examination and Change: May 2003 (New)

Canadian Occurrence: BC

Reason for designation: This is a geographically highly restricted species with a small population occurring at a few scattered sites within remnant Garry oak habitats. It is located within a highly urbanized region with on-going risks to the species from such factors as habitat loss, competition with invasive species, habitat loss, and habitat fragmentation.

Status history: Designated Endangered in May 2003. Assessment based on a new status report.

3.4.1 Description of the species

The species

Howell's triteleia is a perennial herb from a deep, straw-coloured, fibrous-scaly, nearly globe-shaped, bulb-like corm (Pojar 2001). The erect, flowering stem is 20-50 cm tall with one or two smooth, slender, linear basal leaves. The leaves are 20-40 cm long, 3-8 mm wide, sheathed at the base and have entire margins. The flowers consist of six whitish to blue, vase-shaped to narrowly bell-shaped, fused segments forming a 1.5-2 cm long tube. The corolla lobes, which are about as long as the tube, are in two, spreading, petal-like whorls, about as long as the tube. The outer three are broadly lanceolate, the inner three are oblong-egg-shaped and all are slightly ruffled. The fruit consists of a stalked, egg-shaped capsule containing black, rounded seeds.

Howell's triteleia has a similar appearance to its close relative large-flowered triteleia *(Triteleia grandiflora* Lindl.). It is distinguished from the latter by its flat filaments which are attached at the same level on the perianth tube (Pojar 2001). The filaments of large-flowered triteleia, in contrast, are not flat and are attached at two levels on the perianth tube.

The ecological role of Howell's triteleia remains unstudied and there is no record of the plant being used for cultural resources (food, clothing, medicine, ceremonial or symbolic purposes) or ecotourism. *Triteleia* bulbs may have been dug by aboriginals and used as a starchy food source like other lilies (Turner 1999), however, it is unknown whether Howell's triteleia has been used for this purpose. Like many other species of *Triteleia* and *Brodiaea*, Howell's triteleia is now available commercially from a United Kingdom nursery.

Populations and Distribution

Howell's triteleia ranges from south-western British Columbia, south through Washington and Oregon to northern California (Figure 4, Keator 1993; Barkworth 1977a). In Canada, Howell's triteleia is known only from southeasternn Vancouver Island in south-western British Columbia (Figure 4; Pojar 2001, Douglas *et al*. 2002a).

The Canadian populations are about 15 km from the nearest populations in San Juan County in Washington (Barkworth 1977a).

Globally, Howell's triteleia has a rank of G5, indicating that in most of its range the plant is "apparently common, demonstrably secure and essentially ineradicable under present conditions" (NatureServe 2004). In the U.S. the species is ranked S1 in California and SNR (= unranked) in Washington and Oregon. The species has a national rank in Canada of N2. Provincially, Howell's triteleia has been ranked by the BC Conservation Data Centre as S2 and appears on the British Columbia Ministry of Environment red list (Douglas *et al*. 2002). The S2 rank indicates that the species is imperiled in the province "because of rarity due to very restricted range, very few populations (often 20 or fewer), steep declines, or other factors making it very vulnerable to extirpation from the province" (Natureserve 2004).

Howell's triteleia is known at 13 extant (post-1998) sites in British Columbia with all of them located on southeastern Vancouver Island (Table 11). Three other historic sites have been extirpated. The latter represents a loss of 19% of the known sites since 1912. There are currently about 1,000 plants occurring in Canada. One site, at the Cowichan Garry Oak Preserve, contains 45% of all plants.

The current area of occurrence for Howell's triteleia is about 50 km². The current area of occupancy is 3-4 ha. Less than 1% of the current global range of Howell's triteleia occurs in Canada.

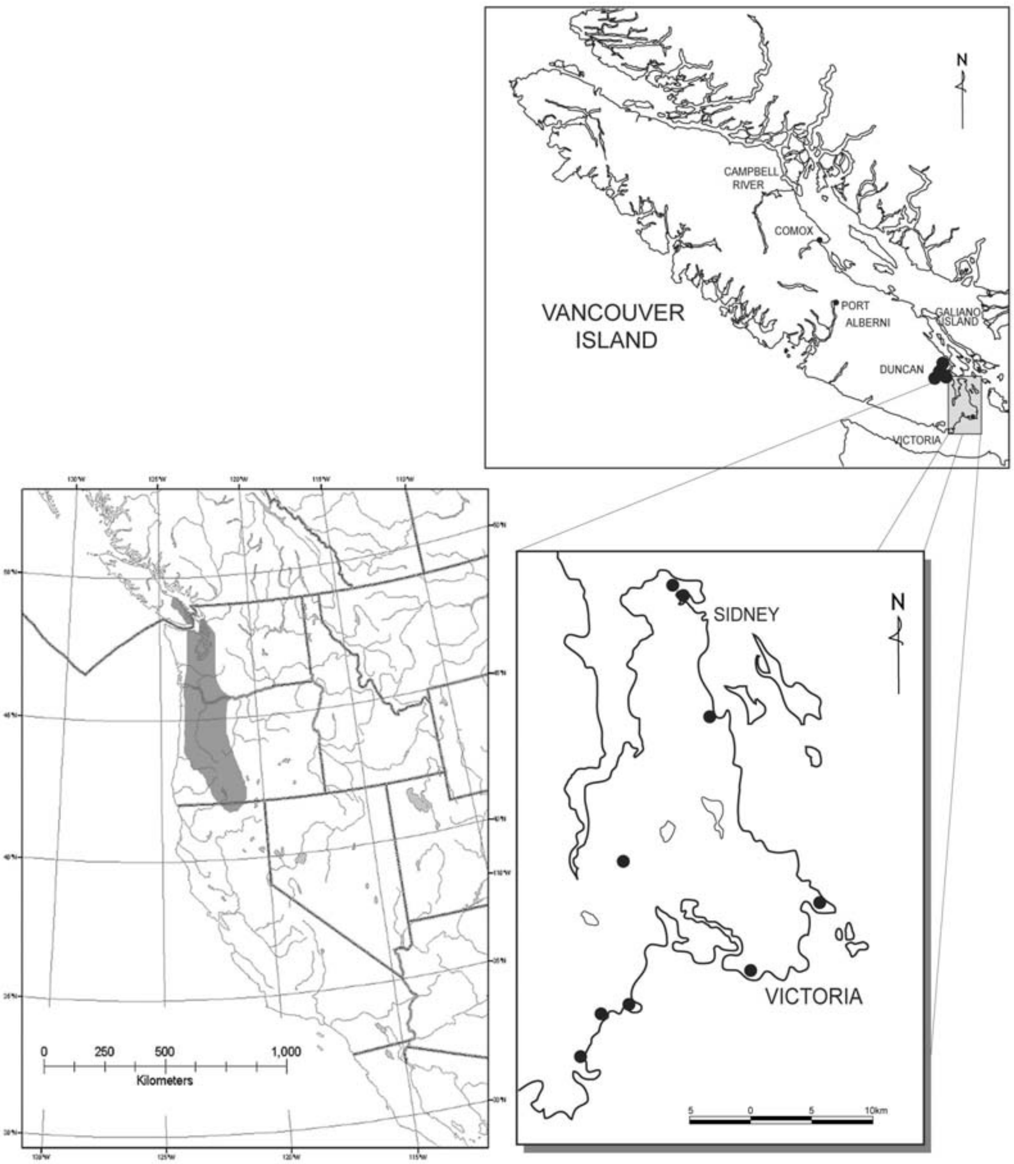

Figure 4. Howell's triteleia distribution in North America and British Columbia

3.4.2 Description of the species' needs

Biological needs

There is little known about Howell's triteleia in terms of its biology throughout its range. Species of *Triteleia* generally require well-drained soil and reproduction is through division of the corm, by the production of numerous cormlets, and by seed (Barkworth 1977b). Pollinators are unknown.

Habitat needs

Howell's triteleia occurs mainly on rock outcrops in Garry oak woodlands and in highly disturbed sites dominated by weeds in urban yards and on roadsides. In the highly disturbed sites, dominants include orchard-grass, common vetch (*Vicia sativa)*, rip-gut brome (*Bromus rigidus)*, soft brome (*B. hordeaceus)*, perennial ryegrass (*Lolium perenne)* and Pacific sanicle, all introduced except for the latter. It is likely that Howell's triteleia may have occurred in deeper soil sites (similar to the Cowichan Garry Oak Preserve) prior to the widespread loss of this habitat in the Victoria area upon European settlement.

Table 11. Howell's triteleia locations and population sizes in Canada.

Collection Site	Last Observation	Collector	Population (no./area)
Oak Bay (Victoria)	1912	Beaven	Extirpated
Uplands (Victoria)	1917	Anderson	Extirpated
Saanich Arm (Victoria)	1919	Newcombe	Extirpated
Witty's Lagoon Regional Park (Metchosin)	1999	Douglas & Penny	43/200 m²
Gordon Head (Saanich)	1999	Fontaine	51/5 m²
Cowichan River Estuary (Duncan)	2001	Douglas	62/3 m²
Cowichan Garry Oak Preserve (Duncan)	2001	Douglas	450/3-4 ha
Thetis Lake Regional Park (View Royal)	2002	Ceska	1/1 m²
Mt. Tzuhalem, base of (along Knipsen Road)	2003	Janszen	6/0.5 m²
Horth Hill Regional Park (North Saanich)	2003	Janszen	3/1 m²
Canoe Cove	2003	Fairbarns	2/1 m²
Island View Beach	2003	Fairbarns	1/1 m²
Beacon Hill Park (Victoria)	2004	Fairbarns	ca. 200/12 m²
Somenos Lake (Duncan)	2004	Roemer	126/140 m²
Albert Head (Metchosin)	2004	Roemer	9/2 m²
William Head Rd. (Metchosin)	2004	Milne	14/10 m²

The Garry oak woodland in the Cowichan Garry Oak Preserve contains the best example of a Howell's triteleia population. The habitat at this site is described above in the white-top aster background (section 3.2).

Howell's triteleia also occurs in a mixed Garry oak–arbutus stand at the base of rock outcrops on Horth Hill. The shrub layer is more prominent at this site than it is at the Cowichan Garry Oak Preserve, and is dominated by tall Oregon-grape (*Mahonia aquifolium)* and oceanspray. Associates include hairy honeysuckle (*Lonicera hispidula)*, rip-gut brome, cleavers, small-flowered nemophila (*Nemophila parviflora)* and hedgehog dogtail (*Cynosurus echinatus)*.

3.5 Yellow montane violet

Common Name: violet, yellow montane

Scientific Name: *Viola praemorsa* ssp. *praemorsa*

Status: Threatened

Last Examination and Change: May 2000 (No change)

Canadian Occurrence: BC

Reason for designation: Highly localized species with few sites and restricted to habitats under threat from development, recreational use and from spread of exotic plants.

Status history: Designated Threatened in April 1995. Status re-examined and confirmed in May 2000. Last assessment based on an existing status report.

3.5.1 Description of the species

The species

Yellow montane violet is a perennial from a fibrous root, ranging from 6 to 25 cm tall with broadly lanceolate, sparsely to densely hairy, mainly basal leaves, with blades 2 to 10 cm long (Ryan and Douglas 1995, Douglas *et al.* 2000). The yellow, terminal flowers are solitary on one to several, erect stems. The fruit is a smooth to hairy capsule with dark brown seeds. Among the yellow violets which occur in western British Columbia, yellow montane violet is distinguished primarily by the slightly serrate, ovate-lanceolate, pubescent leaves. The only other plant occupying similar habitats that superficially resembles flowerless yellow montane violet, is the introduced ribwort plantain (*Plantago lanceolata*). The latter has leaves which are similar in colour and shape to those of yellow montane violet but usually lack hairs and gradually taper to the petiole.

The ecological role of yellow montane violet remains unstudied and there is no record of the plant being used for cultural resources (food, clothing, medicine, ceremonial or symbolic purposes) or ecotourism.

Populations and Distribution

Yellow montane violet occurs on the west coast of North America from south-western British Columbia to northern California (Figure 5, Hitchcock and Cronquist 1961, Little 1993). In Canada, yellow montane violet occurs on southeasternn Vancouver Island and adjacent Salt Spring Island (Figure 5; Douglas and Ryan 1998, Douglas *et al.* 2002). The Canadian populations are approximately 30 km from the nearest populations in San Juan County, Washington.

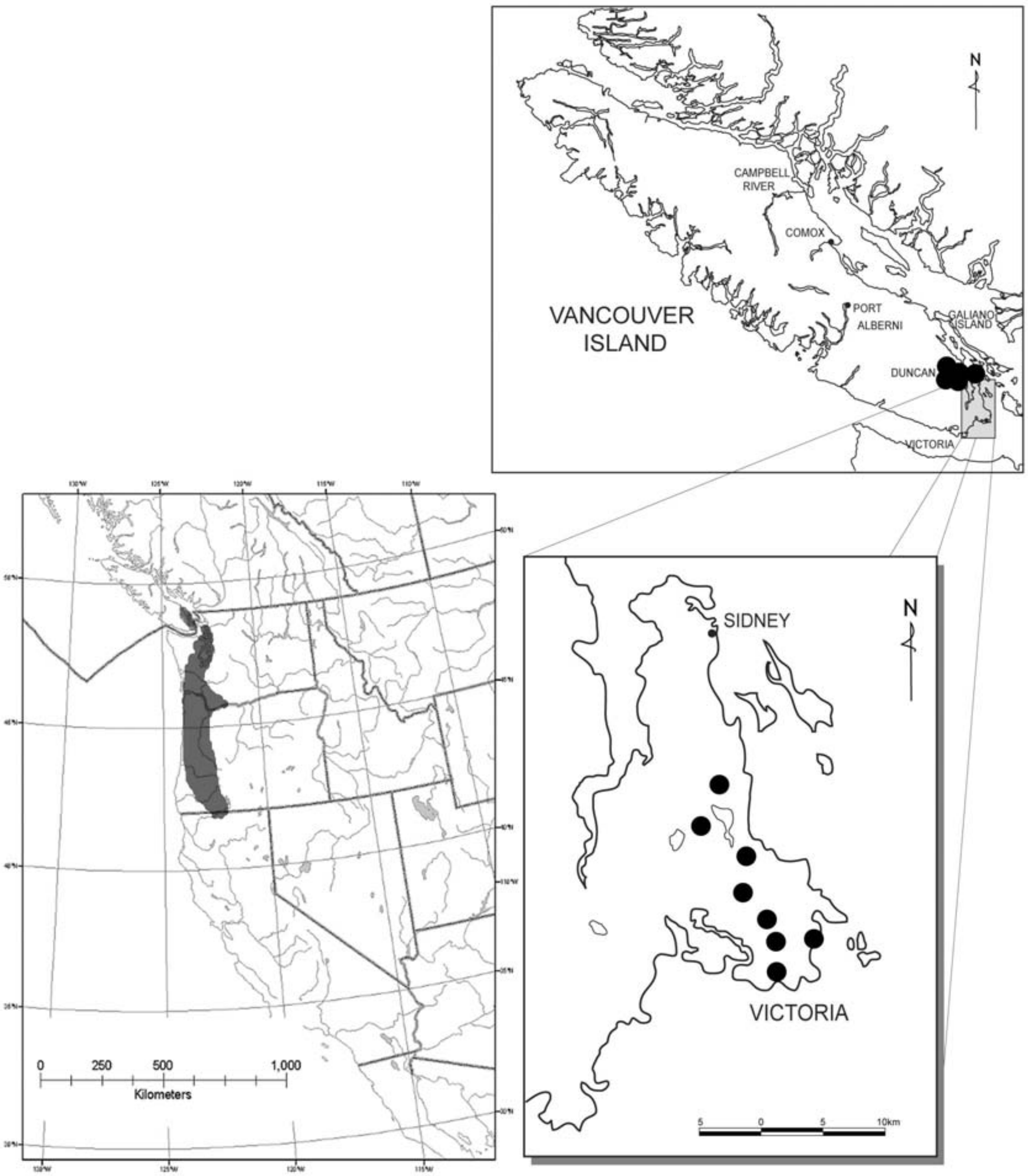

Figure 5. Yellow montane violet distribution in North America and British Columbia

Globally, yellow montane violet has a rank of G5T3T5, indicating that in most of its range this subspecies ranges from “vulnerable” to “apparently common, demonstrably secure and essentially ineradicable under present conditions” (NatureServe 2004). In the U.S., the species is ranked SNR (= unranked) in Washington, Oregon and California. The species has a national rank in Canada of N1. Provincially, yellow montane violet has been ranked by the BC Conservation Data Centre as S1 and appears on the British Columbia Ministry of Environment red list (Douglas *et al*. 2002).

The S1 rank is the most critical rank that can be applied to species at the provincial level and indicates that the species is critically imperilled because of extreme rarity (typically five or fewer occurrences or very few remaining individuals) or because of some factor(s) making it especially vulnerable to extirpation or extinction.

Yellow montane violet is known from 13 extant (post-1996) sites in British Columbia with all but two of these populations (on Salt Spring Island) located on southeastern Vancouver Island (Table 12). Five other historic sites have been extirpated. In addition, three sites, last seen between 1961 and 1977, remain unconfirmed. Therefore, 38% of the known sites have probably been extirpated since 1977. There are currently about 45,000 plants occurring in Canada. One site, at Somenos Lake, contains 88% of all plants that occur in Canada.

The current area of occurrence for yellow montane violet is about 330 km^2. The current area of occupancy is approximately 18,870 m^2. Less than 1% of the current global range of yellow montane violet occurs in Canada.

3.5.2 Description of the species’ needs

Biological needs

Yellow montane violet is a perennial species which overwinters as a short vertical rhizome. In British Columbia, the violet, as with many other forbs located in Garry oak 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 Garry oak leaves have fully emerged and before grasses, which usually dominate the understory, have grown to a sufficient size where they shade or smother yellow montane violet and other forbs. Seeds are explosively ejected from the capsules during early to mid-summer and most plants then dieback to the perennating rhizome (underground stem which persists more than one growing season). Some plants retain their leaves and produce elongated decumbent (lying on ground but with tip ascending) stems which may exceed 25 cm in length. Eventually these plants will also wither and die back to the perennating rhizome (Ryan and Douglas 1995).

Table 12. Yellow montane violet locations and population sizes in Canada.

Collection Site	Last Observation	Collector/ Observer	Population (no./area)
Cedar Hill (Victoria)	1887	Macoun	Extirpated
Prospect Lake (Saanich)	1921	Harvey	Extirpated
Holmes Point (Comox)	1961	Beamish	Unknown
Mount Tolmie (Victoria)	1963	Young	Unknown
Nanoose Hill (Nanaimo)	1976	Douglas	No original data; 2004 search unsuccessful; almost certainly extirpated
Mary Hill (Metchosin)	1977	Ceska	Unknown
Mt. Maxwell (Salt Spring Island)	1985	Roemer	No original data; 2001, 2003, 2004 search unsuccessful; may be extirpated
Rithet's Bog	1987	Ring	Probably extirpated
Beacon Hill Park (Victoria)	1997	Douglas	465/1000 m^2
Smith Hill (Victoria)	1997	Douglas	490/435 m^2
Uplands Park (Victoria)	1997	Douglas	95/18 m^2
Falaise Park (Victoria)	1997	Douglas & Mothersill	59/10 m^2
Cowichan Garry Oak Preserve (Duncan)	2000	Douglas & Penny	3205/10,828 m^2
Playfair Park (Saanich)	2000	Douglas & Penny	282/305 m^2
Mount Tzuhalem (Duncan)	2001	Douglas	55/115 m^2
Christmas Hill (Saanich)	2001	Penny	86/136 m
Bear Hill Regional Park (Saanich)	2001	Fraser	78/6 m^2
Little Saanich Mountain (Saanich)	2004	Fairbarns	25/15 m^2
Mount Tuam (Saltspring Island)	2004	Douglas & Smith	53+/400 m^2
St. Peters Church (Duncan)	2004	Douglas & Smith	5/0.5 m^2
Somenos Lake (Duncan)	2004	Douglas	40,000+/5600 m^2

Yellow montane violet 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. Observations by M. Fairbarns (pers. comm.) indicate that seeds are likely dispersed by ants since the seeds bear what appear to be elaiosomes (lipid-rich structures that attract ants), as well as through ballistic dispersal (explosive opening of the fruit). Both methods probably do not facilitate seed dispersal more than approximately one metre.

Like other *Viola* species, the yellow montane violet may also produce seeds by cleistogamous flowers. These are apetalous (lacking petals) 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 yellow montane violet produces cleistogamous flowers and the importance of their contribution to seed production is not known.

There is little direct information on the importance of insect pollinators, the proportion of flowers which are self- and cross-pollinated, and the average number of viable seeds produced by individual plants. Pollination of the closely related species, Nuttall's violet (*V. nuttallii)*, is by solitary bees and occasionally by butterflies. Despite its broad distribution, there is no indication that pollinators differ between ecogeographical regions (Beattie 1974). Beattie (1974) believes that *Viola* flowers are pollinated by a wide variety of both medium- and long-tongued pollinators. Davidse (1976) has observed flies of the genera *Eristalis* and *Bombylius* (drone flies and bee flies) frequently and indiscriminately visiting the yellow-flowered violets: yellow sagebrush violet (*Viola vallicola*), Utah violet (V. *utahensis)* and upland yellow violet [*V. praemorsa* ssp. *major* (=*V. praemorsa* ssp. *linguifolia*)].

Habitat needs

In British Columbia, yellow montane violet occupies a number of different habitats in Garry Oak communities and grass-dominated meadows. Yellow montane violet is predominantly found in Garry oak communities with deeper soils and less exposed bedrock, typically with a southerly exposure on slopes ranging from relatively flat (0-5% slope) to steep (25-50% slope). These sites tend to be somewhat mesic in the spring, although they may become very dry in the late summer. Sites also contain a substantial number of other forbs including white triteleia (*Triteleia hyacinthina)* and western buttercup (*Ranunculus occidentalis)* but tend to be dominated by a mixture of introduced grasses such as early hairgrass, orchard-grass, hedgehog dogtail, and sweet vernalgrass, and several species of brome. Some stands are dominated in the understorey by shrubs, in particular, common snowberry and Scotch broom, which effectively shade out many herbaceous species. Soils are usually orthic sombric brunisols (Roemer 1972).

The Garry oak woodland in the Cowichan Garry Oak Preserve contains one of the best examples of a yellow montane violet population. The habitat at this site has been described in detail by Douglas *et al*. (2001) and a summary of this habitat appears in the white-top aster section. The largest yellow montane violet population occurs at Somenos Lake, where it occurs on two sides of an open meadow along with brome species, under an open Garry oak canopy. Other associated native species include: mountain sweet-cicely (*Osmorhiza berteroi)*, slender toothwort (*Cardamine nuttallii)*, broad-leaved shootingstar, and *Erythronium oregonum* (Ryan and Douglas 1994).

Some populations are also located on relatively steep rocky slopes where Garry oak–oceanspray is the dominant vegetation type. On these sites, they are usually located in pockets of deep soil partially shaded by Garry oak. Yellow montane violet may occasionally be found in open grass-dominated meadows where soils are relatively deep and likely retain some moisture during summer drought conditions (such as at Somenos Lake). On less optimum sites, such as at Mt. Tuam where soils are very shallow and vegetation is heavily grazed by sheep, plants are noticeably smaller in size.

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Richard Hebda. 2003. Conversation. Curator, Botany and Earth History, Royal BC Museum. Tel: (250) 387-5493

Mike Meagher. 2004. Email correspondence. GOERT Research Recovery Implementation Group (RIG). Email: mmeagher@pfc.forestry.ca

Jenifer Penny. 2005. Email correspondence. Botanist, B.C. Conservation Data Centre, Ministry of Environment. Email: Jenifer.Penny@gov.bc.ca

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Hans Roemer. 2003. Conversation. Botanist, Victoria, BC. Email: hlroemer@shaw.ca

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