Species at Risk Act
Recovery Strategy Series

Recovery Strategy for the Slender Popcornflower (*Plagiobothrys tenellus*) in Canada

Slender Popcornflower


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Canada

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For copies of the recovery strategy, or for additional information on species at risk, including COSEWIC Status Reports, residence descriptions, action plans, and other related recovery documents, please visit the SAR Public Registry [1].

Cover illustration: Slender Popcornflower photograph by Shyanne Smith

Également disponible en français sous le titre
« Programme de rétablissement de la plagiobothryde délicate (Plagiobothrys tenellus) au Canada »

Recommendation and Approval Statement

The Parks Canada Agency led the development of this federal recovery strategy, working together with the other competent minister(s) for this species under the Species at Risk Act. The Chief Executive Officer, upon recommendation of the relevant Park Superintendent(s) and Field Unit Superintendent(s), hereby approves this document indicating that Species at Risk Act requirements related to recovery strategy development have been fulfilled in accordance with the Act.

Recommended by:

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Chief Executive Officer, Parks Canada Agency

Preface

The federal, provincial, and territorial government signatories under the Accord for the Protection of Species at Risk (1996) agreed to establish complementary legislation and programs that provide for effective protection of species at risk throughout Canada. Under the *Species at Risk Act* (S.C. 2002, c.29) (SARA), the federal competent ministers are responsible for the preparation of recovery strategies for listed Extirpated, Endangered, and Threatened species and are required to report on progress five years after the publication of the final document on the SAR Public Registry.

The Minister of the Environment and the Minister responsible for the Parks Canada Agency is the competent minister under SARA for the Slender Popcornflower and has prepared this strategy, as per section 37 of SARA. To the extent possible, it has been prepared in cooperation with the provincial government of British Columbia.

Success in the recovery of this species depends on the commitment and cooperation of many different constituencies that will be involved in implementing the directions set out in this strategy and will not be achieved by the Parks Canada Agency, Environment Canada, or any other jurisdiction alone. All Canadians are invited to join in supporting and implementing this strategy for the benefit of the Slender Popcornflower and Canadian society as a whole.

This recovery strategy will be followed by one or more action plans that will provide information on recovery measures to be taken by the Parks Canada Agency and other jurisdictions and/or organizations involved in the conservation of the species. Implementation of this strategy is subject to appropriations, priorities, and budgetary constraints of the participating jurisdictions and organizations.

The recovery of Slender Popcornflower will be coordinated with the recovery of other species inhabiting Garry Oak Woodlands (Parks Canada Agency 2006).

Acknowledgments

Thank you to Shyanne Smith for collecting and compiling the species and habitat information used in preparing this recovery strategy. The Garry Oak Ecosystems Recovery Team (GOERT) is the recovery team for the Slender Popcornflower and was involved in the development of this recovery strategy. Further revision was the result of comments and edits provided by a number of organizations: the Province of British Columbia, Parks Canada Agency, and Environment Canada. Thank you to all the landowners who support recovery of this species on their land and provided access for surveys.

Executive Summary

The Canadian population of Slender Popcornflower *(Plagiobothrys tenellus)* was assessed as Threatened in 2008 by the Committee on the Status of Endangered Wildlife in Canada (COSEWIC). The population was listed as Threatened under Canada`s Species at Risk Act (SARA) in February 2011.

Slender Popcornflower is a small annual plant that grows in exposed soils on dry, steep, south facing grassy slopes and coastal bluffs. Its range is restricted to North America, mostly on the east side of the Cascade Mountains, through Washington, Idaho, Oregon, Utah, Nevada, and southern California. Isolated patches are found on southeast Vancouver Island (near Victoria), the Gulf Islands, and San Juan Islands. Seven populations are still considered extant in Canada, but only one of these has been observed in the last decade. The Canadian population of Slender Popcornflower comprises <1% of its global range.

Slender Popcornflower is threatened by habitat conversion, invasive alien plant species, encroachment of woody vegetation (both native and alien), and changes in weather patterns (especially spring and early summer precipitation). Limitations to this species include its specificity to rare habitats, small area of physical occupancy, and predisposition to demographic failure.

In the short term, recovery activities for Slender Popcornflower will focus on testing restoration and augmentation techniques through the maintenance of the Saturna Island population and maintenance of habitat at the other locations in order to determine the feasibility of increasing abundance and distribution. Broad strategies to be taken to address the threats to the survival and recovery of the Slender Popcornflower are presented in section 6 Broad Strategies and General Approaches to Meet Objectives.

Critical habitat for the recovery of Slender Popcornflower is identified in this recovery strategy. The best available information has been used to identify critical habitat; however, there are significant knowledge gaps. Additional critical habitat will need to be identified in upcoming planning documents to meet the population and distribution objectives.

Further recovery action for Slender Popcornflower will be incorporated into one or more action plans by October 2018.

Recovery Feasibility Summary

The recovery of Slender Popcornflower in Canada is considered feasible based on the criteria outlined by the Government of Canada (2009):

1. *Are individuals of the wildlife species that are capable of reproduction available now or in the foreseeable future to sustain the population or improve its abundance.*

   Yes. At least one population has numerous reproductive individuals from which seeds could be collected for restoration or population augmentation.

2. *Is sufficient suitable habitat available to support the species or could be made available through habitat management or restoration.*

   Yes. There is sufficient habitat to support at least the Saturna population of Slender Popcornflower at its current level. Active stewardship or restoration would increase the amount of suitable habitat at other locations.

3. *Can the primary threats to the species or its habitat (including threats outside Canada) be avoided or mitigated.*

   Yes. The three primary threats to Slender Popcornflower can be avoided or mitigated though recovery actions. Habitat conversion can be avoided, and encroachment by invasive alien and native plant species can be mitigated or managed through stewardship activities.

4. *Do recovery techniques exist to achieve the population and distribution objectives or can be expected to be developed within a reasonable timeframe.*

   Yes. The necessary techniques for habitat stewardship and population monitoring and inventory exist and have been effective for other species in Garry Oak ecosystems.

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1. COSEWIC[2] Species Assessment Information

Date of Assessment: November 2008

Common Name: Slender Popcornflower

Scientific Name: *Plagiobothrys tenellus*

COSEWIC Status: Threatened

Reason for Designation: An annual herb of grassy slopes and coastal bluffs within the highly reduced and fragmented Garry Oak ecosystem. About half of the known populations have been extirpated from areas heavily impacted by invasive alien plants on southeastern Vancouver Island and adjacent Gulf Islands. Only seven small populations remain. Population sizes fluctuate, likely depending on precipitation, with several comprising only a few individuals. The total population size is estimated to be fewer than 1000 individuals. Invasive plants continue to degrade the species' habitat at all sites.

Canadian Occurrence: British Columbia

COSEWIC Status History: Designated Threatened in November 2008. Assessment based on a new status report.

2. Species Status Information

The Canadian population of Slender Popcornflower (*Plagiobothrys tenellus*) was assessed as Threatened in 2008 by the Committee on the Status of Endangered Wildlife in Canada (COSEWIC). The population was listed as Threatened under Canada`s *Species at Risk Act* (SARA) in February 2011. Less than 1% of the Slender Popcornflower's range and number of populations occurs within Canada. Conservation ranks are provided in Table 1.

3. Species Information

3.1. Species Description

Slender Popcornflower is a small, taprooted annual herb. Plants grow 5-25 centimetres in height, with a single, or sometimes branched, stem. The leaves and stems are conspicuously hairy and the stems rise from a rosette of basal leaves. The few stem leaves are smaller than the basal leaves, alternate, and lance-shaped. The small white flowers are coiled in narrow, elongated clusters at the ends of the stems. The fruits are cross-shaped and have rows of wartlike bumps across the surface (COSEWIC 2008).

[2] COSEWIC (Committee on the Status of Endangered Wildlife in Canada)

Table 1. Conservation ranks for Slender Popcornflower. Sources: B.C. Conservation Data Centre 2012, NatureServe 2012.

Location	Rank*	Rank description
Global	G4G5	Apparently secure or secure
Canada	N1	Critically Imperilled
British Columbia	S1	Critically Imperilled
United States	NNR	Not ranked
Utah	S1	Critically imperilled
Washington	SNR	Not ranked
California	SNR	Not ranked
Idaho	SNR	Not ranked
Nevada	SNR	Not ranked
Oregon	SNR	Not ranked
Arizona	SNR	Not ranked

*NatureServe Conservation ranks are based on a one to five scale, ranging from critically imperilled (1) to demonstrably secure (5). Status is assessed and documented at three distinct geographic scales global (G), national (N), and state/province (S).

3.2. Population and Distribution

Slender Popcornflower occurs from southwest British Columbia, south through Washington, Idaho, Oregon, Utah, Nevada, and California (Figure 1; COSEWIC 2008).

In Canada, the species is found in southwest British Columbia along the southeast coast of Vancouver Island and on the adjacent Gulf Islands (Figure 2; COSEWIC 2008). Thirteen Canadian populations have been recorded in total, six of which have not been seen since 1958 and are presumed extirpated. With the exception of population 4 on Saturna Island, little is known about the remaining seven populations (Figure 2): at last report some populations had only a few individuals, while other populations contained hundreds, but it has been more than 10 years since individuals have been observed anywhere but Saturna Island (Table 2). However, these remaining populations are all considered still extant because the habitat has not been destroyed and a seed bank may still persist in the soil (Bush and Lancaster 2005) (Table 2).

Surveys conducted on Saturna Island in 2010 and 2011 increased the known population size 188%–250% to between 1000 and 1500 plants over approximately 28 hectares. This increase in population size is largely attributed to the increase in area occupied by the species.

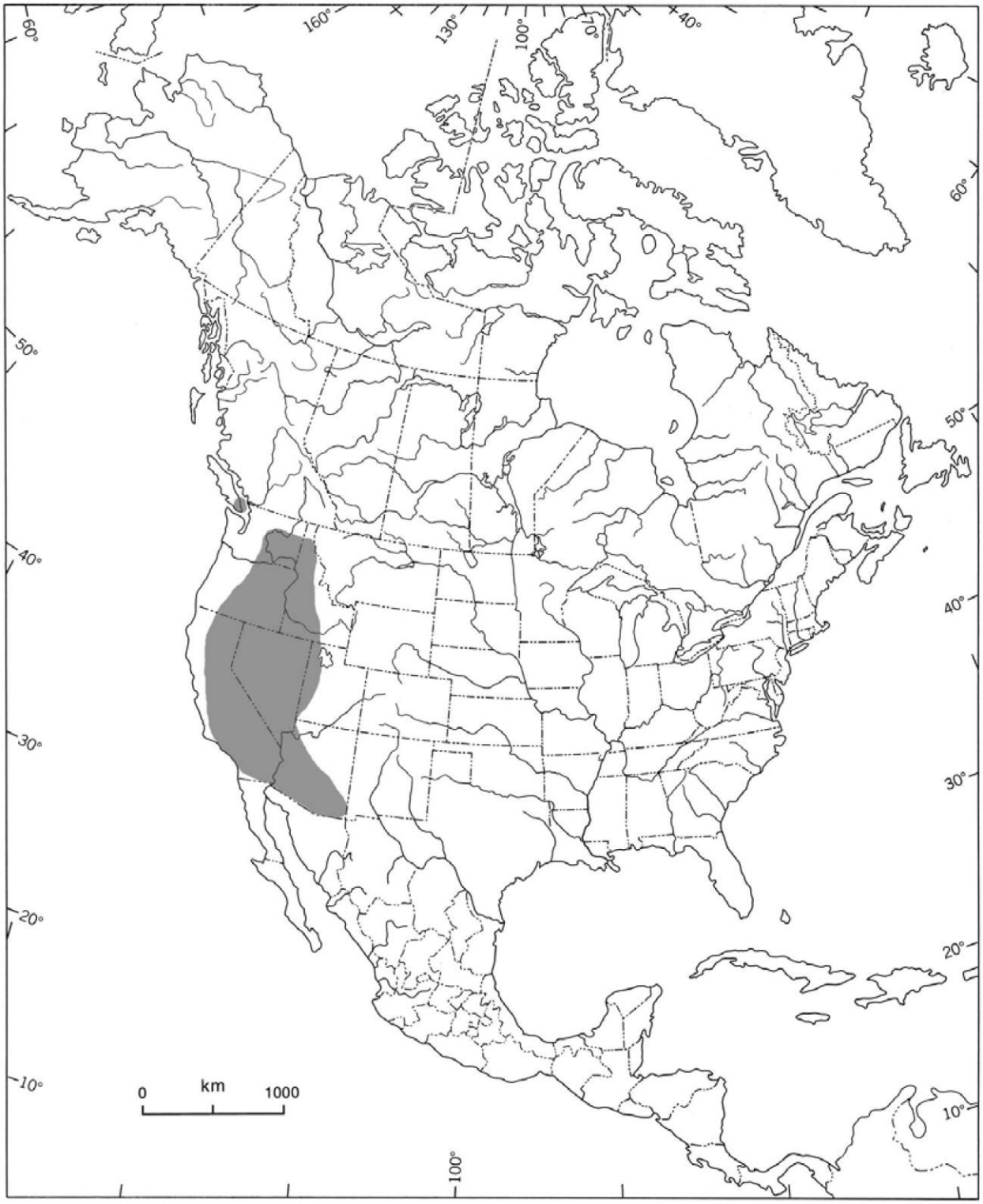

Figure 1. Global distribution of Slender Popcornflower (from COSEWIC 2008). Shaded regions indicate species' range.

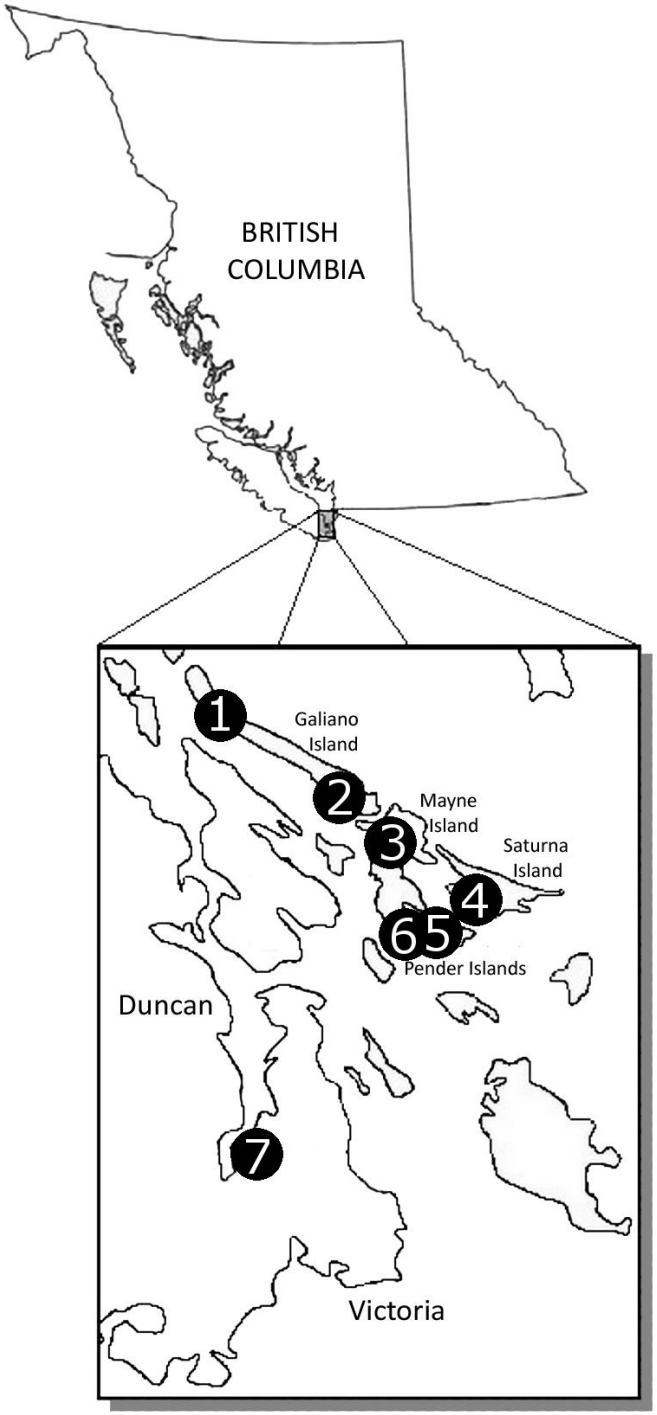

Figure 2. Distribution of Slender Popcornflower in Canada (from COSEWIC 2008). Extant populations represented by closed circles.

Table 2. General location, population size, and land tenure for Slender Popcornflower in Canada.

Population	General location	Population Size (last obs. date)	Land Tenure
1	Galiano Island population 2 (Bodega Ridge)	Status report: 400-500 (1998) 2010/11: not found	Non-federal land
2	Galiano Island population 1 (Mount Sutil)	Status report: data not available (1980) 2010/11: not found	Non-federal land
3	Mayne Island (Heck Hill)	Status report: 15 (1996) 2010/11: not found	Non-federal land
4	Saturna Island	Status report: 400-800 (2007) 2010/11: 1000-1500	Federal and non-federal land
5	South Pender Island (Mount Norman)	Status report: data not available (1980) 2010/11: not found	Federal land
6	North Pender Island (Oaks Bluff)	Status report: data not available (1983) 2010/11: not found	Non-federal land
7	Lone Tree Hill	Status report: 3-13 (1996-1999) 2010/11: not found	Non-federal land

3.3. Needs of the Slender Popcornflower

Little is known of Slender Popcornflower's biological requirements and limitations. In Canada, Slender Popcornflower occurs in Garry Oak and associated ecosystems in the dry Coastal Douglas-fir moist maritime (CDFmm) biogeoclimatic zone (COSEWIC 2008). The CDFmm climate is warm and dry in the summer and mild and wet in the winter. Remaining Slender Popcornflower habitat within this zone can be generally characterized as exposed soils on dry, steep, south facing open grassy slopes and coastal bluffs (Figure 3).

At Saturna Island, Slender Popcornflower is found only in open areas with full sun, indicating that it may be intolerant of shading. It is also believed that this species is a poor competitor and requires exposed soil for germination because in contrast to other popcornflowers on Saturna Island this species is found in the driest, most well-drained areas which receive some disturbance, and individuals were not relocated at other populations where vegetative cover was high (80% to 90% cover). However, because Slender Popcornflower was found at only one location, the habitat described in this recovery strategy may not represent the full range of habitat used by this species in the past. Biophysical attributes of Slender Popcornflower habitat can be found in Section 7.1.2.

Slender Popcornflower is limited by its requirement for specific habitat with limited availability (e.g., open areas that are dry and sparsely-vegetated and/or disturbed).Specific habitat requirements also make Slender Popcornflower vulnerable to climate change and climatic variability, as indicated by dramatically reduced numbers (or absence) of individuals recorded in surveys conducted in drought years in Canada. However, in old cultivated fields in California the species was only found in drought years when other vegetation was limited (Stromberg and Griffin 1996).

It is expected that Slender Popcornflower germinates in late winter because it germinates best after cold stratification (Forbis 2010). Flowering occurs between April and May and flowers are likely cross-pollinated by insects. Short-range dispersal is probably facilitated by gravity and

small mammals and birds may periodically disperse seed between populations (COSEWIC 2008).

The Canadian (and San Juan Island) populations of this species are small, isolated, and disjunct from the majority of the species' range which limits genetic connectivity.

The current Canadian population is believed to be at risk of demographic collapse due to the limited population size and small number of populations, particularly given that no individuals have been observed at six of the seven populations for more than ten years.

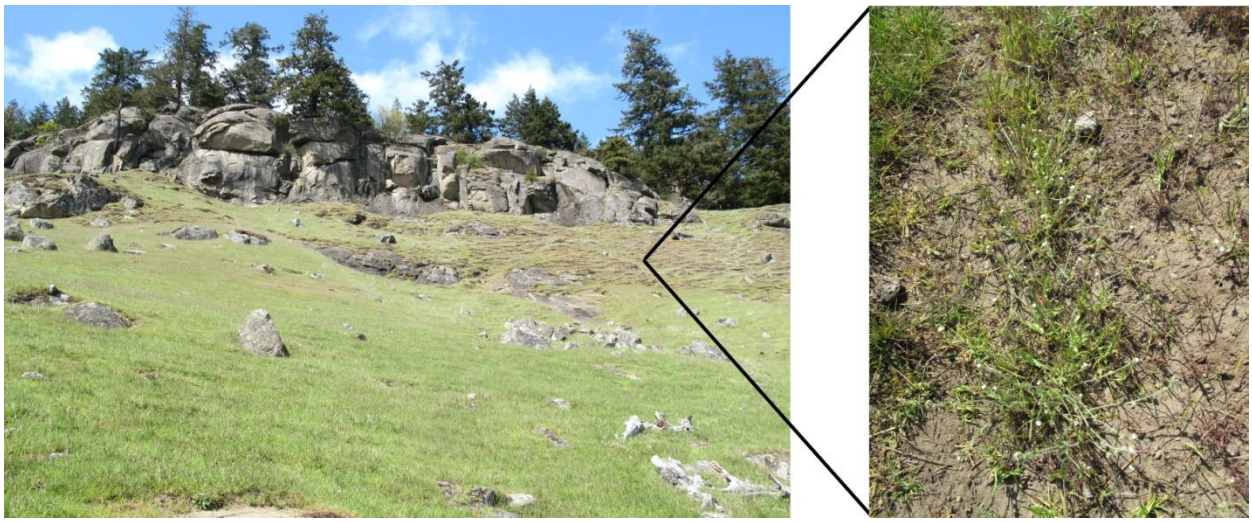

Figure 3. Habitat of Slender Popcornflower on Saturna Island. Photos by Shyanne Smith.

4. Threats

4.1. Threat Assessment

Table 3. Threat Assessment Table.

Threat	Level of Concern[1]	Extent	Occurrence	Frequency	Severity[2]	Causal Certainty[3]
Habitat loss or degradation						
Habitat conversion	High	Localized	Historic and Current	Recurrent	High	Medium
Alien, invasive, or introduced species						
Invasion of alien plants	High	Widespread	Current	Continuous	High	Medium
Changes in ecological dynamics or natural processes						
Encroachment of native and alien vegetation	High	Widespread	Current	Continuous	High	Medium
Altered grazing or browsing regime	Low	Localized	Historic and Current	Continuous	Unknown	Low
Climate change and natural disasters						
Changes in weather patterns, especially spring and early summer precipitation	Low	Widespread	Current	Seasonal	Unknown	Low

[1] *Level of Concern: signifies that managing the threat is of (high, medium or low) concern for the recovery of the species, consistent with the population and distribution objectives. This criterion considers the assessment of all the information in the table).*

[2] *Severity: reflects the population-level effect (High: very large population-level effect, Moderate, Low, Unknown).*

[3] *Causal certainty: reflects the degree of evidence that is known for the threat (High: available evidence strongly links the threat to stresses on population viability; Medium: there is a correlation between the threat and population viability e.g., expert opinion; Low: the threat is assumed or plausible).*

4.2. Description of Threats

4.2.1. Habitat loss and degradation

The most direct and obvious threat to Slender Popcornflower is habitat conversion caused by development and the resulting habitat destruction and fragmentation (Table 3). Six of thirteen known populations in Canada have likely become extirpated due to land development. Extant populations not within a park or protected area are at risk of being extirpated or reduced in size as Slender Popcornflower habitat can be highly desirable for ocean views. While it is impossible to determine whether the construction of houses on Heck Hill, Mayne Island and a viewing platform on Mt. Norman, South Pender Island have affected the populations at those locations these activities are part of an ongoing trend of habitat loss—though the platform now appears to contain most park users, keeping them off the slope and potentially protecting any remaining habitat (Smith 2012). In addition, options for future recovery efforts are reduced as potentially suitable habitat on private lands continue to be converted to housing. For the above reasons, this threat is considered to be a high level of concern.

4.2.2. Alien, invasive, or introduced species

Invasive alien plants pose a critical and urgent threat to Slender Popcornflower because they alter the habitat, suppress Slender Popcornflower growth, compete for resources (such as light, water, and nutrients), and pre-empt space for germination (by germinating in the fall prior to Slender Popcornflower).

Introduced grasses and some herbaceous vegetation are present at all population locations and introduced grasses are the predominant vegetation type at the Saturna Island population. Specific invasive alien grasses causing this threat include Silver Hairgrass (*Aira caryophyllea*), Early Hairgrass (*A. praecox*), Soft Brome (*Bromus hordeaceus*), Barren Brome (*B. sterilis*), Cheatgrass (*B. tectorum*), Hedgehog Dogtail (*Cynosurus echinatus*), and Sweet Vernal Grass (*Anthoxanthum odoratum*). Invasive alien forbs include Hairy Cat's-ear (*Hypochaeris radicata*), Sheep Sorrel (*Rumex acetosella*), Common Forget-me-not (*Myosotis discolor*), Small Hop-Clover (*Trifolium dubium*), Small-flowered Catchfly (*Silene gallica*), and Japanese Hedge-parsley (*Torilis japonica)*. The grasses, Hairy Cat's-ear, and Sheep Sorrel were observed to be growing in closest proximity to Slender Popcornflower. The invasive alien shrub Scotch Broom (*Cytisus scoparius*) is also encroaching on and altering potential Slender Popcornflower habitat at Galiano Island population 2, North Pender Island, and Mayne Island.

Invasive alien species are of high concern because of the potential for complete habitat alteration and extirpation of Slender Popcornflower populations. This threat also interacts with changes in ecological dynamics or natural processes (see Section 4.2.3).

4.2.3. Changes in ecological dynamics or natural processes

Fire changes a wide variety of habitat characteristics including the amount of organic matter, nutrient cycling, soil moisture, and soil biota (Barbour *et al.* 1999). Historically, fire would have created or maintained open habitats suitable for Slender Popcornflower growth. In general, when fire is a common occurrence, it maintains the availability of resources which would otherwise be limiting. For example, a lack of fire allows organic matter to build up and cover the ground, leaves more nutrients in organic matter and unavailable for use, and enables woody species to invade open areas and suppress herbaceous species. Bare soil becomes a limiting factor when it is covered by thatch and occupied by perennial plants. Available habitat is further reduced as woody vegetation invades open areas and decreases their size. These habitat changes threaten the survival of Slender Popcornflower (which requires open areas with exposed soil) by suppressing growth and through competition for light, moisture, and nutrients.

Native annuals are common (~30% of the species present) in Garry Oak grassland habitat that experiences regular disturbance (e.g., fire) and the diversity of native annuals declines with increasing thatch and moss cover which can result from extended periods of fire suppression (Thorpe and Stanley 2011). Within the range of Slender Popcornflower First Nations used fire to maintain open areas (Agee 1993). These open areas would have supported a diversity of annual plants, including Slender Popcornflower. Fire or surrogate disturbance (e.g., grazing/browsing) and thatch removal are likely important processes required by Slender Popcornflower.

The largest Slender Popcornflower population is found on Saturna Island where encroachment of vegetation is limited by heavy grazing and browsing by feral goats. The six locations that do not have surrogate disturbance have greater vegetation cover and little habitat for Slender Popcornflower germination. The reduction or elimination of conditions suitable for germination may be the leading cause of population decline at these locations.

Changes in ecological dynamics and natural processes have the potential to completely alter the habitat such that it is unsuitable for Slender Popcornflower. This threat is of great concern because such alterations will likely lead to population extirpation.

4.2.4. Climate change and natural disasters

Changes in weather patterns due to climate change may threaten Slender Popcornflower populations in Canada. At the northern extent of its range, this species may rely on specific winter and spring precipitation patterns in order to occupy habitat that would otherwise be too dry. Despite intensive search efforts at many of the population locations in 2003 and 2004, plants could only be located on Saturna Island (COSEWIC 2008). These years were two of the driest years on record, indicating that drought may contribute to annual fluctuations in population size (COSEWIC 2008). This threat is considered to be a low level of concern at this time.

5. Population and Distribution Objectives

In Canada, Slender Popcornflower grows in Garry Oak and associated ecosystems and as such had a naturally, restricted range. Within this range, significant habitat loss since European settlement (Lea 2006) has likely resulted in population reductions. Vegetation encroachment, development, and invasive alien plants continue to exacerbate the situation (COSEWIC 2008; Smith 2012). There are seven populations still considered extant in Canada but mature plants have been observed at only one of these populations over the last decade (COSEWIC 2008; Smith 2012).

In general, it is believed that multiple populations and thousands of individuals are likely required to attain a high probability of long-term persistence for a species (Reed 2005; Brook *et al.* 2006; and Traill *et al.* 2009). In an analysis of several published estimates of minimum viable population (MVP) sizes, Traill *et al.* (2007) found that the median population size required for plants to achieve a 99% probability of persistence over 40 generations was approximately 4,800 individuals (but see Flather *et al.* 2011; Garnett and Zander 2011; and Jamieson and Allendorf 2012 for critical evaluations of the analyses and the applicability of the results). Such information provides a useful guide, but developing specific quantitative and feasible objectives must consider more than just generalized population viability estimates, including the historic number of populations and individuals, the carrying capacity of extant (and potential) locations, the needs of other species at risk that share the same habitat, and whether it is possible to establish and augment populations of the species (Parks Canada Agency 2006; Flather *et al.* 2011; Jamieson and Allendorf 2012). Because not enough of this information is available for Slender Popcornflower, it is currently not possible to determine to what extent recovery is feasible, and therefore, it is not possible to establish quantitative long-term objectives.

Recovery planning approaches (see Section 6) are designed to respond to knowledge gaps so that long-term, feasible, and quantitative recovery objectives regarding size and number of populations can be set in the future. At this time it is possible to set short-term objectives that focus on maintaining the Saturna Island population and habitat at the remaining six population locations while exploring the feasibility of establishing and/or augmenting populations to increase abundance and distribution:

Objective 1: Maintain the Saturna Island population of Slender Popcornflower.

Objective 2: Maintain the habitat at the Galiano Island population 1, Galiano Island population 2, Lone Tree Hill, Mayne Island, South Pender Island, and North Pender Island locations while the feasibility of population restoration is assessed for Slender Popcornflower.

Objective 3: Establish and/or augment populations to increase abundance and distribution[3] if determined to be feasible and biologically appropriate for Slender Popcornflower.

6. Broad Strategies and General Approaches to Meet Objectives

Broad strategies and approaches to meet the population distribution objectives for Slender Popcornflower include:

- Habitat and species protection: protect existing populations and their habitat from destruction (e.g., from land conversion) by developing mechanisms/instruments for protection;
- Stewardship: engage and involve landowners and land managers in recovery activities and decisions for Slender Popcornflower;
- Public education and outreach: increase public awareness of the species, value of natural habitat and connectivity, threats and harm reduction measures, and conservation value;
- Research: address knowledge gaps concerning genetic connectivity, threats, and habitat requirements;
- Population research and monitoring: monitor population trends, habitat attributes, and threats, and conduct population demographic research;
- Population restoration: develop and test population (re)introduction/augmentation techniques to recover the Canadian population of the species.

[3] The intent is to increase the area of occupancy and maintain the extent of occurrence.

6.1. Strategic Direction for Recovery

Table 4. Recovery Planning Table.

Threat or Limitation	Priority[4]	Broad Strategy to Recovery	General Description of Research and Management Approaches
Habitat conversion	High	Habitat and species protection	• Identify protection mechanisms/instruments for the species and its critical habitat. • Conserve habitat which could be made suitable (may require restoration) where the species is known to have occurred within the last 35 years.
Invasion of alien plants Encroachment of native and alien vegetation Altered grazing or browsing regime Threat: Changes in weather patterns, especially spring and early summer precipitation	High	Stewardship	• Prepare Best (Beneficial) Management Practices guidelines for Slender Popcornflower to support landowners and land managers in stewardship activities. • Develop location-specific plans for managing invasive alien plants, encroachment of vegetation, grazing/browsing regimes, and key habitat attributes such as amount of bare soil. • Engage landowners and land managers in recovery decisions and activities.
	Medium	Public education and outreach	• Develop priorities to deliver public education and outreach concerning species at risk, their habitats, and their management. • Increase public awareness of the existence, conservation value, threats, and harm reduction measures for Slender Popcornflower and associated species at risk.
	Medium	Research	• Determine effects of grazing/browsing and invasive alien plants on Slender Popcornflower. • Consider effects of climate change on all aspects of recovery.

[4] "Priority" reflects the degree to which the approach contributes directly to the recovery of the species or is an essential precursor to an approach that contributes to the recovery of the species.

Threat or Limitation	Priority[4]	Broad Strategy to Recovery	General Description of Research and Management Approaches
Knowledge gaps regarding population size and trends and demography.	High	Population research and monitoring	• Design and implement an inventory and monitoring program to track population trends for 10 successive years, with subsequent monitoring as required. • Report on population trends, area of occupancy, and habitat condition every 2 years. • Conduct demographic research in order to identify critical life stages (e.g., pollination/reproduction, dispersal, seed production, recruitment, and recruit survival) necessary for population growth. • Identify demographic criteria that would trigger immediate re-evaluation of recovery priorities and activities, and incorporate these into the management plans. • Determine species-specific population thresholds and targets suitable for long-term population objectives. • Monitor impacts of recovery activities on habitat, non-target species, plant communities, and ecological processes.
Knowledge gaps regarding and propagation and augmentation techniques. Knowledge gaps: genetic connectivity Limitation: Demographic collapse	High	Population restoration	• Identify, prioritize and rank habitat within the Canadian range for suitability and recovery potential. • Develop appropriate restoration techniques and location-specific management/restoration plans (including prescribed burn and invasive alien plant management) for Slender Popcornflower habitat. • Determine conditions (e.g., light requirements, soil type, vegetative cover) necessary for germination, establishment, growth and reproduction. • Collect soil samples from locations and conduct germination trials to evaluate presence of an existing seed bank at each population location. • Develop and implement establishment/ augmentation plans (including monitoring of success and effects on non-target species), consistent with existing guidelines (i.e., Maslovat 2009). • Assess genetic connectivity (if plants are found at locations other than Saturna Island).

6.2. Narrative to Support the Recovery Planning Table

Intensive surveys for Slender Popcornflower, conducted in 2004 and 2010-2011, indicate that the Saturna Island population may now be the only population in Canada (COSEWIC 2008, Smith 2012). However, undetected individuals or a seed bank may still persist at up to six additional locations. The most urgent recovery activities are to monitor all seven populations while protecting and restoring the habitat and populations at these locations.

Stewardship, public education, and outreach are critical to recovery because five of the seven extant populations occur on private property or in community parks. Successful stewardship will involve the cooperation of landowners and land managers to protect and manage species at risk

and their habitat. For example, threats from invasive alien plants and encroachment of vegetation will need to be addressed through appropriate restoration and adaptive management techniques and will require the engagement and cooperation of landowners and land managers. Delivering public education and outreach to the broader public will alert residents and park visitors to the presence of Slender Popcornflower and its needs in their area and create a greater social awareness of species at risk, their habitats, and their management.

Observations made during surveys in 2010/2011 indicate that habitat disturbance likely plays a critical role in regeneration and maintenance of Slender Popcornflower populations (Smith 2012). Further examination of Slender Popcornflower needs will fill in knowledge gaps and provide critical information on which to base restoration activities. For Example, if monitoring of goat herbivory at the Saturna population indicates that increased grazing/browsing by goats is indeed beneficial, then increased grazing/browsing may be considered as a restoration technique for other habitat. A better understanding of other Slender Popcornflower needs will similarly provide direction and options for restoration.

Design of the monitoring program is an important consideration, especially for rare annual plants which are likely to exhibit population fluctuations or have seed banks (Bush and Lancaster 2004). Data should be collected regularly over several years to account for population fluctuations. Further, data should be collected in years when plants are absent as well as when they are present to provide information on the species' responses to environmental conditions. Seed banks are an important part of the lifecycle and must be considered in estimates of population size—the presence of even one individual may indicate a viable seed bank is present (Bush and Lancaster 2004).

7. Critical Habitat

Areas of critical habitat for Slender Popcornflower are identified in this recovery strategy. Critical habitat is defined in the *Species at Risk Act* as "…habitat that is necessary for the survival or recovery of a listed wildlife species and that is identified as the species' critical habitat in the recovery strategy or in an action plan for the species" (Subsection 2(1)). Habitat for a terrestrial wildlife species is defined in the *Species at Risk Act* as "…the area or type of site where an individual or wildlife species naturally occurs or depends on directly or indirectly in order to carry out its life processes or formerly occurred and has the potential to be reintroduced" (Subsection 2(1)).

7.1. Identification of the Species' Critical Habitat

Critical habitat for Slender Popcornflower is identified in this recovery strategy to the extent possible based on best available information. It is recognized that the critical habitat identified below is insufficient to achieve the population and distribution objectives. Critical habitat has been fully identified for the population on Saturna Island and further study is required to identify critical habitat at the remaining six populations where individuals could not be located (seed banks may be present). The schedule of studies section (Section 7.2; Table 5) outlines activities required to identify additional critical habitat necessary to support the population and distribution objectives.

7.1.1. Geographical Location

Within the geographical boundaries identified in Figure 4 (Saturna Island), habitat matching the biophysical attributes described in section 7.1.2 is critical for the survival of Slender Popcornflower. This is a precautionary identification based on the general location where plants were found during recent surveys (Smith 2012). There is currently not enough information to determine what smaller amount of habitat would allow this population to achieve a high probability of long-term persistence and it is likely that further study will enable a more focused identification. Further, it is not possible to determine the location of seed banks when individuals are not present during the survey and subpopulations could have been missed because the survey years were particularly dry and may have had fewer individuals compared to wetter years. Suitable habitat that did not exhibit individuals in 2010/2011 could contain a seed bank that may germinate under more suitable conditions. All habitat matching the biophysical attributes within the identified geographical boundaries is considered necessary for survival until further study indicates otherwise. Unsuitable habitat (e.g., bare rock, forest) or infrastructure (e.g., developed or designated trails, roads, parking lots, and buildings) within these areas is not necessary for the survival or recovery of Slender Popcornflower and is not critical habitat.

7.1.2. Biophysical Attributes

The habitat of Slender Popcornflower plants is generally characterized as dry grassy slopes and bluffs in or near Garry Oak and associated ecosystems in the dry Coastal Douglas-fir zone of southeast Vancouver Island and adjacent Gulf Islands (COSEWIC 2008). The habitat is generally steep and south-facing, with broad expanses of open areas containing exposed soils. Field surveys conducted at all seven locations in 2010 and 2011 located Slender Popcornflower individuals only at the Saturna Island location (Smith 2012). Surveys were not able to relocate individuals at the six locations where Slender Popcornflower has not been observed for at least 10 years (since natural areas still exists at all six locations, potential seed banks may also exist). The potential habitat at the six locations where Slender Popcornflower plants were not located in 2010/2011 was found to differ from the Saturna Island habitat in the amount of exposed soil present. Significantly more exposed soil was observed at the Saturna Island location where disturbance from feral goats apparently reduces vegetative cover to 40-85% compared to the other six locations where vegetative cover ranged from 80-90%. Critical habitat is not proposed for these six populations at this time for three reasons: 1) individuals have not been observed at these six locations in the last 10 years, 2) the habitat appears to differ significantly in amount of exposed soil, a key biophysical attribute, and 3) the location of the last reported individuals is not well understood (spatial precision > 100 metres).

The critical habitat attributes for Slender Popcornflower are listed below:

- Open areas (sunny) with short or sparse vegetation (trees and shrubs are absent or sparse),
- Elevations between 250 to 320 metres above sea level,
- Hill crest or gently sloping (22-50%) south facing bench,
- Shallow well drained soils (5-20 centimetres) with exposed soil (15-60%) and fine litter, and
- Soils are moist in early growing season (October to March) with water deficits by late spring to early summer.

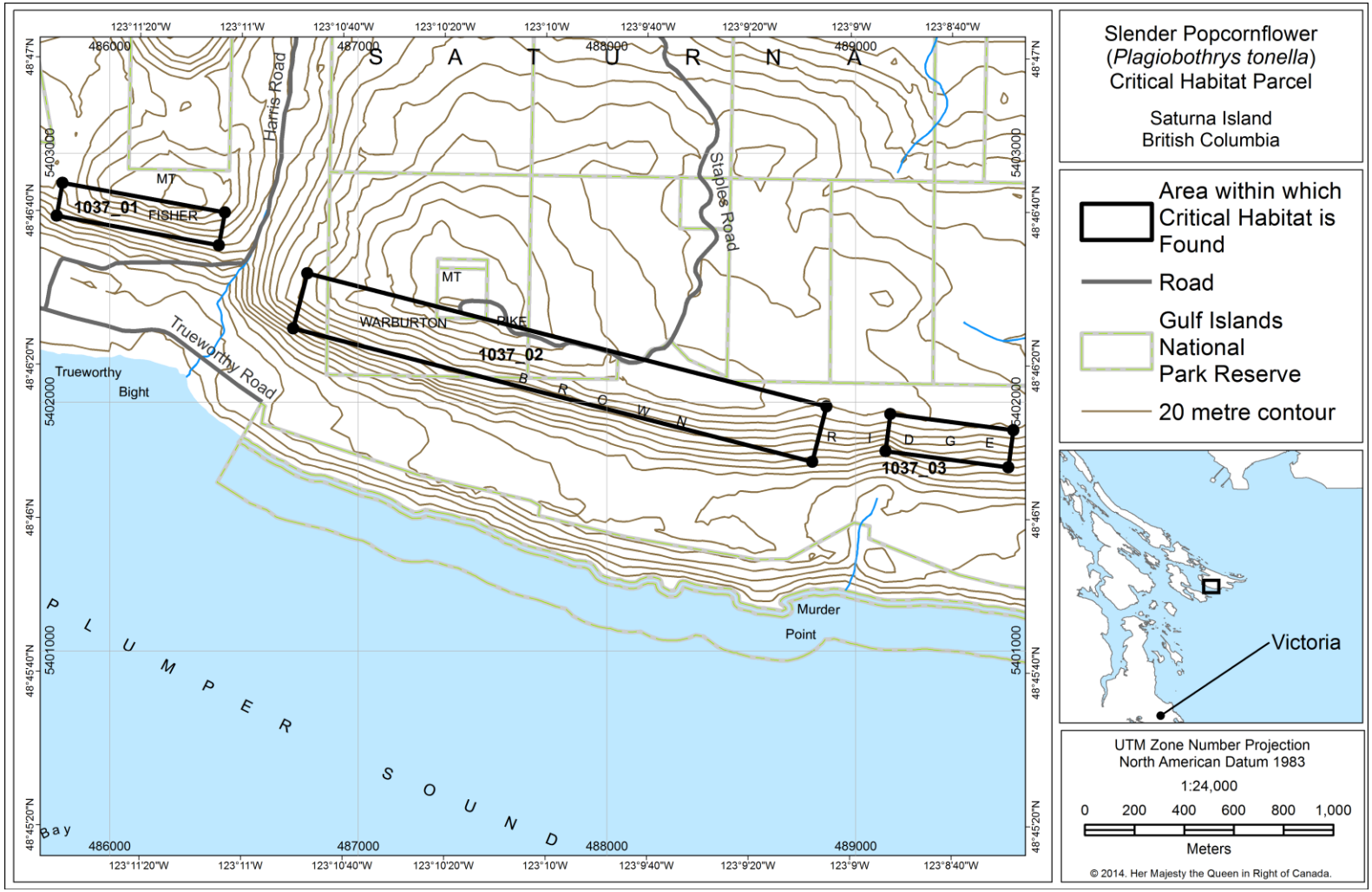

Figure 4. Area (~28 ha) within which critical habitat for Slender Popcornflower is found on Saturna Island, on federal and non-federal lands.

7.2. Schedule of Studies to Identify Critical Habitat

Table 5. Schedule of Studies to Identify Critical Habitat.

Description of Activity	Rationale	Timeline
Conduct annual monitoring for at least 5 years to ascertain suitability of habitat and presence of Slender Popcornflower in the vicinity of recorded populations on Galiano Island, Lone Tree Hill, Mayne Island, North Pender Island, and South Pender Island.	Required in order to confirm existence of populations, determine their location, and to identify critical habitat for them or for establishing new populations.	2014-2019
Survey the species' distribution to identify potentially suitable habitat, focusing on vicinity of historic populations.	To locate suitable habitat for establishing new populations.	2014-2019

7.3. Activities Likely to Result in the Destruction of Critical Habitat

Examples of some activities likely to destroy critical habitat are provided below (Table 6). It is important to note that some activities performed outside critical habitat have the potential to destroy critical habitat, and further, that changes to ecological dynamics and ecological processes and introduction of invasive alien plants (though these are not listed in Table 6) can also alter critical habitat attributes so that they no longer support the species. Destruction of critical habitat will result if any part of the critical habitat is degraded, either permanently or temporarily, such that it would not serve its function when needed by the species. Destruction may result from single or multiple activities at one point in time or from the cumulative effects of one or more activities over time.

Table 6. Examples of activities likely to result in the destruction of critical habitat.

Activity	Effect of activity on critical habitat	Most likely locations
Development or land use changes	This activity can destroy habitat outright, or cause soil compaction, and shading (e.g., by introduced or encroaching plants or nearby structures). Disturbance of seed bank by potentially burying seeds. Plants may become stressed and die or be unable to germinate due to impaired ability of the habitat to provide suitable soil moisture or light availability.	Saturna Island

8. Measuring Progress

The performance indicators presented below provide a way to define and measure progress toward achieving the population and distribution objectives.

Objective 1: *Maintain the Saturna Island population of Slender Popcornflower.*

- By 2019 best management practices are developed and implemented.
- Ongoing monitoring continues to indicate that the population remains extant.
- By 2024, the population shows a stable or increasing trend in population size[5].

[5] Note that annual plant populations are expected to fluctuate and require long term datasets to estimate. (Bush and Lancaster 2004).

Objective 2: *Maintain the habitat at the Galiano Island population 1, Galiano Island population 2, Lone Tree Hill, Mayne Island, South Pender Island, and North Pender Island locations while the feasibility of population restoration is assessed for Slender Popcornflower.*

- Habitat suitable for Slender Popcornflower or its seed bank remains extant at all six locations.

Objective 3: *Establish and/or augment populations to increase abundance and distribution if determined to be feasible and biologically appropriate for Slender Popcornflower.*

- By 2019, additional habitat has been identified on Vancouver Island and in the vicinity the Gulf Islands locations, for establishment or restoration of Slender Popcornflower population(s).
- By 2019, propagation techniques have been developed.
- By 2024, one or more (re)introduction or augmentation experiments are underway at suitable locations.

9. Statement on Action Plans

One or more action plans will be completed by 2019.

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Appendix A: Effects on the Environment and Other Species

A strategic environmental assessment (SEA) is conducted on all SARA recovery planning documents, in accordance with the Cabinet Directive on the Environmental Assessment of Policy, Plan and Program Proposals. 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 and to evaluate whether the outcomes of a recovery planning document could affect any component of the environment or any of the Federal Sustainable Development Strategy's[6] goals and targets.

Recovery planning is intended to benefit species at risk and biodiversity in general. However, it is recognized that recovery 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 upon non-target species or habitats. The results of the SEA are incorporated directly into the strategy itself, but are also summarized below in this statement.

This recovery strategy was evaluated for potential effects (positive and negative) on non-target species, natural communities, and/or natural processes. Important to note is that a number of other rare species (Table 7) have been reported in the vicinity of one or more Slender Popcornflower populations and efforts to recover the Slender Popcornflower may benefit these nearby rare species because they share common threats such as encroachment by native and invasive alien plants.

Table 7. Partial list of species at risk and vulnerable species potentially affected by Garry Oak Ecosystem Recovery Team (GOERT) and/or SARA recovery activities. Sources: B.C. Conservation Data Centre 2012, NatureServe 2012.

Species and Common Name	British Columbia provincial rank	COSEWIC designation
White Meconella *Meconella oregana*	S1 Red	Endangered
Purple Sanicle *Sanicula bipinnatifida*	S2 Red	Threatened
California Hedge-parsley *Yabea microcarpa*	S1S2 Red	Not assessed
Scalepod *Idahoa scapigera*	S2 Red	Not assessed
Macrae's Clover *Trifolium dichotomum*	S2S3 Blue	Not assessed
Banded Cord-moss *Entosthodon fascicularis*	S2S3 Blue	Special Concern
Small-flowered Godetia *Clarkia purpurea* ssp. *quadrivulnera*	S1 Red	Candidate
Spanish-clover *Lotus unifoliolatus* var. *unifoliolatus*	S3 Blue	Not assessed

[6] http://www.ec.gc.ca/dd-sd/default.asp?lang=En&n=F93CD795-1

Although it is not feasible to discuss all of the potential species interactions that may result from implementation of this recovery strategy, the following specific positive effects can be identified:

- Protection of habitat will, in general, reduce shared threats for co-existing species and associated habitat.
- Increased public education and awareness will help reduce harmful activities in locations supporting this and other species at risk.
- Management of encroaching plants will restore habitat for other plant species at risk and native woodland species in general.

Overall the strategy for the recovery of the Slender Popcornflower is positive; however, there is the potential for negative effects on non-target species, natural communities, and/or natural processes if sound conservation approaches are not applied. Sound conservation approaches include:

- Carefully planning and implementing large-scale management actions, such as vegetation removal, use of herbicides, or reintroduction of disturbance. These actions may have a negative effect on other plants at risk (e.g., through trampling, increased herbivory, inadvertent dispersal of invasive alien plants during disposal, potential colonization of newly created gaps by other invasive alien plants, and harm from improper herbicide application, or disturbance) and the environment (e.g., runoff from herbicide application).
- Management of all restoration activities (surveys, research, and management) to avoid trampling, damage, or disturbance of co-occurring or nearby plants and animals, particularly other species at risk.

Potential negative effects can be mitigated or eliminated at the project implementation phase through proper field procedures and/or collaboration with key conservation partners such as the Garry Oak Ecosystems Recovery Team and appropriate government agencies. If sound conservation practices are applied (for example following practices outlined in the Garry Oak Ecosystems Recovery Team Decision Support Tool for Invasive Species Removal) the risk of important negative effects to other species during recovery efforts is low.

In summary, the SEA process has concluded that this recovery strategy will likely have several positive effects on the environment and other species. There are no obvious adverse environmental effects anticipated with the implementation of this recovery strategy.