

Recovery Strategy for the Foothill Sedge (*Carex tumulicola*) in Canada

Foothill Sedge



2013

Recommended citation:

Parks Canada Agency. 2013. Recovery Strategy for the Foothill Sedge (<i>Carex tumulicola</i>) in Canada. <i>Species at Risk Act</i> Recovery Strategy Series. Parks Canada Agency, Ottawa. vi + 25 pp.
--

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 Species at Risk Public Registry (<http://www.sararegistry.gc.ca>).

Cover illustration: P. Lawn, Parks Canada Agency

Également disponible en français sous le titre

« Programme de rétablissement du carex tumulicole (*Carex tumulicola*) au Canada »

© Her Majesty the Queen in Right of Canada, represented by the Minister of the Environment, 2013. All rights reserved.

ISBN 978-1-100-22307-0

Catalogue no. En3-4/160-2013E-PDF

Content (excluding the illustrations) may be used without permission, with appropriate credit to the source.

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 within five years.

The Minister of the Environment and the Minister responsible for the Parks Canada Agency is the competent minister for the recovery of the Foothill Sedge and has prepared this strategy, as per section 37 of SARA. It has been prepared in cooperation with Environment Canada/Canadian Wildlife Service, the Province of British Columbia, the Department of National Defence, and Becher Bay First Nation.

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 Environment Canada, or the Parks Canada Agency, or any other jurisdiction, alone. All Canadians are invited to join in supporting and implementing this strategy for the benefit of the Foothill Sedge 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 Environment Canada and/or 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 the Foothill Sedge will be coordinated with the recovery of other species inhabiting woodlands and maritime meadows associated with Garry Oak ecosystems as outlined in Parks Canada Agency (2006a; 2006b).

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.

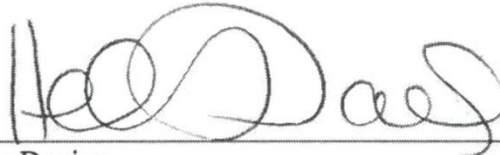
Recommended by:



Todd Shannon

Acting Superintendent, Gulf Islands National Park Reserve of Canada

Recommended by:



Helen Davies

Field Unit Superintendent, Coastal British Columbia

Approved by:



Alan Latourelle

Chief Executive Officer, Parks Canada Agency

ACKNOWLEDGMENTS

Many thanks to Matt Fairbarns and Michael T. Miller for preparing initial drafts of this recovery strategy and to Simone Runyan for gathering additional background information for this report. The Garry Oak Ecosystems Recovery Team (GOERT) is the recovery team for the Foothill Sedge 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 Department of National Defence, Natural Resources Canada, Environment Canada, and Province of British Columbia. Thank you to the various landowners who support recovery of this species on their land and provided access for surveys.

EXECUTIVE SUMMARY

The Canadian population of Foothill Sedge (*Carex tumulicola* Mack.) was assessed as Endangered in 2008 by the Committee on the Status of Endangered Wildlife in Canada (COSEWIC), and in February 2010 the species was listed as Endangered under Canada's *Species at Risk Act*, affording it legal protection.

Foothill Sedge is a tufted, grass-like perennial plant with drab green flowers. It is restricted to western North America from southern British Columbia to central California. Within its range, Foothill Sedge occurs in upland prairies, dry to moist meadows, and in openings in Garry Oak woodlands. Globally, the species is listed as “apparently secure”.

In Canada, Foothill Sedge is found along the southeast coast of Vancouver Island and on one adjacent Gulf Island. The COSEWIC status report indicates a population consisting of 500-1,500 mature individuals in Canada; however, subsequent surveys have revealed the presence of unreported subpopulations increasing the estimated Canadian population size to approximately 2,500 mature individuals. The Canadian distribution of Foothill Sedge represents less than one per cent of the total global range.

Foothill Sedge occurs on private, municipal and federal lands where it faces threats from habitat conversion, encroachment of native and invasive alien herbaceous and woody vegetation, recreational and land management activities, grazing, and bank slumping. A number of factors limiting the recovery and survival of Foothill Sedge include low competitive ability, limited recruitment and dispersal ability, specific habitat requirements and habitat availability. As a slow-growing and long-lived plant, Foothill Sedge may be prone to elimination by stochastic demographic or environmental events. High population fragmentation in combination with small population sizes may result in a loss of genetic diversity.

In the short term, recovery objectives for Foothill Sedge will focus on the maintenance of the seven extant Canadian populations and the distribution. Broad strategies to address the threats to the survival and recovery of Foothill Sedge are presented in section 6 Broad Strategies and General Approaches to Meet Objectives.

This recovery strategy identifies critical habitat for the Foothill Sedge in Canada, to the extent possible at this time, based on the best available information. Activities likely to result in the destruction of critical habitat have been identified.

Further recovery action for Foothill Sedge will be incorporated into one or more action plans by 2018.

RECOVERY FEASIBILITY SUMMARY

The recovery of the Foothill Sedge in Canada is deemed to be technically and biologically feasible based on the criteria identified in the *Species at Risk Act* Policies: Overarching Policy Framework [Draft] (Government of Canada 2009):

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

Yes. Each of the seven extant populations supports at least one reproductive individual, while two of the populations support 50 or more reproductive individuals.

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

Yes. While some extant populations face strong habitat limitations, and may for this reason be unviable in the long-term, there is sufficient habitat available to support most of the larger populations on their existing sites. Furthermore, in some areas (but not all) there appears to be sufficient unoccupied habitat available to allow for a local expansion in the species' distribution. The current range of Foothill Sedge spans an extensive area of Garry Oak woodlands and associated non-forest ecosystems; it is thus likely that additional suitable habitat could be made available through active habitat stewardship or restoration, if needed.

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

Yes. With the participation of all responsible jurisdictions and those stewarding the land, the most significant threats to this species can be addressed and at least partially mitigated through recovery actions. There are no unavoidable threats to the species or its habitat that preclude recovery.

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

Yes. Recovery success will be tied primarily to threat reduction through habitat stewardship, in combination with long-term population monitoring and inventory. However, the feasibility of introducing/re-introducing populations at the northern edge of the range is still unknown.

TABLE OF CONTENTS

PREFACE	I
RECOMMENDATION AND APPROVAL STATEMENT	II
ACKNOWLEDGMENTS	III
EXECUTIVE SUMMARY	IV
RECOVERY FEASIBILITY SUMMARY	V
1. COSEWIC Species Assessment Information	1
2. Species Status Information	1
3. Species Information	1
3.1. Species Description	1
3.2. Population and Distribution	1
3.3. Needs of the Foothill Sedge	5
4. Threats	6
4.1. Threat Assessment	6
4.2. Description of Threats	6
5. Population and Distribution Objectives	8
6. Broad Strategies and General Approaches to Meet Objectives	9
6.1. Strategic Direction for Recovery	10
6.2. Narrative to Support the Recovery Planning Table	12
7. Critical Habitat	13
7.1. Identification of the Species' Critical Habitat	13
7.2. Activities Likely to Result in the Destruction of Critical Habitat	21
8. Measuring Progress	21
9. Statement on Action Plans	22
10. References	22
APPENDIX A: EFFECTS ON THE ENVIRONMENT AND OTHER SPECIES	24

1. COSEWIC Species Assessment Information

Date of Assessment: April 2008

Common Name (population): Foothill Sedge

Scientific Name: *Carex tumulicola*

COSEWIC Status: Endangered

Reason for Designation: This perennial species is known from 10 localized and highly fragmented sites in south western British Columbia where it occurs in meadows and shrub thickets within Garry oak ecosystems, a critically imperilled habitat in Canada. The total Canadian population likely consists of fewer than 1000 mature individuals. Factors such as competition and habitat degradation from invasive alien plants, altered fire regimes, urbanization, trampling and mowing place the species at risk.

Canadian Occurrence: British Columbia

COSEWIC Status History: Designated Endangered in April 2008. Assessment based on a new status report.

2. Species Status Information

Globally, Foothill Sedge is ranked as apparently secure (G4); meaning that it is “uncommon but not rare, with some cause for long-term concern due to declines or other factors” (NatureServe 2010). In the U.S., it is not ranked nationally or subnationally in California, Oregon, and Washington, but is ranked as critically imperilled (S1) in Idaho. The Canadian national ranking is imperilled (N2) and in British Columbia it is provincially ranked imperilled (S2) (NatureServe 2010). The Canadian distribution of Foothill Sedge represents less than one per cent of the total global range.

3. Species Information

3.1. Species Description

Foothill Sedge is a tufted, grass-like perennial plant with drab green flowers. A detailed description of the species is provided in the status report (COSEWIC 2008).

3.2. Population and Distribution

Globally, Foothill Sedge ranges from Vancouver Island south to Washington, along the Oregon coast and the Willamette Valley (Oregon) to California (Figure 1). In Canada, it is found along the southeast coast of Vancouver Island and on one adjacent Gulf Island (Figure 2). The nearest

U.S. populations occur in the San Juan Islands, a few kilometres from Victoria, and at Port Townsend. While it is possible that seed exchange occurs between U.S. and Canadian populations on occasion, such dispersal events are likely to be extremely rare, limiting the likelihood of any rescue effect. The COSEWIC status report indicates the presence of ten localities in Canada (COSEWIC 2008). The population in the municipal conservation area in Saanich (population 3 in the status report) appears to have been extirpated since the status report was prepared, and two other localities have been shown to be contiguous with other populations (in the status report: populations 4 and 5, and populations 6 and 9). Accordingly, there now appear to be only seven extant populations in Canada. For the purposes of this recovery strategy, extant populations have been renumbered and are named as follows: Harewood Plains (population 1), Sidney Spit (population 2), University of Victoria/Mt. Tolmie (population 3), Uplands Park (population 4), Albert Head (population 5), Rocky Point East (population 6), and Rocky Point West (population 7).

The COSEWIC status report indicates that there were 500-1,500 (probably less than 1,000) mature individuals (flowering tussocks) in Canada. Subsequent surveys revealed the presence of unreported subpopulations and the estimated Canadian population size has been increased to 2,273-2,693 individuals.

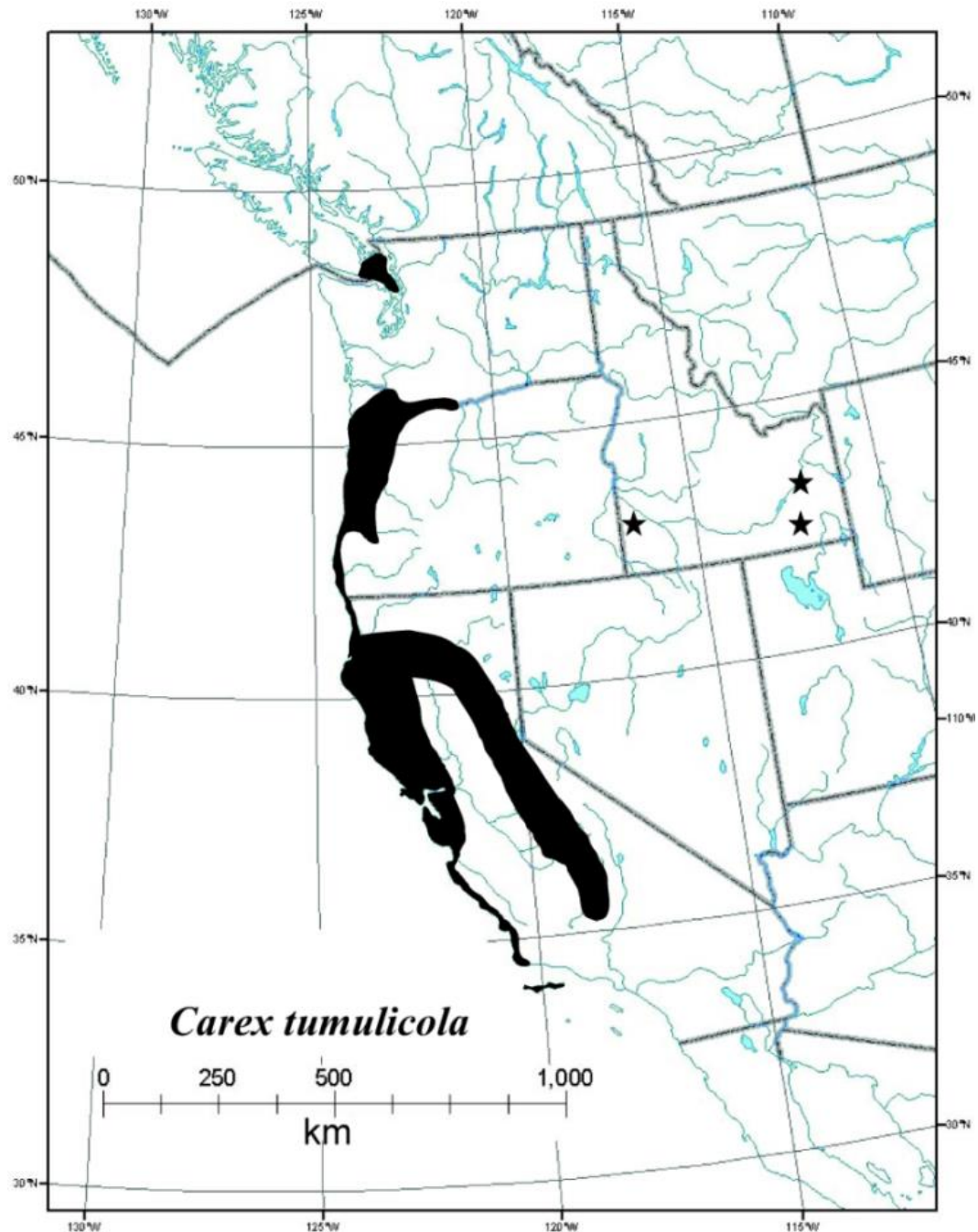


Figure 1: Global distribution of Foothill Sedge (from COSEWIC 2008). Dark shaded regions indicate species native range. Stars are unconfirmed collections.

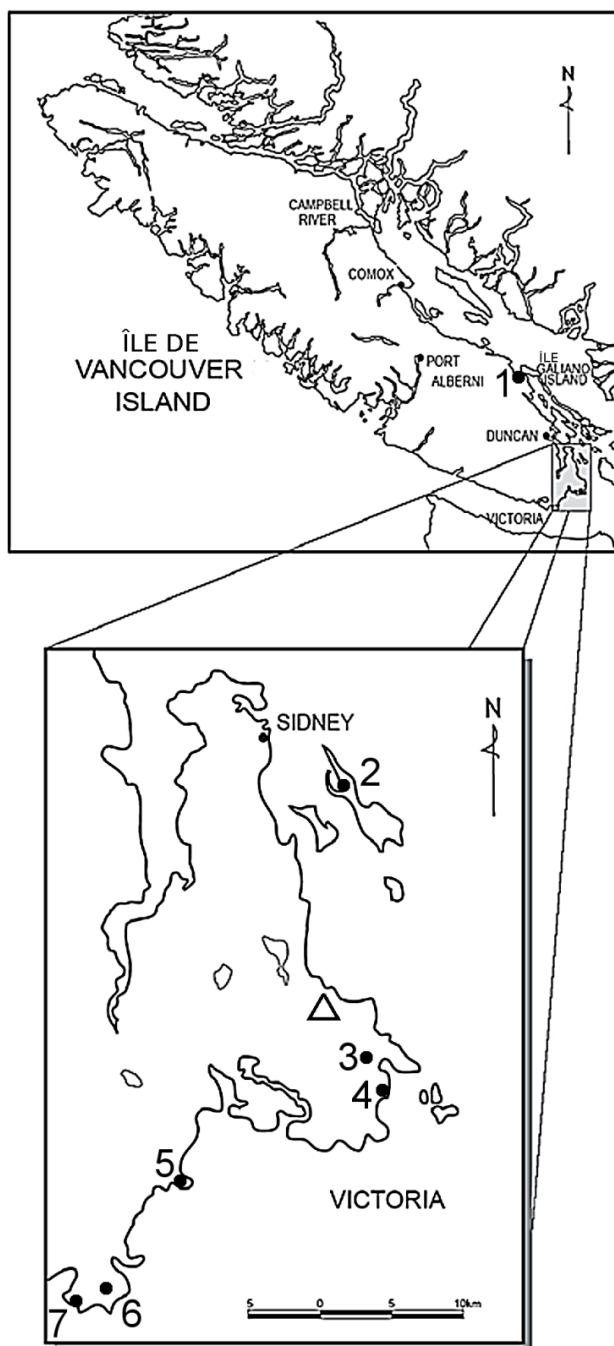


Figure 2: Distribution of Foothill Sedge in Canada (modified from COSEWIC 2008). Open triangle indicates the municipal conservation area population presumed to be extirpated. Closed circles and numbers refer to seven extant Foothill Sedge populations: (1) Harewood Plains (Nanaimo); (2) Sidney Spit; (3) University of Victoria/Mt. Tolmie (Saanich); (4) Uplands Park (Oak Bay); (5) Albert Head; (6) Rocky Point East; and (7) Rocky Point West.

3.3. Needs of the Foothill Sedge

In the U.S., Foothill Sedge has been reported from upland prairies, dry to moist meadows, and open woodlands. On Vancouver Island, the species is found in the Coastal Douglas-fir Biogeoclimatic Zone (moist maritime subzone). This zone features a Mediterranean-like climate with warm, dry summers and mild, wet winters. Summer drought is an important climatic feature. No soil assays have been attempted for Foothill Sedge on Vancouver Island, but most populations occur in openings in Garry Oak woodlands or associated non-forest ecosystems (e.g., maritime meadow ecosystems), where the soils are typically Orthic Sombric and Lithic Sombric Brunisols, with a well-developed Ah horizon and Moderate to weak Mor humus formations (Jungen 1985).

On Vancouver Island, Foothill Sedge is generally found only at elevations of less than 100 m and generally within 500 m of the coastline. Its restriction to low elevation coastal sites suggests that poor frost hardiness may limit its distribution. Foothill Sedge is most frequently associated with the shrubby margins of vernal wet or moist meadows, and appears to do best on sites that are too wet in winter for shrubs and too dry in summer for wetland plants. Here the soils become moistened with the arrival of autumn rains and remain moist (but not saturated) through the winter and early spring. Soil moisture levels decline as the summer drought progresses and by mid-summer most of the surrounding vegetation has withered, although the foliage of Foothill Sedge often remains green into the fall.

Because Foothill Sedge is at the northern edge of its range, it may be more limited in its ecological amplitude on Vancouver Island than elsewhere. Over much of its U.S. range, it is known as a hardy adaptable plant capable of surviving an array of disturbances and environmental extremes including summer drought, winter flooding, mowing, shading, and foot traffic.

Prior to European settlement, frequent fires were the norm in Garry Oak woodlands and associated dry non-forest ecosystems (Fuchs 2001). The ability of Foothill Sedge to reproduce by underground rhizomes may have been a feature that enabled it to persist and spread under a frequent fire regime. Fire exclusion in the last century has led to widespread encroachment of invasive alien and native shrubs into many Garry Oak meadows. This may have significantly reduced the preferred habitat of Foothill Sedge.

A number of factors may limit the survival and recovery of Foothill Sedge in Canada including:

- The rarity of Foothill Sedge may, in part, be the result of an intrinsic factor such as low competitive ability, limited recruitment, and limited dispersal ability.
- Specific habitat requirements (e.g., meadow and open woodland) combined with limited habitat availability.
- Basic population dynamics of Foothill Sedge have not been studied; however, as a slow-growing and long-lived plant, Foothill Sedge, similar to other organisms with slow growth and long lifespan, may be characterized by low intrinsic population growth rates (Roff 1992). This trait (if it applies) could make it difficult for Foothill Sedge to respond to sudden environmental disruptions or population declines (Meffe and Carroll 1994).

- High population fragmentation, in combination with small population sizes, may result in a loss of genetic diversity as well as reduce the potential for local rescue effects.

4. Threats

4.1. Threat Assessment

Table 1. Threat Assessment Table

Threat	Level of Concern ¹	Extent	Occurrence	Frequency	Severity ²	Causal Certainty ³
Alien, Invasive or Introduced Species						
Encroachment of invasive alien plants (herbs)	High	Widespread	Current	Continuous	High	Medium
Changes in Ecological Dynamics or Natural Processes						
Encroachment of native and invasive alien woody vegetation	High	Widespread	Current	Continuous	High	Medium
Grazing	Low	Localized	Current	Continuous	Low	Low
Habitat Loss or Degradation						
Habitat Conversion	High	Localized	Historic, current, anticipated	Unknown	Unknown	High
Disturbance or Harm						
Off-road vehicle traffic	Medium	Localized	Current	Recurrent	Medium	Medium
Mowing	Medium	Localized	Current	Seasonal	Medium	Medium
Pedestrian trampling	Low	Localized	Current	Recurrent	Low	Low
Climate and Natural Disasters						
Bank slumping	Low	Localized	Historic, possibility current	Continuous	Low	High

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. Alien, Invasive or Introduced Species

The most immediate threats to Foothill Sedge (Table 1) result from the influences of herbaceous invasive alien plant species which dominate most sites where it occurs. The identity of these invaders varies from site to site. Some, including many invasive alien grasses, have added significantly to the annual accumulation of thatch, which provides difficult germination conditions for Foothill Sedge. Tufted and rosette-forming perennial invasive alien plants compete for space while all invasive alien species compete for moisture and nutrients.

4.2.2. Changes in Ecological Dynamics or Natural Processes

Native woody shrubs including Common Snowberry (*Symphoricarpos albus*) and Nootka Rose (*Rosa nutkana*), and native conifers such as Douglas-fir (*Pseudotsuga menziesii*) have increased as a result of fire suppression, expanding into habitat formerly suited to Foothill Sedge. The population in a Saanich municipal conservation area appears to have been lost as the result of forest in-growth; correspondingly, other populations under dense tree cover have poor vigour.

Invasive alien woody shrubs such as Scotch Broom (*Cytisus scoparius*), Gorse (*Ulex europaeus*), Spurge-laurel (*Daphne laureola*) and Himalayan Blackberry (*Rubus armeniacus*) have created shrub lands in meadow areas which were formerly suited to Foothill Sedge. In most sites, fire suppression has allowed invasive alien woody species to become abundant, although they may now continue to flourish even if natural fire regimes were restored.

Native and invasive alien woody species present as great a threat as do invasive alien herbaceous species as they impose further threats such as shading and hydrological alterations. The severity of this threat varies from site to site. However, as it is present at most sites and has the potential for large population level effects (due to altering habitat suitability over a large area) it is of high concern.

The Sidney Spit population in the Gulf Islands has been heavily damaged by the intense grazing of a hyper abundant deer population. Fallow Deer (*Dama dama*) appear to be the main grazer, although Columbia Black-tailed Deer (*Odocoileus hemionus columbianus*) are also present and may also graze Foothill Sedge. While grazing by deer is detrimental to Foothill Sedge at this site, it does not appear to be the preferred browse species (observational evidence). Furthermore, while grazing is likely to remove reproductive structures, it is unlikely to kill individuals which are able to reproduce by underground rhizomes. Intense deer grazing on Sidney Spit has likely contributed to the maintenance of meadow habitat required by the Foothill Sedge. Accordingly, grazing is considered to be of low concern.

4.2.3. Habitat Loss or Degradation

Much of the habitat once suited to Foothill Sedge has been destroyed or converted by road construction, fire line maintenance, and facility development. The aforementioned developments continue a century-long trend that has seen the loss of more than 95% of Garry Oak ecosystems in the Victoria area (Lea 2006). Although most extant populations of Foothill Sedge are located on federal land and municipal park land, habitat conversion through infrastructure maintenance and operational practices remains of high concern. Habitat loss and conversion has the potential for severe population level effects through habitat fragmentation (i.e., population isolation), hydrologic alterations and damage/mortality to individuals.

4.2.4. Disturbance or Harm

Off-road vehicle use poses a serious threat in a small number of populations including those on Uplands Park in Oak Bay and Harewood Plains, a population near Nanaimo. Off-road vehicle traffic is prohibited at Uplands Park. However, tire tracks have been repeatedly observed throughout the park in areas occupied by Foothill Sedge. This threat can result in damage to

individual plants, soil erosion and compaction, and hydrologic and microsite alterations. Consequently, off-road vehicle use is considered to be of medium concern.

Mowing presents a serious threat to portions of the Foothill Sedge populations at Uplands Park and the University of Victoria. Decades of mowing at Rocky Point East appears to have improved Foothill Sedge habitat by reducing competition from invasive alien herbaceous and woody vegetation. However, where required, mowing should be minimal during the species' reproductive stages. While the threat of mowing has the potential to severely reduce plant growth and reproduction in a given population it is not occurring range wide. Accordingly, this threat is considered to be of medium concern.

Pedestrian traffic poses a localized threat in some sites, particularly Uplands Park and the University of Victoria. Pedestrian traffic can potentially damage individual plants, reduce growth and reproduction, and increase mortality yet their affects are of low concern. Foothill Sedge is a relatively large hardy perennial plant, and individual tussocks are generally scattered within an area of suitable habitat so at most, only one individual would be affected by any single trampling incident.

4.2.5. Climate and Natural Disasters

A small proportion of the Foothill Sedge populations at Uplands Park, Rocky Point East and West and Sidney Spit occur on slumping banks along the shoreline. Continuing erosion at these sites may lead to severe damage to individuals and microsites; however, as this threat only affects a small portion of the total population, the level of concern is low.

5. Population and Distribution Objectives

In Canada, Foothill Sedge is found in shrubby margins of vernal wet or moist meadows associated with Garry Oak ecosystems and as such has a naturally, highly restricted range. Within this range, significant habitat loss since European settlement (Lea 2006) has likely resulted in population reductions. Encroachment of vegetation, development, and effects resulting from recreational activities continue to exacerbate the situation (COSEWIC 2008). Given the permanent loss of most of the original habitat, it is not possible to recover the species to its natural area of occupancy or to its original probability of persistence. Today there are seven extant Foothill Sedge populations in Canada with fewer than 3,000 individuals (COSEWIC 2008).

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) sites, 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 Foothill Sedge, 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 seven extant Canadian populations and the distribution:

Objective 1: Maintain the seven extant populations of Foothill Sedge.

Objective 2: Prevent declines in the known distribution¹ of Foothill Sedge populations in Canada.

6. Broad Strategies and General Approaches to Meet Objectives

Broad strategies and approaches to meet the population and distribution objectives for Foothill Sedge include:

- *Habitat and species protection*: protect extant populations and their habitat from destruction (e.g., habitat conversion) by developing mechanisms/instruments for protection;
- *Stewardship*: engage landowners to understand the species' needs and support recovery activities for the species;
- *Monitoring*: habitat attributes and threat management;
- *Research*: address knowledge gaps relating to the species or habitat management techniques;
- *Public outreach and education*: provide general public education and outreach to increase interest in the protection and stewardship of the species and alter general public behaviour;
- *Population monitoring*: inventory and monitoring related to locating and describing trends for populations; and
- *Population restoration*: develop and test population establishment/augmentation techniques.

¹ Distribution is measured by the extent of occurrence (currently about 1700km²) and area of occupancy (currently estimated at 10km²) (COSEWIC 2008). If new populations are discovered, these baseline figures should be updated as required.

6.1. Strategic Direction for Recovery

Table 2. Recovery Planning Table

Threat or Limitation	Priority	Broad Strategy to Recovery	General Description of Research and Management Approaches
Habitat conversion	High	Habitat and species protection	<ul style="list-style-type: none"> • Identify protection mechanisms under local, provincial, and federal regulations and policies in consultation with affected parties.
Encroachment of invasive alien plants (herbs)	High	Stewardship	<ul style="list-style-type: none"> • Engage landowners in recovery decisions and activities. • Increase landowner awareness of Foothill Sedge and its needs. • Develop and communicate Best (Beneficial) Management Practices to landowners and land managers. • Investigate various avenues for protecting populations and habitat through stewardship and other voluntary measures. • Develop site-specific management plans using information gained from demographic research to manage habitat so as to enable critical life stages (e.g., recruitment, growth, and survival) necessary for population growth.
Encroachment of native and invasive alien woody vegetation			
Bank slumping			
Mowing			
Grazing	Medium	Monitoring	<ul style="list-style-type: none"> • Monitor impacts of recovery activities on non-target species, communities, and ecological processes. • Develop habitat assessment and inventory protocols. • Monitor habitat trends.
Off-road vehicle traffic	Medium	Public education and outreach	<ul style="list-style-type: none"> • In conjunction with landowners, assess the desirability of establishing signage and interpretative trails, as well as the need for educational material on the species for the general public. • Improve enforcement of existing park use bylaws and introduce new bylaws as necessary.
Pedestrian trampling			

Threat or Limitation	Priority	Broad Strategy to Recovery	General Description of Research and Management Approaches
<p>Knowledge gaps: Population size and extent</p> <p>Population dynamics and habitat requirements</p>	Medium	Population monitoring	<ul style="list-style-type: none"> • Further inventory focused on coastal areas between Victoria and Sooke, the Nanaimo area, and the Southern Gulf Islands. • Additional surveys in: (1) areas of apparently suitable habitat adjacent to known populations (e.g., Rocky Point and Harewood Plains); (2) areas within known Foothill Sedge populations where mowing/grazing has prevented the determination of the true population size and extent (e.g., Sidney Spit, Uplands Park, and University of Victoria); and (3) areas where new Foothill Sedge populations have been recorded and population and distribution data has yet to be collected. • Design and implement an inventory and monitoring program to track population trends for 10 years, with subsequent monitoring as required. • Report on population trends, area of occupancy, and habitat condition every five years. • Identify criteria with respect to rate of population decline (size/distribution) that would trigger immediate re-evaluation of recovery priorities and activities, and incorporate them into the management plans.
	Medium	Research	<ul style="list-style-type: none"> • Identification of life stages most prone to mortality; determination of soil seed bank longevity; determination of necessary conditions for germination; and establishment and identification of the population size necessary for long-term viability. • Identify suitable unoccupied habitat with the potential for supporting Foothill Sedge translocations, rank for suitability and recovery potential.
Knowledge gaps on population augmentation techniques	Low	Population restoration	<ul style="list-style-type: none"> • Use monitoring and other research results to determine if/when population augmentation is required to meet the population and distribution objectives. • Develop a potential population augmentation and translocation plan consistent with guidelines recently developed for the Garry Oak Ecosystems Recovery Team (Maslovat 2006). • Monitor impacts of any augmentation on non-target species, communities, and ecological processes.

6.2. Narrative to Support the Recovery Planning Table

6.2.1. Habitat conversion

Given the extreme rarity of Foothill Sedge in Canada, and uncertainties regarding the potential for introducing the species into unoccupied areas, protecting existing populations is clearly a first priority of recovery (Table 2). Diligence must be exercised in preventing extirpations due to preventable causes (including benign neglect). Ensuring proper environmental conditions for plant growth and establishment will be the most straightforward and cost-effective way of ensuring species persistence and meeting population and distribution objectives and will be a top priority of recovery.

6.2.2. Encroachment of Invasive Alien Plants (Herbs), Encroachment of Native and Invasive Alien Woody Vegetation, Bank Slumping, Mowing and Grazing

Site-specific management plans will focus on achieving measurable, sustained reductions in forest and woody shrub in-growth at degraded extant sites, increased control of invasive alien species, and improved landscape connectivity between occupied sites.

Although the species may be dependent on some form of disturbance for survival, not all disturbances are beneficial. More research is required to determine the impacts of vegetation management.

6.2.3. Off-Road Vehicle Traffic and Pedestrian Trampling

In order to mitigate the threats imposed by intensive public use at some of the Foothill Sedge sites, public support and involvement is necessary. Current damaging land use practices will need to be redirected so that activities are compatible with the needs of the Foothill Sedge.

6.2.4. Knowledge Gaps: Population Size and Extent, and Population Dynamics And Habitat Requirements

Regular population surveys and monitoring are needed to assess the true extent of Foothill Sedge and determine its ongoing viability and response to threats and management activities. In order to evaluate changes in populations over time, it is important that the inventory and monitoring methods chosen are appropriate for Foothill Sedge and are sufficiently robust for application in different areas and different years by different people. They should be accurate enough to detect change (i.e., acceptable levels of error), consistently applied across the range of the species to allow comparison, practical, economically feasible, and sustainable. They should be conducted frequently enough to allow conservation managers to distinguish trends from fluctuations and should be timed such that responses to management actions can be rigorously tested.

Demographic studies should be conducted in order to determine basic population processes and identify key life stages. In order to determine the full extent of Foothill Sedge in Canada, additional surveys are needed (1) in areas where the species has been difficult to detect due to mowing regimes, (2) in areas of apparently suitable habitat adjacent to known populations and (3) in areas where the species has been previously recorded but is considered extirpated.

6.2.5. Knowledge Gaps: Propagation Techniques

Artificial augmentation will only be considered if population and distribution objectives cannot be met first through other recovery activities such as site protection and habitat management. In the event demographic intervention is required to safeguard populations from extirpation, or to replace an extirpated occurrence, it is recommended that a plan be developed for population augmentation and translocation.

7. Critical Habitat

Areas of critical habitat for Foothill Sedge are identified in this recovery strategy. Critical habitat is defined in the *Species at Risk Act* as “the 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 the Foothill Sedge is identified in this recovery strategy to the extent possible based on the best available information. This habitat is believed to be sufficient for the recovery of the Foothill Sedge; however, more precise boundaries may be mapped, and additional critical habitat may be added in the future if additional research supports the inclusion of areas beyond those currently identified.

On Vancouver Island and the Gulf Islands, the habitat of Foothill Sedge is openings in Garry Oak woodlands or associated non-forest ecosystems. To further characterize habitat of the species, critical habitat attributes of known Foothill Sedge populations were refined based on field surveys conducted in 2009 (Fairbarns unpublished data 2009).

The Foothill Sedge depends directly on canopy openings to provide certain habitat attributes. Although Foothill Sedge plants have been found growing under tree canopies, these shaded areas are not optimum growing conditions for Foothill Sedge as moderately high levels of light are required by the species. Minimum canopy openings must be large enough that Foothill Sedge plants are not sheltered by surrounding vegetation, nor smothered by tree blow down. When tall vegetation falls it will cover an area of ground for a distance equal to its height. The minimum size of openings can be determined based on the height of vegetation likely to grow in the area and cast shade or smother the Foothill Sedge (e.g., Spittlehouse *et al.* 2004). The presence of surrounding vegetation (e.g., trees and shrubs) within these canopy openings will also compete with Foothill Sedge for water and nutrients.

To accommodate the need for additional surveys and natural recruitment of new individuals in known populations, critical habitat is identified within the geographical boundaries in Figure 3 to 8. Critical habitat for the survival of extant Foothill Sedge populations consists of the minimum

canopy opening supporting each recorded tussock or patch² of tussocks. The default canopy opening required for light to reach the plants is the area bounded by a 20 m distance surrounding each tussock or patch of tussocks in all directions (20 m is generally the maximum height attained by trees in the soils surrounding Foothill Sedge). At Harewood Plains where the average height attained by conifers in the habitat surrounding the Foothill Sedge population is 10 m, a lower value of 10 m instead of the default 20 m is used to define the minimum canopy opening.

The nature of the habitat for Foothill Sedge varies substantially among Canadian sites and most of the larger populations occur throughout a diversity of microhabitats. Consequently, while the critical habitat attributes listed below are broad enough to include all sites, they do not exclude unsuitable habitat and should not be used as a basis for critical habitat identification.

Critical habitat attributes of extant Foothill Sedge sites are as follows:

- Elevations between 0 to 100 m above sea level on lower slopes to level terrain.
- Open sites with short or sparse vegetation (tree/shrub cover appears to be associated with a decline in habitat quality).
- Moderately well to well drained soil.
- Glaciomarine clay or loam at a depth of no less than 10 cm.

²A patch is a term used in the status report to refer to groups of several tussocks confined to a relatively small area. For the purposes of this recovery strategy, the identification of patches is based on survey work performed by a botanist familiar with the species.

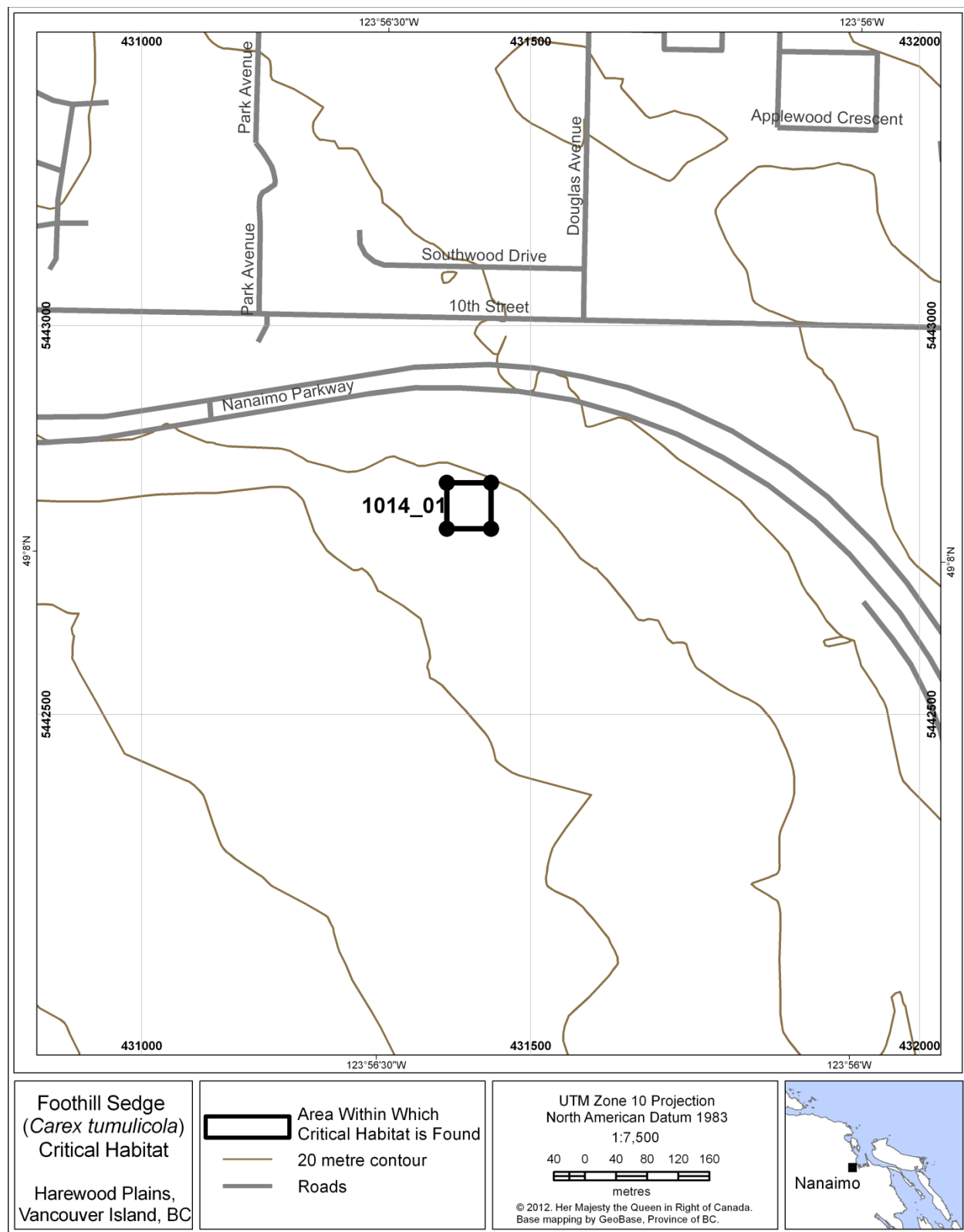


Figure 3: Area (0.34 ha) within which critical habitat for Foothill Sedge is found at Harewood Plains, Nanaimo. This area is on non-federal lands.

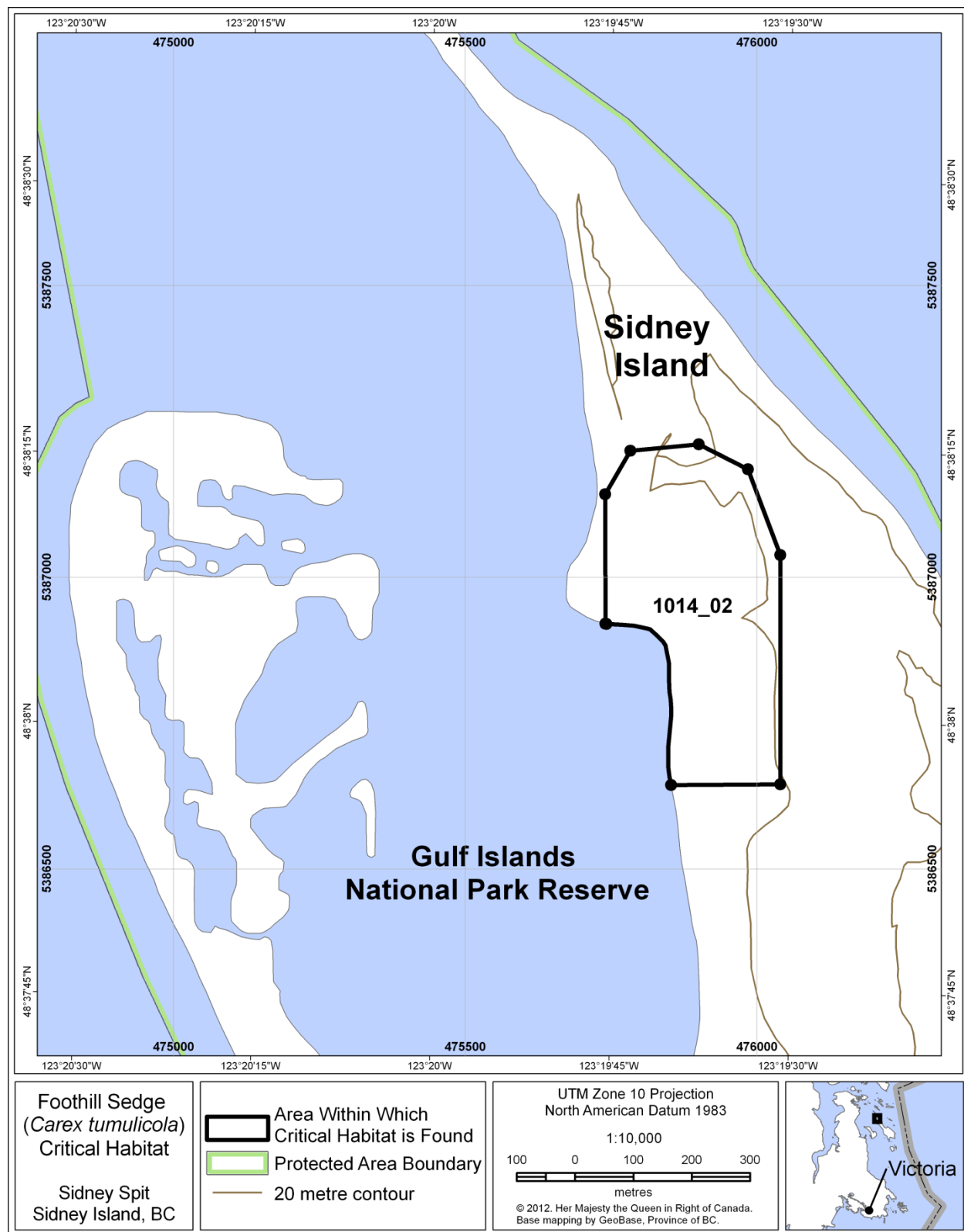


Figure 4: Area (13.48 ha) within which critical habitat for Foothill Sedge is found at Sidney Spit, Sidney Island. This area is on federal lands.

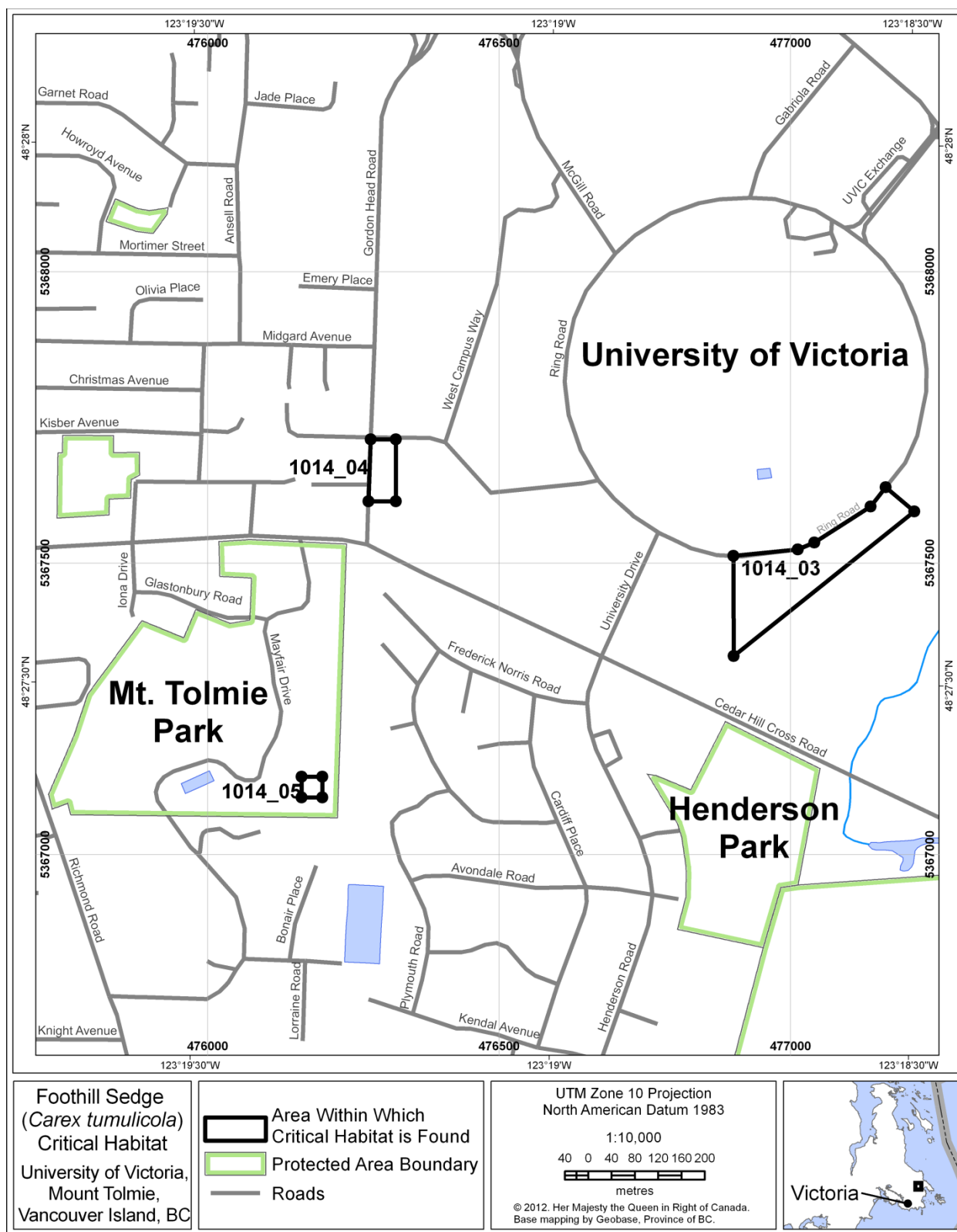


Figure 5: Total area (3.4ha) within which critical habitat for Foothill Sedge is found at the University of Victoria and Mt. Tolmie. These areas are on non-federal lands.

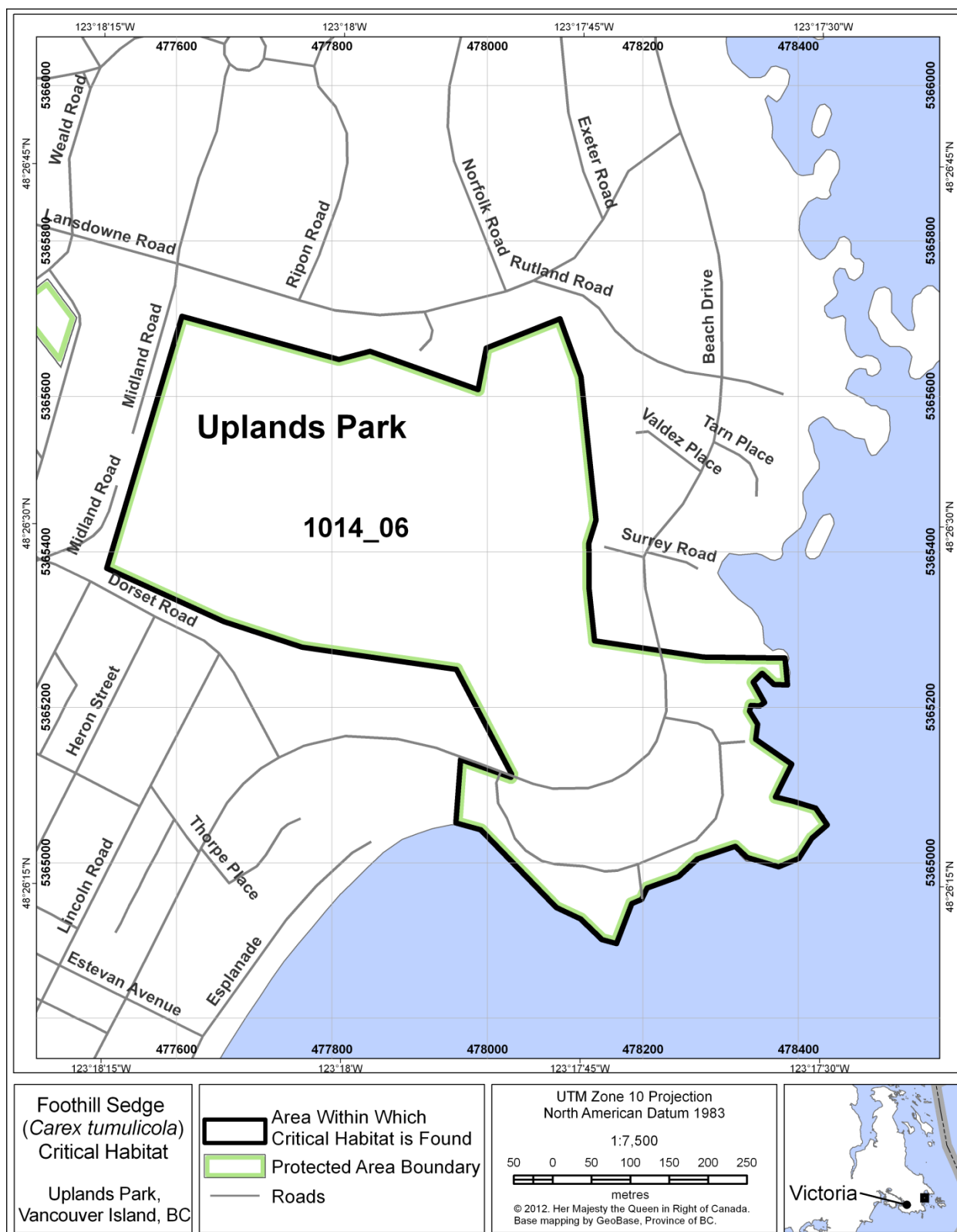


Figure 6: Area (33.7 ha) within which critical habitat for Foothill Sedge is found at Uplands Park. This area is on non-federal lands.

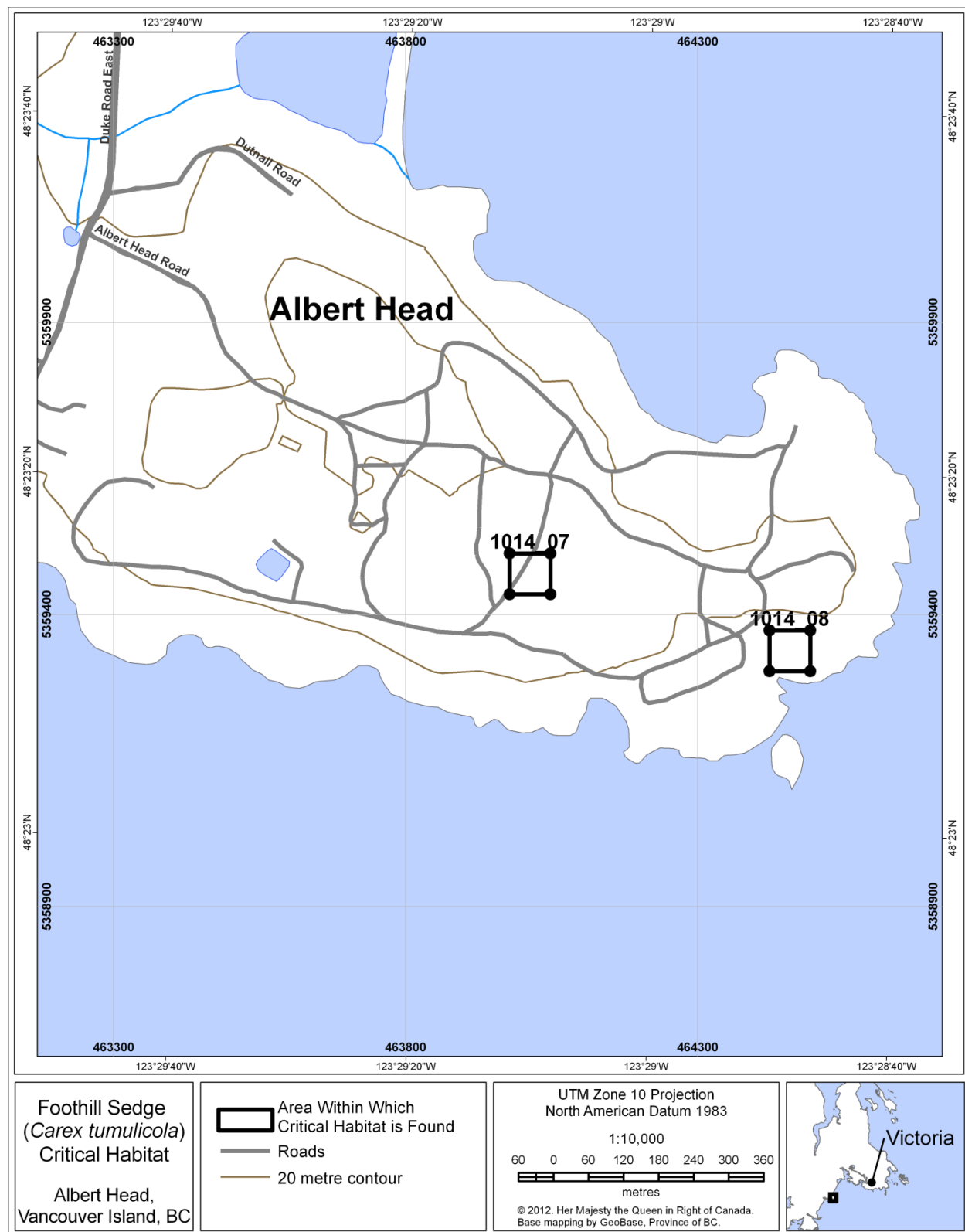


Figure 7: Total area (0.98 ha) within which critical habitat for Foothill Sedge is found at Albert Head. This area is on federal lands.

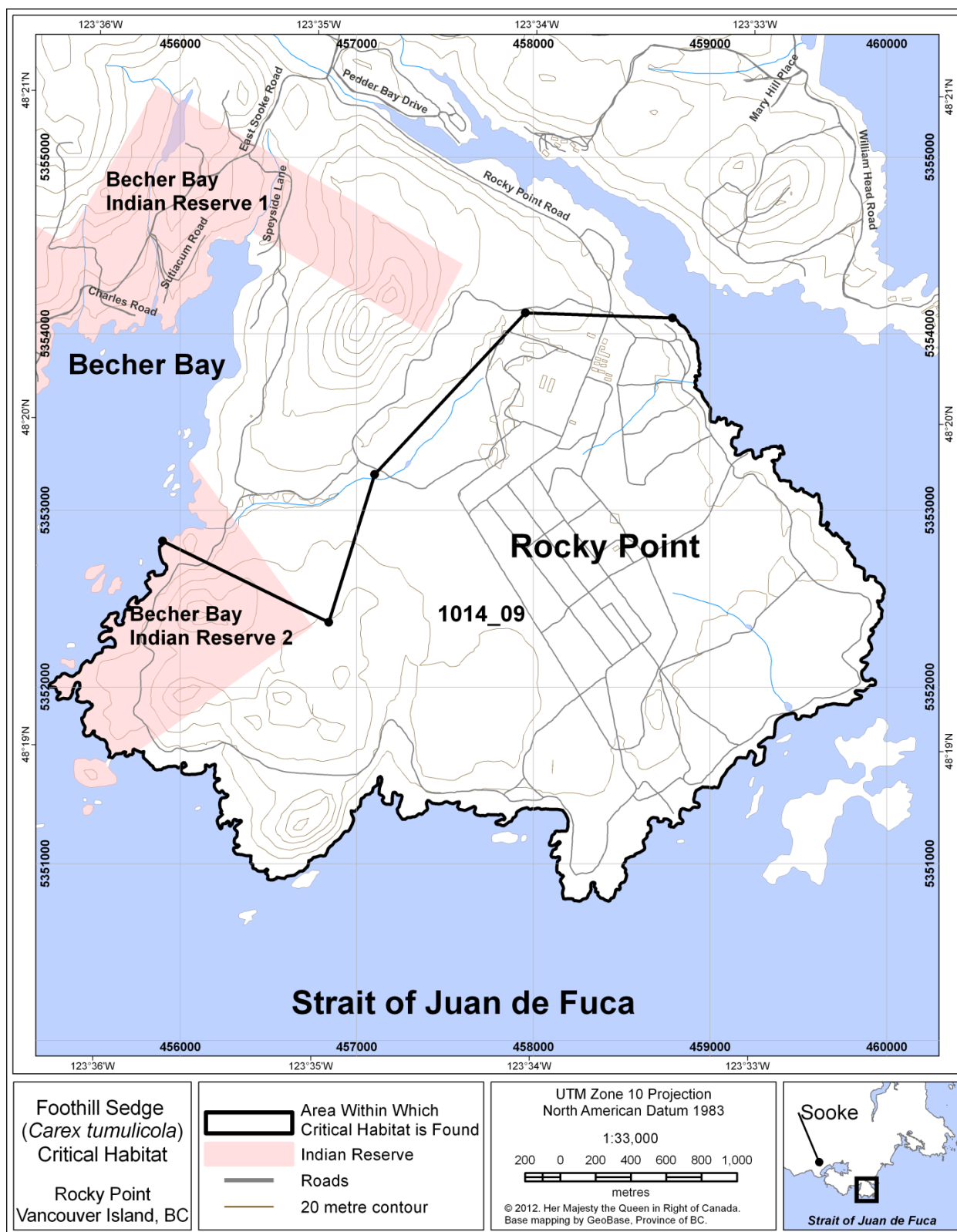


Figure 8: Area (843.8 ha) within which critical habitat for Foothill Sedge is found at Rocky Point. This area is on federal and Indian Reserve lands.

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

Examples of activities likely to destroy critical habitat are provided below (Table 3). 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. It is important to note that some activities have the potential to destroy critical habitat from outside the critical habitat.

Table 3. Examples of activities likely to result in the destruction of critical habitat.

Activity	Effect of activity on critical habitat	Most likely sites
Landscaping and development (e.g., planting, development and maintenance or modification of existing structures, roads or trails)	These activities can cause direct land conversion, soil compaction, shading (e.g., by introduced plants or nearby structures), and introduction of invasive alien species (e.g., intentional plantings or accidental introductions facilitated by contaminated machinery (see recreational use for effect of invasive alien species). Some construction activities may destroy critical habitat even if they occur outside of the critical habitat. For example, tall buildings may cast shade on individual plants. Also, some activities such as road or trail construction, ditching, or irrigation may alter hydrological regimes within the critical habitat area.	University of Victoria, Rocky Point (East and West), Uplands Park , Harewood Plains
Damaging recreational use (e.g., off-road vehicle traffic and intensive walking, cycling, and camping activities).	Soil compaction and loss of vegetation leading to changes in hydrology (such as decreased infiltration and increased runoff). Habitat is likely to be directly lost due to increased erosion and plants may become stressed and die due to impaired ability of the habitat to provide a suitable moisture regime. In addition, this activity is likely to introduce or spread invasive alien plant species. Invasive alien plant species compete with Foothill Sedge and alter the availability of light, water, and nutrients in the habitat, such that the habitat would not provide the necessary habitat conditions required by Foothill Sedge.	Sidney Spit, Uplands Park, Harewood Plains, University of Victoria, Mt. Tolmie

8. Measuring Progress

The performance indicators presented below provide a way to define and measure progress toward achieving the population and distribution objectives. Progress towards meeting the population and distribution objectives for Foothill Sedge in Canada will be measured using the following indicators:

Objective 1: Maintain the seven extant populations of Foothill Sedge.

- By 2018, best management practices are developed and implemented at three or more sites.
- The populations remain extant.
- By 2023, all populations show a stable or increasing trend in population size.

Objective 2: Prevent declines in the known distribution of Foothill Sedge populations in Canada.

- There is no decrease in the known distribution (extent of occurrence and area of occupancy) of Foothill Sedge in Canada.

9. Statement on Action Plans

One or more action plans will be completed by 2018.

10. References

- Brook, B.W., L.W. Traill, and J.A. Bradshaw. 2006. Minimum viable population sizes and global extinction risk are unrelated. *Ecology Letters* 9:375-382.
- COSEWIC. 2008. COSEWIC assessment and status report on foothill sedge *Carex tumulicola* in Canada. Committee on the Status of Endangered Wildlife in Canada. Ottawa. vi + 37 pp.
- COSEWIC (Committee on the Status of Endangered Wildlife in Canada). 2010. COSEWIC's Assessment Process and Criteria. Web Site: http://www.cosewic.gc.ca/pdf/assessment_process_e.pdf [accessed Feb 2012].
- GOERT. 2002. Recovery Strategy for Garry Oak and Associated Ecosystems and Their Associated Species at Risk in Canada, 2001-2006. Draft 20 February 2002. Garry Oak Ecosystems Recovery Team, Victoria, BC. 115 pp.
- Flather, Curtis H., Gregory D. Hayward, Steven R. Beissinger, and Philip A. Stephens. 2011. Minimum viable populations: is there a 'magic number' for conservation practitioners? *Trends in Ecology and Evolution* 26: 307-316.
- Fuchs, M.A. 2001. Towards a Recovery Strategy for Garry Oak and Associated Ecosystems in Canada: Ecological Assessment and Literature Review. Technical Report GBEI/EC-00-0300. Environment Canada, Canadian Wildlife Service, Pacific and Yukon Region. 106 pp.
- Garnett, S.T., and K.K. Zander. 2011. Minimum viable population limitations ignore evolutionary history. *Trends in Ecology and Evolution* 26(12): 618-619.
- Government of Canada. 2009. Species at Risk Act Policies: Overarching Policy Framework [Draft]. Pp ii+ 38pp. in Species at Risk Act Policies and Guidelines Series, Environment Canada. Web site: http://www.sararegistry.gc.ca/document/default_e.cfm?documentID=1916 [accessed December 2010].
- Jamieson, I.G., and F. W. Allendorf. 2012. How does the 50/500 rule apply to MVPs? *Trends in Ecology and Evolution*, Online, 1566: 1-7.
- Jungen, J.R. 1985. Soils of southern Vancouver Island: Technical Report 17, Report N. 44. British Columbia Soil Survey, Surveys and Resource Mapping Branch, British Columbia Ministry of Environment, Victoria.
- Lea, T. 2006. Historical Garry Oak Ecosystems of Vancouver Island, British Columbia, pre-European Contact to the Present. *Davidsonia* 17:34-50.

- Maslovat, C. 2006. Guidelines for translocation of plant species at risk in British Columbia. Unpublished report prepared for British Columbia Ministry of Environment, Victoria. 60 pp.
- Meffe, G. K. and C. R. Carroll. 1994. Principles of conservation biology. Sinauer Associates, Sunderland, Mass. 600 pp.
- NatureServe. 2010. NatureServe Explorer: An online encyclopedia of life [web application]. Version 7.1. NatureServe, Arlington, Virginia. Web site: <http://www.natureserve.org/explorer> [accessed November 12, 2010].
- Parks Canada Agency. 2006a. Recovery Strategy for Multi-species at Risk in Maritime Meadows Associated with Garry Oak Ecosystems in Canada. xii + 93 pp. in Government of Canada. Species at Risk Act Recovery Strategy Series, Ottawa, Ontario.
- Parks Canada Agency. 2006b. Recovery Strategy for Multi-Species at Risk in Garry Oak Woodlands in Canada. x + 59 pp. in Government of Canada. Species at Risk Act Recovery Strategy Series, Ottawa, Ontario.
- Roff, D.A. 1992. The evolution of life histories: Theory and Analysis. Chapman and Hall, New York, NY. xii + 535 pp.
- Reed, D.H. 2005. Relationship between population size and fitness. *Conservation Biology* 19:563-568.
- Spittlehouse, D. L., R.S. Adams, and R.D. Winkler. 2004. Forest, edge and opening microclimate at Sicamous Creek: Research Report 24. British Columbia Ministry of Forests, Research Branch, Victoria, B.C. vii+ 43 pp. Web site: <http://www.for.gov.bc.ca/hfd/pubs/Docs/Rr/Rr24.htm> [accessed November 2011].
- Trall, L.W., C.J.A. Bradshaw, and B.W. Brook. 2007. Minimum viable population size: A meta-analysis of 30 years of published estimates. *Biological Conservation* 139:159-166.
- Trall, Lochran W., Barry W. Brook, Richard R. Frankham, and Corey J.A. Bradshaw. 2009. Pragmatic population viability targets in a rapidly changing world. *Biological Conservation* 143(1):28-34.

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.

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 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.

Foothill Sedge tends to occur in the same habitats as many other species at risk found in Garry Oak and associated ecosystems (Table 4). Most recovery activities proposed for Foothill Sedge (e.g., site protection and threat mitigation) can be expected to have a net positive effect on the habitat of these other non-target species and communities. Nevertheless, it is possible that specific management actions carried out during the course of Foothill Sedge recovery (e.g., invasive alien plant species removal, shrub clearing, mowing, population augmentation, or species translocations) could have unforeseen collateral effects on co-occurring non-target species and ecosystems. While probably slight, the chances of negative effects accruing due to recovery activities must be duly considered. In keeping with the principles of adaptive management, an important component of recovery action planning will be anticipating and monitoring potential collateral effects (both positive and negative) on non-target species, communities, and ecological processes.

To ensure that recovery actions for one species do not unduly hinder the recovery of another, collaboration with key conservation partners such as the Garry Oak Ecosystems Recovery Team and appropriate government agencies is essential.

Table 4. Partial list of non-target plant species at risk potentially affected by recovery activities.

Species	Provincial rank	COSEWIC status	SARA schedule	GOERT or SARA recovery planning document potentially affected
<i>Allium amplexans</i> Slim-leaf Onion	S3 Blue	Not assessed		Yes
<i>Bidens amplissima</i> Vancouver Island Beggarticks	S3 Blue	SC	1	Yes
<i>Callitriche marginata</i> Winged Water-starwort	S1 Red	Status pending		Yes
<i>Centaureum muehlenbergii</i> Muhlenberg's Centaury	S1 Red	E		Yes
<i>Crassula connata</i> var. <i>connata</i> Erect Pygmyweed	S2 Red	Not assessed		Yes
<i>Epilobium densiflorum</i> Dense Spike-primrose	S1 Red	E	1	Yes
<i>Helenium autumnale</i> var. <i>grandiflorum</i> Mountain Sneezeweed	S2S3 Blue	Not assessed		No
<i>Juncus kelloggii</i> Kellogg's Rush	S1 Red	E	1	Yes
<i>Limnanthes macounii</i> Macoun's Meadowfoam	S2 Red	T	1	Yes
<i>Lotus formosissimus</i> Seaside Birds-foot Lotus	S1 Red	E	1	Yes
<i>Lotus pinnatus</i> Bog Bird's-foot Trefoil	S1 Red	E	1	Yes
<i>Minuartia pusilla</i> Dwarf Sandwort	S1 Red	E	1	Yes
<i>Orthocarpus bracteatus</i> Rosy Owl-clover	S1 Red	E	1	Yes
<i>Psilocarphus elatior</i> Tall woolly-heads	S1 Red	E	1	Yes
<i>Ranunculus alismifolius</i> var. <i>alismifolius</i> Water-plantain Buttercup	S1 Red	E	1	Yes
<i>Ranunculus californicus</i> California Buttercup	S1 Red	E		Yes
<i>Sanicula bipinnatifida</i> Purple Sanicle	S2 Red	T	1	Yes
<i>Triphysaria versicolor</i> ssp. <i>versicolor</i> Bearded Owl-clover	S1 Red	E	1	Yes