PROPOSED

Species at Risk Act
Recovery Strategy Series

Recovery Strategy for the Smooth Goosefoot (*Chenopodium subglabrum*) in Canada

Smooth Goosefoot

2014

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

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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 is the competent minister under SARA for the Smooth Goosefoot and has prepared this strategy, as per section 37 of SARA. To the extent possible, it has been prepared in cooperation with:

1) provincial jurisdictions in which the species occurs – Manitoba, Saskatchewan, Alberta and British Columbia
2) Federal land managers – Department of National Defence (Canadian Forces Base Suffield), Agriculture and Agri-Food Canada - Agri-Environment Services Branch (previously known as Prairie Farm Rehabilitation Administration).

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 any other jurisdiction alone. All Canadians are invited to join in supporting and implementing this strategy for the benefit of the Smooth Goosefoot 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 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.

Acknowledgments

The recovery strategy was prepared by Candace Neufeld (Environment Canada). The document was prepared in cooperation with the Recovery Team for Plants at Risk in the Prairie Provinces (see Section 11 for present members). Valuable reviews were also provided by K. Sadler, M. Wayland, A. Hassan, and W. Dunford of Environment Canada, J. Gould (Alberta Tourism, Parks and Recreation), P. Fargey (Alberta Environment and Sustainable Resource Development), and Leah Westereng (BC Ministry of Environment), SK Ministry of Environment and SK Ministry of Agriculture. Acknowledgement and thanks is given to all other parties who expressed an interest in the recovery strategy, and/or who provided advice and input used to help inform the development of this recovery strategy, including various Aboriginal organizations and individuals who attended meetings. The Saskatchewan Conservation Data Centre, Alberta Conservation Information Management System and the Manitoba

Conservation Data Centre provided updated element occurrences for this species. The co-operation of all the landowners, lessees and land managers who granted access to their land to do surveys and who continue to provide habitat for species at risk is greatly appreciated.

Executive Summary

- Smooth Goosefoot is an annual plant in the Goosefoot family with green flowers in widely-spaced clusters, erect and branching stems, and shiny black seeds. In Canada, it is associated with semi-arid sand dune complexes in Manitoba, Saskatchewan, Alberta and British Columbia.

- Currently there are 45 confirmed populations in Canada with 3 in Manitoba, 29 in Saskatchewan, 12 in Alberta and 1 in British Columbia, along with 5 historic, 6 unconfirmed and 1 likely extirpated population. In 2013, the Canadian population was estimated to be over 11,140 plants that year. Smooth Goosefoot was listed as Threatened under the *Species at Risk Act* in 2007.

- Additional loss of habitat quantity or quality among the known populations of Smooth Goosefoot could adversely affect the species' survival in Canada. Threats are mainly related to loss or degradation of habitat from the following: alteration to, or suppression of, natural grazing and/or fire regimes; invasive alien species; prolonged wet climatic periods; cultivation; oil and gas activities; sand and gravel extraction; recreational activities; military activities; erosion or flooding.

- Recovery of Smooth Goosefoot is deemed biologically and technically feasible. The population and distribution objectives are to maintain extant naturally occurring populations and any newly-discovered naturally occurring populations within the current range of Smooth Goosefoot in Canada. Broad strategies to be taken to address the threats to the survival and recovery of Smooth Goosefoot are presented in the section on Strategic Direction for Recovery.

- Critical habitat is identified for all known and confirmed naturally occurring Smooth Goosefoot populations in Canada. Smooth Goosefoot habitat is restricted to sand dune complexes and other sandy deposits in an early transitional state between recently disturbed (active sand) and fully stabilized sand, where low densities of early colonizing grasses and forbs occur, with some amount of moving sand and little to no shrub or forest overstory. Critical habitat consists of the occurrence, plus all natural landforms, soil and native vegetation within a 300 m critical function zone of the occurrence.

- One or more action plans for Smooth Goosefoot will be posted on the Species at Risk Public Registry by 2019.

Recovery Feasibility Summary

Under the *Species at Risk Act* (Section 40), the competent minister is required to determine whether the recovery of the listed species is technically and biologically feasible. Based on the following criteria outlined by the Government of Canada (2009) for recovering species at risk, recovery of the Smooth Goosefoot (*Chenopodium subglabrum*) is considered biologically and technically feasible.

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. Currently, there are 45 naturally occurring Smooth Goosefoot populations in Canada which are successfully reproducing. Under proper management regimes, individuals are likely to continue to reproduce and persist at these sites as they have historically. Future targeted surveys should result in the discovery of additional occurrences or populations although substantial increases are not likely.

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

   Yes. Suitable habitat currently exists where extant populations occur and with proper management the habitat should be sufficient to maintain species persistence at current levels, with natural population fluctuations. Beneficial management practices have the potential to maintain and enhance Smooth Goosefoot habitat, possibly creating additional suitable habitat within the management area.

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

   Yes. The main threats to Smooth Goosefoot recovery are those contributing to losses of habitat quality and quantity. Dune stabilization and habitat succession are driven by a combination of climatic change (e.g. prolonged wet climatic periods) as well as alteration to, or suppression of, natural grazing and/or fire regimes, invasive alien species, cultivation, and oil/gas activities. Threats directly attributable to human activity can be mitigated through beneficial management practices, protection, or stewardship of species and their habitat. Predominant climatic conditions, as well as erosion or natural flooding can exacerbate anthropogenic threats.

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

   Yes. Recovery techniques related to habitat conservation and adaptive habitat management can be implemented. Twenty populations currently occupied by Smooth Goosefoot are in areas that are, or could be, managed for conservation using above-mentioned approaches and beneficial management practices, such as

provincial parks, National Wildlife Areas, Agriculture and Agri-Food Canada Community Pastures, or ecologically significant areas; however, the AAFC Community Pastures are being divested and the future land management is currently unknown. Remaining areas could be secured through stewardship arrangements and implementing beneficial management practices with public and private landowners.

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1. COSEWIC[1,2] SPECIES ASSESSEMENT INFORMATION

Date of Assessment: April 2006

Common Name (population): Smooth Goosefoot

Scientific Name: *Chenopodium subglabrum*

COSEWIC Status: Threatened

Reason for Designation: An herbaceous annual with fluctuating populations of relatively small size. The species is restricted to areas of active sand habitats in southern Alberta, Saskatchewan and Manitoba. Current risks to the species include sand dune stabilization, invasive species, oil and gas development and recreational activities.

Canadian Occurrence: AB, SK, MB

COSEWIC Status History: Designated Special Concern in April 1992. Status re-examined and designated Threatened in April 2006.

[1] *COSEWIC (Committee on the Status of Endangered Wildlife in Canada)*
[2] *Since the 2006 COSEWIC assessment, Smooth Goosefoot has been found in BC as well.*

2. Species Status Information

In Canada, Smooth Goosefoot is listed as threatened under Schedule 1 of the *Species at Risk Act* (SARA). It is also protected on all lands in Manitoba where it is listed as endangered under the provincial *Endangered Species Act*. The conservation status of Smooth Goosefoot throughout its range is described in Table 1.

Table 1. Conservation status of Smooth Goosefoot (NatureServe 2013a).

Global (G) Rank[1]	National (N) Rank[1]	Sub-national (S) Rank[1]
G3G4	Canada: N2 United States: N3N4	Canada: Manitoba (S1), Saskatchewan (S2), Alberta (S1), British Columbia (S1) United States: Colorado (SNR), Kansas (SH)[2], Michigan (SNA), Montana (S2), Nebraska (S3S4), Nevada (SNR)[3]^, North Dakota (S1), South Dakota (S2), Utah (SNR), Washington (SNA), Wyoming (S3)[4]

[1]Rank 1– critically imperiled; 2– imperiled; 3- vulnerable to extirpation or extinction; 4- apparently secure; 5– secure; H– possibly extirpated; NR – status not ranked; NA – not applicable (species is not a suitable target for conservation activities)
[2] The status in Kansas is reported as possibly extirpated in NatureServe (2013a) but COSEWIC (2006) reports that the herbarium curator in Kansas confirmed there are no records of this species in their herbarium or state; Kansas is not included in the Flora of North America distribution map (Clements and Mosyakin 2004).
[3] Washington, Iowa and Nevada are listed as introduced in Kartesz (2013) but not indicated as such in the Flora of North America (Clements and Mosyakin 2004); Iowa is not listed in NatureServe (2013a) other than in range extent comments.
[4] *USDA also has Oregon, Ohio and Minnesota on their range map (USDA, 2013).*

It is possible that upwards of 30-40% of the Smooth Goosefoot global range is in Canada; however, this estimate may be an overestimate as Smooth Goosefoot populations are not tracked in the U.S. states where it is common.

3. Species Information

3.1 Species Description

Smooth Goosefoot is a shallow-rooted annual herb from the Goosefoot family (Chenopodiaceae). It is erect and branching with an airy look, growing to 10-55 (80) cm high (Clements and Moyakin 2004; COSEWIC 2006). Leaves are alternate, fleshy, one-veined, hairless and almost or entirely lacking the mealiness (whitish scales) common to most goosefoots. Flowers are small, with only 5 green tepals (no petals), and are in rounded clusters (glomerules) that are widely spaced along the upper, leafy branches. Seeds are lens-shaped, black, shiny, and do not remain stuck to the fruit wall when ripe (Clements and Moyakin 2004). The whole plant has a yellowish green coloration, turning reddish as the plant matures in August or September.

Figure 1. Smooth Goosefoot © Environment Canada, Photo: C. Neufeld.

3.2 Population and Distribution

The range of Smooth Goosefoot in North America has a discontinuous distribution with questionable presence in some U.S. states, but confirmed as far south as Utah and Colorado, and ranging in Canada from British Columbia to Manitoba (Fig. 2).

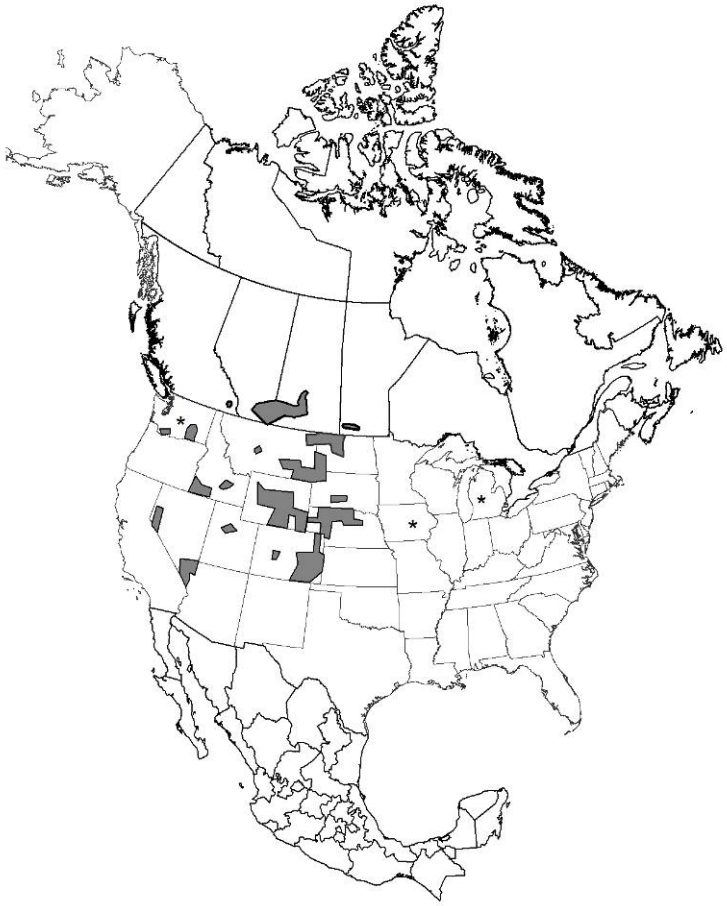

Figure 2. Current range of Smooth Goosefoot in North America [U.S. data adapted from USDA (2013), Clements and Mosyakin (2004), and Kartesz (2013). Gray areas represent county boundaries containing Smooth Goosefoot; the stars indicate possible introduced populations. Refer to Table 1 for discrepancies].

Smooth Goosefoot has a relatively large Canadian range (COSEWIC 2006; Figure 3), occurring in Manitoba (MB), Saskatchewan (SK), Alberta (AB) and British Columbia (BC). However, in the four provinces where it occurs, it has a small area of occupancy[2]. This is because the species is restricted to specialized habitat in localized sand dune complexes, and occurs in small populations[3] that can vary in size and area from year to year because of its annual habit and climatic factors.

[2] Area of occupancy is the portion within or range of a species that is actually occupied by the species (COSEWIC 2013). For the purpose of this recovery strategy, an occurrence is a grouping of plants separated from another grouping of plants, either temporally or spatially, and sometimes referred to as a patch, source feature, or sub-element occurrence. Each population is composed of one or more occurrences.

[3] For the purposes of this recovery strategy, an element occurrence in a dynamic landscape mosaic as defined by NatureServe (2013b) will be equivalent to a population.

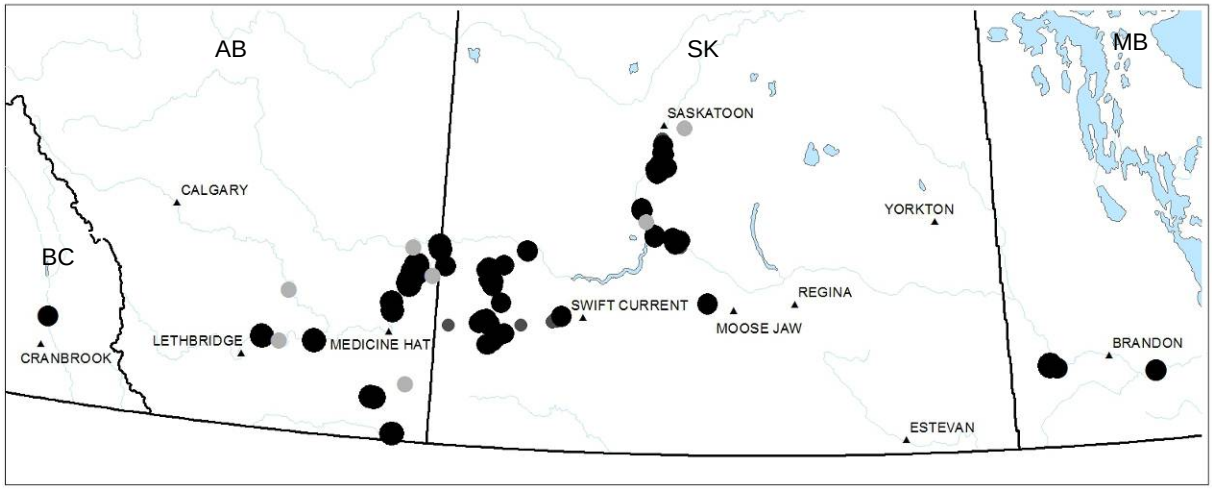

Figure 3. Range of Smooth Goosefoot in Canada. [Note: Large black circles are known, extant populations, light gray circles are historic populations and dark gray circles are unconfirmed populations. Overlap of populations (circles) is due to the scale of the map.]

Targeted surveys in the last few years have increased the knowledge of Smooth Goosefoot populations since the last COSEWIC status update (COSEWIC, 2006). In 2013, the Canadian population of Smooth Goosefoot was estimated to be well over 11,140 plants that year in about 143 quarter sections (not including BC) for a total of 45 extant[4] populations in four provinces, plus 5 historic[5], 6 unconfirmed[6] and 1 likely extirpated[7] population (Table 2, Appendix A). The 2006 COSEWIC status update estimated a total of 5200-10000 mature individuals in 72 quarter sections for a total of 27 extant populations in MB, SK, and AB, plus 10 unconfirmed and 5 likely extirpated populations. The 2006 and 2013 numbers are likely minimum estimates as not all suitable habitat has been surveyed, recent estimates are lacking for some populations, and multiple years of surveying in good growing years are required for an accurate estimate of annual plants.

[4] *Extant means the occurrence has been recently verified as still existing, information on the location is accurate, and habitat still exists at the time of writing the recovery strategy (NatureServe 2013c).*
[5] *Historic means that the habitat still exists, or could exist with proper management, but presence of the species has not been reconfirmed at that occurrence for 20 or more years. In some cases, historic may also indicate an occurrence greater than 20 years old that also has inaccurate or vague locational information, making it difficult or impossible to confirm relocation (NatureServe 2013c).*
[6] *Unconfirmed means that the occurrence is less than 20 years old (not historic) but has inaccurate or vague location information usually associated with a high level of mapping uncertainty with a Conservation Data Centre, and has not been relocated.*
[7] *Extirpated either means that conditions or habitat no longer exist at an occurrence to support the species, or sufficient surveys have taken place at the occurrence over an adequate time period and during good growing years, conducted by experienced surveyors, yet failed to relocate the species at the occurrence (NatureServe 2013c).*

Table 2. Summary table for Smooth Goosefoot populations among Provinces in Canada (for detailed population information, refer to Appendix A).

Province	Number of Populations				Estimated Population Size
	Extant	Unconfirmed	Historic	Extirpated	
Manitoba	3				75-100
Alberta	12	1	4[1]		>7300[2]
Saskatchewan	29	5	1	1	>3750[2]
British Columbia[3]	1				2

[1]These populations in AB may no longer have habitat suitable for Smooth Goosefoot due to dune stabilization and invasive species; additional surveys may be warranted.
[2]Population estimates were not taken for many of the populations revisited recently so it is difficult to state the number of plants present in a given year; estimates presented here are minimum estimates for 2012.
[3]This population is an outlier from the main range of the species in the Prairie Provinces.

Due to past inconsistencies in methods for accurately surveying and monitoring the species, and the inter-annual variability in the species' population-level response to its environment, no overall trend in population size or area of occupancy can be established for the Canadian range of this species at this time.

3.3 Needs of the Smooth Goosefoot

Smooth Goosefoot grows in the Moist Mixed and Mixed Grassland Ecoregions of AB and SK, the Aspen Parkland of MB, all within the Prairie Ecozone (Marshall and Schut 1999). In BC, the occurrence was found growing in the Southern Rocky Mountain Trench Ecoregion within the Montaine Cordillera Ecozone. Smooth Goosefoot primarily grows in a climate characterized as being dry year-round due to low annual precipitation levels, high rates of evaporation, and fast surface runoff (Fung et al. 1999).

Smooth Goosefoot inhabits sand dune complexes and other sand deposits shaped by wind activity (minor dunes, sand sheets, loess and deflation areas), and derived mostly from glacial lake (glacio-lacustrine) or glacial river (glacio-fluvial) deposits (Trenhaile 1990; Wolfe 2001). The soil texture in dunes where Smooth Goosefoot occurs is sandy, including loamy sand, sandy loam and fine sand. The habitat for Smooth Goosefoot is characterized as partially stabilized sand dunes. These sand dunes are typically in an early- to mid-successional state. In other words, it is transitional between recently disturbed (active) sand dunes, and those that become fully stabilized through the process of natural vegetative succession. Active sand dunes start to stabilize with vegetation through natural succession and only remain active, or in the earlier stages of succession, through repeated disturbances from factors like fire and grazing, erosion, animal burrow mounds, as well as extended periods of drought (Wallis 1988; Lesica and Cooper 1999; Wolfe 2001). Some level of perpetual natural disturbance which mimics historical regimes is therefore important toward maintaining the early- and mid-successional sand dune states that support Smooth Goosefoot.

More specifically, Smooth Goosefoot appears to be an opportunistic specialist, occupying the transitional habitats that occur along the eroding to stabilizing edge of

sand dunes and other sand deposits (Environment Canada unpubl data; Lamont and Gerry 1999; Robson 2006; COSEWIC 2006; Linowski et al. 2011, 2012). This margin edge of the sand dune is associated with lower densities of early sand-colonizing grasses and forbs (e.g., *Oryzopsis hymenoides*, *Psoralea lanceolata*, *Helianthus couplandii*, *Lygodesmia juncea*, *Calamovilfa longifolia*) and some amount of moving sand (Environment Canada unpubl data). Rarely, occurrences are found on the edge of active blowouts; however, the extremes of densely vegetated and actively moving sand are usually uninhabited by Smooth Goosefoot. Occasionally Smooth Goosefoot plants are also observed along sandy game trails or on sand mounds dug up by burrowing rodents (C. Neufeld pers. obs.; Lamont and Gerry 1999). Plants tend to occupy south, west or east-oriented slopes (Environment Canada unpubl. data; Lamont and Gerry 1999; COSEWIC 2006; Linowski et al. 2011, 2012). The majority of the occurrences are found in habitat where the dominant land use is grazing by cattle and/or wild ungulates (Environment Canada unpubl data; COSEWIC 2006; Catellier 2012).

Limiting Factors

Habitat availability

The sand dune complexes in the Prairie Ecozone are naturally limiting and isolated from each other, further exacerbated by intervening cultivated lands, and are not evenly distributed across the Canadian range of the species. These factors may limit the recovery of Smooth Goosefoot as it results in isolated populations separated by unsuitable habitat. Even within a particular dune complex, Smooth Goosefoot is found in small, discrete areas, while seemingly similar, and sometimes adjacent, apparently suitable habitat is uninhabited by Smooth Goosefoot. These isolated clusters of Smooth Goosefoot may appear or disappear through competitive exclusion by native and invasive alien plant species, low rates of immigration from distant populations, habitat succession, and potential reproductive problems due to inbreeding and genetic drift. The Canadian range of Smooth Goosefoot represents the northern limit, and isolated populations may represent colonizing satellites of an expanding range, or fragmented remnants of a retracting and formerly more extensive range. Genetic analysis of populations in Canada and adjacent parts of the United States could help resolve whether habitat isolation and availability is an issue.

Seed Germination and Establishment

Smooth Goosefoot is also limited by climatic factors that affect seed germination and established, key transitions in the life history of this species. As an annual plant, a large portion of its life cycle is spent dormant as a seed. Most aspects of the Smooth Goosefoot ecology including seed bank dynamics and germination requirements are unknown. However, future survival of populations is dependent on having a viable seed bank present and having conditions favourable for seed germination and seedling establishment to occasionally replenish that seed bank (e.g., flushes of spring precipitation). Therefore, Smooth Goosefoot may be limited if its inherent ability to maintain a large viable seed bank is reduced through factors like prolonged periods of drought.

4. Threats

4.1 Threat Assessment

Table 3. Threat Assessment Table

Threat	Level of Concern[1]	Extent[2]	Occurrence[3]	Frequency[4]	Severity[5]	Causal Certainty[6]
Changes in ecological dynamics or natural processes						
Alteration to, or suppression of, natural grazing and/or fire regimes	High	Widespread	Current	Seasonal	Moderate	Medium
Exotic, Invasive or Introduced Species						
Invasive alien species						
Leafy Spurge (Euphorbia esula)	High	Widespread (MB, SK)	Current	Continuous	Moderate	High
Others (e.g. Agropyron cristatum, Salsola kali)	Medium	Localized	Current	Continuous	Low	Medium
Habitat Loss or Degradation						
Oil and gas activities	Medium	Widespread	Current	One-time, Recurrent, Seasonal	Moderate	Medium-High
Cultivation	Low-Medium	Widespread	Historic, Current	One-time	Moderate (historic), Low (current)	High
Climate and Natural Disasters						
Prolonged wet climatic periods	Low-Medium	Widespread	Historic, Current	Unknown	Unknown	Medium
Erosion and flooding	Low	Localized	Historic, Anticipated	Seasonal	Low	Medium-High
Habitat Loss or Degradation						
Sand and gravel extraction	Low	Widespread	Historic, Current, Anticipated	One-time, Recurrent	Low (current), Unknown (anticipated)	High

Threat	Level of Concern[1]	Extent[2]	Occurrence[3]	Frequency[4]	Severity[5]	Causal Certainty[6]
Disturbance or Harm						
Recreational activities	Low	Localized	Current	Seasonal	Low	Low-Medium
Military activities	Low	Localized	Anticipated, Unknown	One-time, Continuous, Recurrent, Unknown	Unknown	Low-Medium

[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] *Extent – Defined as widespread, localized or unknown across the species range.*
[3] *Occurrence is defined as historic (contributed to decline but no longer affecting the species), current (affecting the species now), imminent (is expected to affect the species very soon), anticipated (may affect the species in the future), or unknown.*
[4] *Frequency is defined as a one-time occurrence, seasonal (either because the species is migratory or the threat only occurs at certain times of the year), continuous (on-going), recurrent (re-occurs from time to time but not on an annual or seasonal basis), or unknown.*
[5] *Severity reflects the population-level effect (High: very large population-level effect, Moderate, Low or Unknown).*
[6] *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

Threats are listed in order of decreasing level of concern. Additional loss of habitat quantity or quality among the known populations of Smooth Goosefoot could adversely affect the species' survival in Canada (COSEWIC 2006). Future loss of habitat will most likely be as a result of threats leading to dune stabilization or habitat succession (e.g., climate, grazing and fire regimes, invasive alien species), or through direct habitat loss, fragmentation or degradation (e.g., cultivation or oil and gas activities, invasive alien species, sand and gravel extraction).

Alteration to, or Suppression of, Natural Grazing and/or Fire Regimes

Dunes in the southern Canadian prairies have been stabilizing over the last century through a combination of climate and changes in land-use practices since European settlement (Epp and Townley-Smith 1980; Wallis 1988; Wallis and Wershler 1988; Geological Survey of Canada 2001). Changes in land-use practices contributing to dune stabilization primarily include eradication of Bison (*Bison bison*), a reduction in the frequency and extent of prairie fires, as well as a more homogenous pattern of grazing (Higgins et al. 1989; Frank et al. 1998; Brockway et al. 2002; Samson et al. 2004; Hugenholtz and Wolfe 2005). In sand dunes, the absence of natural disturbances like grazing, burrowing and fire interacting with cycles of drought can lead to vegetation growth at the edges of open dunes; natural succession by grasses and forbs, then shrubs, and eventually trees, can stabilize and eventually cover sand dunes with vegetation (Hulett et al. 1966; Potvin and Harrison 1984; Lesica and Cooper 1999), thereby reducing or eliminating suitable habitat for Smooth Goosefoot.

Prairie plants evolved with ecological processes such as fire and grazing (Daubenmire 1968; White 1979; Lesica and Cooper 1999). Historically, it is possible that fires in the summer or fall created lush vegetation the following spring which attracted large herds of grazing animals like bison (Higgins 1986; Vinton et al. 1993) and resulted in reactivation of sand dunes through their trampling, wallowing and grazing activity. Fire can also increase wind erosion by removing the vegetative barrier which had prevented sand from being exposed to wind (Whicker et al. 2002; Vermeire et al. 2005). A combination of fire and grazing likely destabilizes sand dunes and disrupts vegetative succession more effectively than either disturbance independently (Lesica and Cooper 1999). Dunes have been stabilizing in some areas where there have been repeated fires but minimal grazing, while in other areas dunes have stabilized where there has been grazing but few fires (Wallis 1988). Historically, the stabilization of active dunes was thought to be good conservation practice and land managers attempted to stabilize dunes by extinguishing fires, actively reseeding, altering grazing patterns, and placing objects, such as tires or bales, on blowouts (David 1977; Wallis and Wershler 1988).

Grazing, primarily by cattle, occurs at almost all of the known Smooth Goosefoot populations in Canada. However, factors such as stocking rates, frequency and duration of grazing differ among, and even within, populations. These factors, along with diet selection of domestic and wild ungulates are unlike what would have occurred

historically under natural grazing regimes (Milchunas and Lauenroth 1993; Knapp et al. 1999; Fuhlendorf and Engle 2001; Kohl et al. 2013). There have been observations of grazing on Smooth Goosefoot plants (COSEWIC 2006), but this does not occur frequently enough to be considered a threat (C. Neufeld, pers. obs.). Trampling by cattle in areas where activities are concentrated (e.g., dugouts around sand dunes) may result in mortality of some plants (COSEWIC 2006, Appendix A). Fire does not occur at historic intervals at any of the populations, although the habitat within CFB Suffield NWA is subject to occasional burning when the fire spreads from the adjacent military base.

Invasive Alien Species

Some invasive alien plant species may be relatively unpalatable to livestock and wildlife, or have different fuel properties, resulting in altered fire regimes (Brooks et al. 2004). As a result, an influx of these invasive alien plants could stabilize sand dunes and represent a threat to Smooth Goosefoot habitat. Invasive alien plants can pose a direct threat through competition because they can displace native species, decrease species diversity or richness through their superior competitive ability and/or result in overall negative effects on ecosystem functioning (Wilson 1989; Wilson and Belcher 1989; Reader et al. 1994; Christian and Wilson 1999; Bakker and Wilson 2001; Butler and Cogan 2004; Henderson 2005; Henderson and Naeth 2005). Leafy Spurge (*Euphorbia esula*), an invasive Eurasian species, is present at some of the Smooth Goosefoot populations in SK and MB (Appendix A; COSEWIC 2006; Environment Canada unpubl data). It reduces the abundance of native species in areas where it occurs, and is capable of turning sites into a stabilized monoculture (Wilson and Belcher 1989). In MB, it was found that 95% of spurge occurrences were associated with human disturbances such as fireguards or vehicle tracks as it was easier for Leafy Spurge to establish in areas with more exposed soil (Wilson and Belcher 1989); active sand dunes may be particularly susceptible to establishment of Leafy Spurge. Other invasive alien species noted at Smooth Goosefoot occurrences that may pose a threat to habitat quality include Crested Wheatgrass (*Agropyron cristatum*), Kentucky Bluegrass (*Poa pratensis*), Baby's-breath (all *Gypsophila* species), Russian Thistle (*Salsola kali*), Downy Brome (*Bromus tectorum*) and Sweet Clover (*Melilotus* sp.) (Appendix A; COSEWIC 2006). There is also the potential for Smooth Goosefoot plants to be killed, or its habitat negatively altered, by indiscriminate use of herbicides intended to control invasive species.

Oil and Gas Activities

Oil and gas activities include a number of processes such as exploration, drilling, completion, production and transportation, abandonment and reclamation[8]. These activities have the potential to harm Smooth Goosefoot and its habitat, either directly (e.g., contamination of soil by drilling waste or pipeline ruptures, mortality from vehicular traffic on trails, destruction of plants or seed bank during construction) or indirectly

[8] *For a detailed description of differences between impacts of oil and gas activities, refer to the Threats section of the Small-flowered Sand-verbena Recovery Strategy (Environment Canada 2012).*

(e.g., invasive species introduction, habitat fragmentation). Oil and gas activity continues to increase in the sandhills despite the sensitive nature of the habitat to disturbance (COSEWIC 2006); for example, in the Great Sandhills, gas wells doubled between 1991-2005, also resulting in the construction of pipelines, flowlines, access roads and other facilities (Government of Saskatchewan 2007). Oil and gas activities were reported in the vicinity of 14 Smooth Goosefoot populations (Appendix A), and this number is expected to increase in future years.

Cultivation

Historical conversion of native sandy grassland habitats to cultivated cropland likely contributed to the loss of Smooth Goosefoot habitat and habitat fragmentation. Cultivation results in permanent habitat loss for which there is no mitigation. In general, remaining sandhill areas that support Smooth Goosefoot are not considered suitable habitat for agriculture due to low soil moisture, low soil fertility, and high risk of wind erosion (Geological Survey of Canada 2001). However, within sand dune complexes where there are level sandy plains between dunes, it is possible to grow certain types of crops which need irrigation, such as potatoes, corn and sugar beets. This has occurred in sandhills in AB and MB (C. Neufeld pers. obs.) and it is possible that this practice will increase in the future, potentially impacting dunes inhabited by Smooth Goosefoot. The relative threat is likely limited by economics of irrigation infrastructure development, crop prices and water supply.

Prolonged Wet Climatic Periods

In Canada, Smooth Goosefoot occupies a specific niche of early successional sand dune habitat with some amount of shifting sand; stabilized dunes could eliminate the habitat suitable for Smooth Goosefoot. Progressive stabilization of sand dunes dating back as far as the 1700's and driven mainly by decreased periods of drought and decreased wind speed and erosion may have contributed to habitat loss and degradation, even in the absence of anthropogenic factors that are currently contributing to dune stabilization (Wallis 1988; Wolfe *et al*. 2001, Hugenholtz and Wolfe 2005; Hugenholtz et al. 2010). Prolonged wet climatic periods can increase vegetation growth, including woody vegetation, in the sand dunes, thereby suppressing wind erosion and sand movement leading to stabilization and vegetation succession (Thorpe et al. 2001; Wolfe et al. 2001). Stabilization rates in sand dunes in the Canadian prairies where Smooth Goosefoot occurs, are estimated to be as low as 0.4 ha/yr to as high as 17.7 ha/yr (Hugenholtz and Wolfe 2005). In some areas, as much as 90% of active dunes have vegetated since the early 1900s (Wallis 1988; Hugenholtz and Wolfe 2005). However, projections of future climate warming and increased evapotranspiration may favour increased sand dune activity, reversing the current stabilization trend (Wolfe 2001; Wolfe and Thorpe 2005).

Minor or potential future threats

Sand and gravel extracted from sand dunes is used for road construction, oil and gas activities (e.g., fracking), agriculture (e.g., potato farming), and personal use. Currently, there are active borrow pits in many sand dunes in which habitat is suitable for Smooth Goosefoot (e.g., Environment Canada 2012, 2013). Sand has recently been removed from a dune at Pakowki Lake Sandhills, AB, where Smooth Goosefoot occurs (Environment Canada 2013) and sand/gravel extraction is occurring near some of the Smooth Goosefoot occurrences within the Lake Diefenbaker, SK, population. With the continued need for aggregate, it is possible this will become a larger threat for sand dune obligate species such as Smooth Goosefoot.

Recreation within dunes can lead to damage of plants or habitat. Use of motorized or recreational vehicles (e.g., dune bikes, snowmobiles, all-terrain vehicles, 4 x 4 trucks) is occurring near Smooth Goosefoot in three sandhills (Appendix A; Goulet and Kenkel 1997; Krause-Danielson and Friesen 2009; Environment Canada 2013), and hiking is a common activity in four dunes (Appendix A; COSEWIC 2006; F. Lomer pers. comm. 2014). Hiking is less of a concern, but could lead to trampling of plants, particularly at Wasa Lake, although this area is specially zoned and there has been an attempt to divert recreational activity and events away from this dune feature in the recent past (BC Ministry of Environment pers. comm. 2014). A small amount of disturbance to the sandhills by these types of activities may benefit some populations by preventing dunes from stabilizing, thereby favouring the growth of early successional species like Smooth Goosefoot. However, repeated disturbance can lead to shifting and eroding dunes, which does not support any vegetation growth; therefore, this type of activity is not encouraged as it is difficult to control, may result in plant mortality, and natural methods are likely more effective.

Smooth Goosefoot has been found growing in the National Wildlife Area (NWA) portion of CFB Suffield, AB (Environment Canada unpubl data; Linowski et al. 2012). The NWA portion of CFB Suffield is sometimes affected by fires and minor disturbances (e.g. overshot ordinances) from military activities. Activities such as road creation and maintenance, and use of heavy tracked or wheeled tactical vehicles can negatively affect native prairie, particularly in sand habitats, by reducing vegetation cover and altering species composition as well as directly damaging plants and the seed bed (McKernan 1984; Wilson 1988; Severinghaus 1990; but also see Warren et al. 2007).

Along river systems, such as the South Saskatchewan River, there are regions with sandy deposits or sand dunes along the banks, terraces, adjacent uplands, floodplains and meander lobes. Depending on water levels and rates of flow, sand can be removed or deposited in these spots, and erosion or slumping can occur on steeper slopes. There are a few populations of Smooth Goosefoot that occur in such habitats and are at risk of extirpation, habitat loss or declines in population size if flooding, erosion or slumping were to occur, and one population in SK was reported to be extirpated due to flooding (Appendix A). It is also possible that these processes may create additional

habitat for Smooth Goosefoot and seeds may get deposited there in future years. However, these areas are likely more of a sink habitat than a source habitat.

5. Population and Distribution Objectives

There has been an increase in knowledge about the occurrences and distribution of Smooth Goosefoot in Canada over the last few years as survey effort has increased. Substantial increases to area of occupancy are less likely to be documented in the future given that 1) the suitable habitat for the species is limited and highly fragmented; 2) the area of occupancy of occurrences documented to date have been relatively small; and 3) the Canadian populations exist at the northern limit of the species' range. However, it is likely some additional populations will be found with future survey effort. If habitat quality and quantity continue to decline, known populations may also decline as a result. Factors leading to dune stabilization and habitat succession are likely the greatest threats to Smooth Goosefoot (COSEWIC 2006), so the population and distribution objectives have been set in the context of reversing or preventing further declines in quality and quantity of habitat through beneficial management practices and stewardship arrangements in order to maintain, and if possible, increase existing populations over the long term.

Population and distribution objectives for Smooth Goosefoot are to maintain all extant and any newly discovered naturally[9] occurring populations within the natural range of population fluctuation, within the current range of the species in Canada, and to reconfirm historic and unconfirmed populations to the extent possible.

Rationale

Smooth Goosefoot is restricted to isolated sand dunes across the Prairies and the one locality in BC. Active sand dunes were more prevalent over a hundred years ago so it is likely that present populations of Smooth Goosefoot are smaller and more isolated than in the past. Recent survey efforts focused on relocating historical occurrences of Smooth Goosefoot (Environment Canada unpubl. data), and while some relocation attempts were unsuccessful, there is uncertainty over whether the plants were no longer present, or whether the original location information was too imprecise for relocation. Targeted surveys in recent years have greatly increased the number of known populations as well as the range. A goal to actively increase the number of populations through translocation or other techniques is not recommended at this time.

For annual plants, the largest and most genetically diverse component of the population exists as seed in the seedbank (Harper 1977; Silvertown and Charlesworth 2001). Therefore, an enumeration of mature individuals is usually an unreliable indicator of actual population size for annuals in the short-term (Brigham and Thomson 2003). The

[9] *Naturally occurring population refers to any population within the native range on naturally occurring habitat. It excludes horticultural populations or those that are dispersed by humans and establish themselves outside the native range or on unnatural habitats.*

number of mature individuals for this species fluctuates depending on factors which influence germination in any given year (e.g., precipitation). Similarly, the spatial distribution of plants observed growing varies from year to year based on which seeds germinate and survive. These fluctuations in abundance and distribution are not necessarily indicators of threats to survival but they greatly complicate the determination of trends or the ability to set specific quantitative population and distribution objectives. In addition, the majority of occurrences have been found very recently, or have been revisited only once or twice; therefore data on area of occupancy, population sizes, magnitude of fluctuations, range of natural variability, etc. is lacking. Therefore, only a general statement can be provided on population and distribution objectives at this time.

6. Broad Strategies and General Approaches to Meet Objectives

6.1 Actions Already Completed or Currently Underway

Inventory and Monitoring

- Guidelines have been written to standardize occupancy surveys for plant species at risk (Henderson 2010a).
- Smooth Goosefoot status reports for Canada (Smith and Bradley 1992; COSEWIC 2006) have been written.
- The Recovery Team for Plants at Risk in the Prairie Provinces was formed in 2003; the Smooth Goosefoot is one of the plant species the recovery team addresses.
- In SK and AB, recent surveys for new and historic occurrences have been conducted by Environment Canada, Saskatchewan Ministry of Environment (Conservation Data Center), Alberta Environment and Sustainable Resource Development, Nature Saskatchewan and the Native Plant Society of Saskatchewan in multiple sand dunes on private, provincial and federal lands.
- In CFB Suffield and CFB Suffield NWA, annual monitoring of known occurrences and surveying for new occurrences has been ongoing since Smooth Goosefoot was first observed there in 2010 (Environment Canada unpubl. data; Linowski et al. 2011, 2012).
- In MB, recent surveys have been conducted by Manitoba Conservation (Conservation Data Center).

Habitat Conservation and Stewardship

- Non-government organizations in SK, AB and MB have been working with private landowners and lessees on management plans and voluntary stewardship agreements on properties with plant species at risk, some containing Smooth Goosefoot.
- AAFC-AESB has developed management guidelines and decision support tools for pasture land managers who have species at risk on their properties.

- Leafy Spurge monitoring and control has been ongoing since 1991 using an integrated pest management approach, including sheep grazing on AAFC-AESB lands.
- Saskatchewan Parks, Culture and Sport has implemented a multi-year adaptive and integrated management program for Western Spiderwort and Smooth Goosefoot habitat using prescribed burning, integrated pest management for invasive exotic species such as Leafy Spurge, and grazing (R. Wright pers. comm.).

6.2 Strategic Direction for Recovery

Table 4. Recovery Planning Table

Threat or Limitation	Priority[1]	Broad Strategy to Recovery	General Description of Research and Management Approaches
All threats; knowledge gaps	Medium-High	Inventory and monitoring	• Using consistent survey guidelines (Henderson 2010a), continue surveys to locate new occurrences and populations, and relocate unconfirmed and/or historic records. • Use models (e.g., habitat suitability and/or species distribution models) to predict priority search areas for new populations. • Using consistent monitoring techniques, determine range of natural variation for population size and area of occupancy. • Coordinate inventory and monitoring activities through the Recovery Team to ensure effective and efficient use of funds and labour.
Alteration/ suppression of grazing and/or fire; Invasive alien species; Oil and gas activities; Knowledge gaps; Limiting Factors	High	Research	• Determine long-term impacts of threats and management practices on populations and habitat quality. • Conduct research to develop an understanding of the species ecology and needs (e.g., seed bank, germination). • Apply findings to develop beneficial management practices (BMPs) for the species.
All threats	High	Habitat conservation and stewardship	• Engage landowners and managers in conservation arrangements aimed at implementing BMP's and protecting critical habitat. • Monitor and assess the effectiveness of conservation arrangements and critical habitat protection. • Educate public and land users to minimize or eliminate habitat deterioration during recreational use. • Using adaptive habitat management, monitor the effectiveness of BMPs to improve habitat; amend BMPs as necessary. • Integrate habitat management with that for other dune specialist species (Appendix C) and evaluate effectiveness of other habitat restoration/management projects in dune ecosystems.

[1] *"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. It is consistent with the level of concern of the threats the broad strategy is addressing.*

6.3 Narrative to Support the Recovery Planning Table

Several knowledge gaps and limiting factors identified for Smooth Goosefoot may be addressed through research and adaptive habitat management. Information on the impacts of human-related threats and habitat management techniques on its ecology and habitat needs is relevant to recovery and long-term conservation and management. More specifically, research and adaptive management are needed to evaluate the magnitude and direction of threats and mitigation effects on plant fitness, population size, and area of occupancy. Ex-situ or in-situ experimental and observational field investigations that could be undertaken include examining the effects, timing and intensity of grazing, fire, invasive species control, brush control, and idled habitats, or a combination thereof, on Smooth Goosefoot survival and reproductive output and its habitat quality and availability. Other knowledge gaps requiring research include: aspects of the species' life cycle; seed bank dynamics; the influence of factors such as temperature and precipitation on germination, seed dormancy, population health, and population fluctuations; its tolerance for varying conditions (climate, vegetation encroachment, dune stabilization, precipitation); pollination (insect or wind). The research findings need to be applied to beneficial management practices developed for the species and may be used to re-evaluate critical habitat.

7. Critical Habitat

7.1 Identification of the Species' Critical Habitat

Critical habitat is defined in the *Species at Risk Act* (S.C.2002, c29) section 2(1) 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". Section 41 (1)(c) of SARA requires that recovery strategies include an identification of the species' critical habitat, to the extent possible, as well as examples of activities that are likely to result in its destruction.

Critical habitat for Smooth Goosefoot is partially identified in this recovery strategy, to the extent possible, based on best available information[10]. The approach used for identifying critical habitat for Smooth Goosefoot is based on a decision tree developed by the Recovery Team for Plants at Risk in the Prairie Provinces as guidance for identifying critical habitat for all terrestrial and aquatic prairie plant species at risk (see Appendix A in Environment Canada 2012 for the full decision tree).

Smooth Goosefoot is restricted to sand dune complexes and other sand deposits on sandy soils (sand, loamy sand, sandy loam, fine sand). Its habitat is an early transitional or successional state between recently disturbed (active sand) and fully stabilized; low

[10] *Information on Smooth Goosefoot occurrences known to Environment Canada as of September, 2013 was used in this recovery strategy (note that data from surveys done in 2013 were not included as they were not available).*

densities of early colonizing grasses and forbs occur, with some amount of moving sand and little to no shrub or forest overstory (see Section 3.3). These early successional habitats are maintained by some level of perpetual disturbance(s). The nature of sand dune disturbance regimes are difficult to characterize in space and time (i.e. not well defined or easily delineated); different types of disturbance may act in combination and/or with varying frequencies to result in the observed state of dune succession.

Thus, identification of critical habitat for the Smooth Goosefoot is occurrence-based rather than habitat-based. Critical habitat is identified as the area encompassing each extant occurrence (area of occupancy) and all natural landform, soil, and vegetation features within a 300 meter critical function zone of each occurrence[11]; existing human developments and infrastructure within the area identified as critical habitat are not considered to be critical habitat. The 300 m critical function zone represents the minimum distance needed to maintain the habitat required for long term survival of the species at each occurrence. This specific distance is based upon a detailed literature review that examined edge-effects of various land use activities that could affect resource availability for native prairie plants generally, and could contribute to negative population growth (for literature review, see Henderson 2010b and Appendix B in Environment Canada 2012).

More precise boundaries may be identified, and additional critical habitat may be added in the future, as new information (e.g. from research, surveys or monitoring) supports the inclusion of areas beyond those currently identified. The Schedule of Studies (Table 5) outlines the activities required for identification of additional critical habitat necessary to support the population and distribution objectives.

The area containing critical habitat is approximately 5163 hectares (52 km^2), with 123 hectares identified in MB, 4097 hectares identified in SK, 914 hectares identified in AB, and 28 hectares identified in BC (Appendix B). This occupies or overlaps into approximately 336 quarter sections of land in the Dominion Land Survey (12 in MB, 257 in SK, 67 in AB; BC does not use the Dominion Land Survey system in the area where critical habitat is being identified).

All jurisdictions and landowners who are controlling surface access to the area, or who are currently leasing and using parts of this area, will be provided with geo-referenced spatial data or large-format maps delineating the boundaries of critical habitat displayed in Appendix B, upon request.

[11] *Rivers, wetlands, and forested areas are exempt from the definition of natural landforms and vegetation. In addition, large barriers like river channels or cultivated fields (e.g., greater than 150 m wide) can create a discontinuity in the natural habitat. These barriers may effectively overwhelm other edge effects at the distal end of critical habitat, or prevent effective dispersal of the plant at the proximal end closest to the occurrence. In these particular cases, some patches of natural vegetation on natural landforms within a distance of 300 m but discontinuous from the habitat occupied by the plants are not included in the critical habitat.*

7.2 Schedule of Studies to Identify Critical Habitat

Accurate or recent occurrence data is lacking for several Smooth Goosefoot populations, or occurrences within populations. Reconfirming these populations is part of the population and distribution objective, and if confirmed, critical habitat will need to be identified for these occurrences and/or populations. The following schedule of studies will address these gaps to enable decisions about whether additional critical habitat needs to be identified for Smooth Goosefoot in Canada.

Table 5. Schedule of Studies to Identify Critical Habitat

Description of Activity	Rationale	Timeline
Confirm or obtain details of location information for unconfirmed/historic occurrences or populations and conduct surveys.	By using details provided by the original observer (e.g. habitat, directions) and known habitat information (e.g. soil type, sand dunes) in combination with high resolution orthophotos or satellite imagery, suitable survey areas within the mapping uncertainty radius will be identified where possible and surveys will be conducted to increase knowledge of extant Smooth Goosefoot occurrences/populations for consideration as critical habitat[1].	2015-2017
Repeat surveys in subsequent years if suitable habitat still exists but no plants are found.	. Increase confidence in data used to determine if occurrences or populations meet the criteria to be identified as critical habitat.	2017-2018

[1]*Details for some of the historic or unconfirmed occurrences and populations are so vague or inaccurate that it would be impossible to know whether the original occurrence had been relocated or not. Therefore, these will likely always remain as historic or unconfirmed.*

7.3 Activities Likely to Result in the Destruction of Critical Habitat

Destruction is determined on a case by case basis. Destruction would result if part of the critical habitat were degraded, either permanently or temporarily, such that it would not serve its function when needed by the species. Destruction may result from a single or multiple activities at one point in time or from the cumulative effects of one or more activities over time (Government of Canada 2009). Activities described in Table 6 outline examples of activities likely to cause destruction of critical habitat for Smooth Goosefoot; however, destructive activities are not limited to those listed.

Table 6. Activities Likely to Result in the Destruction of Critical Habitat

Description of activity	Description of effect (on biophysical attribute or other) in relation to function loss of critical habitat	Additional information
Compression of soil (e.g. creation or expansion of permanent/temporary structures, trails, roads, repeated motorized traffic, concentrated livestock activity from things like bales, new corrals, additional watering sites)	Compression can damage soil structure and porosity, or reduce water availability by increasing runoff and decreasing infiltration, such that critical habitat is destroyed.	This activity must occur within the bounds of critical habitat to cause its destruction, can be a direct or cumulative effect, and is applicable at all times, with the exception of winter months when the ground is snow covered and frozen solid (soil temperature below -10^0C).
Covering of soil (e.g. creation or expansion of permanent/temporary structures, spreading of solid waste materials, roadbed construction)	Covering the soil prevents solar radiation and water infiltration needed for germination and survival of plants, such that critical habitat is destroyed.	This activity must occur within the bounds of critical habitat to cause its destruction, is a direct effect, and is applicable at all times.
Inversion/excavation/extraction of soil (e.g. new or expanded cultivation, sand and gravel extraction pits, dugouts, road construction, pipeline installation, stripping of soil for well pads or fireguards)	Soil inversion or extraction can alter soil porosity, and thus temperature and moisture regimes, such that vegetation communities change to those dominated by competitive invasive species; thus critical habitat is destroyed.	This activity must occur within the bounds of critical habitat to cause its destruction, can be both a direct and cumulative effect, and is applicable at all times.
Alteration to hydrological regimes (e.g., temporary or permanent inundation from construction of impoundments downslope or downstream, and accidental or intentional releases of water upslope and upstream)	As the seed bank and plants of Smooth Goosefoot are adapted to semi-arid conditions, flooding or inundation by substances like water or hydrocarbons, even for a short period of time, can be sufficient to alter habitat enough to be unsuitable for survival and re-establishment. For example, road construction can interrupt or alter overland water flow, altering habitat conditions and threatening the long-term survival of the species at this occurrence.	This activity can occur within and outside the bounds of critical habitat to cause its destruction, can be a direct or cumulative effect, and is applicable at all times.
Indiscriminate application of fertilizers or pesticides	Herbicide and fertilizer effects that can destroy critical habitat include altering soil water and nutrient availability such that species composition in the surrounding plant community can change. These changes, in addition to the altered interspecific competition that results from them, could render the habitat unsuitable for Smooth Goosefoot.	This activity can occur within and outside the bounds of critical habitat to cause its destruction (e.g. chemical drift, groundwater or overland flow of contaminated water), can be a direct or cumulative effect, and is applicable at all times.
Spreading of wastes (spreading of materials such as manure, drilling mud, and septic fluids)	These have the potential to negatively alter soil resource availability, species compositions, and increase surrounding competitor plants -	This activity can occur within and outside the bounds of critical habitat to cause its destruction (e.g. drift,

Description of activity	Description of effect (on biophysical attribute or other) in relation to function loss of critical habitat	Additional information
	effectively destroying the critical habitat. These liquid or semi-liquid materials can infiltrate the surface in the short-term, but leave little long-term evidence at the surface that could point to the cause of negative changes observed thereafter.	groundwater or overland flow of contaminated), can be a direct or cumulative effect, and is applicable at all times.
Deliberate introduction or promotion of invasive alien species (e.g., intentional dumping or spreading of feed bales containing viable seed of invasive alien species, or seeding invasive alien species, use of uncleaned motorized vehicles contaminated with invasive species material)	Once established, invasive alien species can alter soil resource availability and directly compete with species at risk, such that population declines occur, effectively destroying the critical habitat. Critical habitat may be destroyed by invasive alien species (refer to Section 4.2), as well as by other prohibited or noxious prohibited weeds. It may also be destroyed by the following species which are not restricted by any legislation due to their economic value: Smooth or Awnless Brome (*Bromus inermis*), Crested Wheatgrass, Yellow Sweet Clover (*Melilotus officinalis*), White Sweet Clover (*Melilotus alba*). This form of destruction is often a cumulative effect resulting from the first four examples of critical habitat destruction.	This activity can occur within or adjacent to the bounds of critical habitat to cause its destruction, can be a direct or a cumulative effect, and is applicable at all times.
Deliberate actions to stabilize sand dunes (e.g. revegetating, use of flax bales or tires, straw crimping, drift fencing, or landscape fabric)	These activities can artificially promote vegetation cover, change plant community structure and diversity, stabilize dunes or hasten vegetative succession on dunes, thereby contributing to the loss of critical habitat.	This activity must occur within the bounds of critical habitat to cause its destruction, can be a direct or a cumulative effect, and is applicable at all times. This activity is only intended to apply to culpable activities..

While the human activities listed above can destroy critical habitat, there are a number of activities that may be beneficial to Smooth Goosefoot and its habitat. These activities are described in Appendix D.

8. Measuring Progress

The performance indicators presented below provide a way to define and measure progress toward achieving the population and distribution objectives. Every five years, success of recovery strategy implementation will be measured against the following performance indicators:

- all extant naturally-occurring populations and any newly-discovered naturally occurring populations within the range of natural population fluctuations and within the current range of the species in Canada are maintained.
- Quantity of critical habitat for Smooth Goosefoot has been maintained, at a minimum, at the amount defined in this recovery strategy.
- Quality of critical habitat for Smooth Goosefoot has been maintained at a level that supports Smooth Goosefoot populations.

9. Statement on Action Plans

One or more action plans for Smooth Goosefoot will be posted on the Species at Risk Public Registry by December 2019.

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11. RECOVERY TEAM

Current Recovery Team for Plant Species at Risk in the Prairies:
Candace Neufeld (Environment Canada, recovery team chair)
Nicole Firlotte (Manitoba Conservation Data Centre)
Fawn Jackson (Canadian Cattlemen's Association)
Sarah Lee (Environment Canada, recovery team secretary)
Bill Bristol/ Rick Ashton (Agriculture and Agri-Food Canada – Agri-Environment Services Branch)
Joel Nicholson (Alberta Sustainable Resource Development)
Sherry Lynn Punak-Murphy (Department of National Defence, CFB Shilo)
Drew Taylor (Department of National Defence, CFB Suffield)

APPENDIX A: SUMMARY OF SMOOTH GOOSEFOOT POPULATIONS IN CANADA

Table A1. Summary of Smooth Goosefoot populations in Canada [1,2]. Grey shading indicates that the population is extirpated or historic (see footnotes).

Population Name (EO_ID)	First Observed	Last Observed	Last Survey	Recent Estimate [Year] [3]	Highest Estimate [Year] [3]	Land Tenure	Threats and Limiting Factors
MANITOBA							
Routledge Sandhills (4229)	2004	2005	2011	0 [2011]	63 [2005]	Private, Crown-Provincial	Invasive species (*Euphorbia esula*). Dune stabilization (woody vegetation).
Routledge Sandhills - Oak Lake (2270)[4]	1959	2010	2011	1 [2010]	1 [2010]	Private	Invasive species (*Euphorbia esula*). Dune stabilization (woody vegetation). Recreation (trail clearing, ATV).
Spruce Woods Provincial Park - Spirit Sands (4930)	2005	2012	2012	5 [2012]	14 - 29 [2005]	Crown-Provincial Park	Recreation (hiking trail).
SASKATCHEWAN							
Coteau Pasture (15007)	2004	2004	2004	2 [2004]	2 [2004]	Crown Federal[8]	Cultivation (historic). Invasive alien species (e.g. *Agropyron cristatum*). Dune stabilization (woody vegetation).
Coteau Pasture (16000)	2004	2004	2004	>0 [2004]	>0 [2004]	Crown - Federal[8]	Cultivation (historic). Invasive alien species (e.g. *Agropyron cristatum*). Dune stabilization (woody vegetation).
Lake Diefenbaker (15363)	1989	2012	2012	165 [2012]	165 [2012]	Crown – Provincial	Flooding/erosion. Gravel extraction.
Elbow Sandhills (9105)[4]	1879	2012	2012	2916 [2012]	2916 [2012]	Provincial Park, Crown - Federal[8]	Invasive species (*Euphorbia esula, Agropyron cristatum, Poa pratensis*). Dune stabilization (woody vegetation). Lack of grazing (Provincial Park). Recreation (hiking, dune surfers).

Population Name (EO_ID)	First Observed	Last Observed	Last Survey	Recent Estimate [Year] [3]	Highest Estimate [Year] [3]	Land Tenure	Threats and Limiting Factors
Dundurn AAFC-AESB Pasture (15982)	2008	2008	2008	>0 [2008]	>0 [2008]	Crown - Federal[8]	Dune stabilization.
Dundurn AAFC-AESB Pasture (15983)	2007	2010	2010	>0 [2010]	>0 [2010]	Crown - Federal[8]	Dune stabilization.
Dundurn AAFC-AESB Pasture (15984)	2008	2008	2008	>5 [2008]	>5 [2008]	Crown - Federal[8]	Dune stabilization.
Dundurn and Rudy Rosedale AAFC-AESB Pastures (15970)	2009	2012	2012	3 [2012]	>9 [2010]	Crown - Federal[8]	Dune stabilization.
CFB Dundurn (2357)	1951	2007	2007	10 [2007]	10 [2007]	Crown-Federal	Dune stabilization.
CFB Dundurn (15981)	2005	2005	2005	1 [2005]	1 [2005]	Crown – Federal	Dune stabilization.
Great Sandhills - Northwest (4475)[4]	1949	2012	2012	40 [2012]	2581 [2008]	Crown – Provincial	Dune stabilization.
Great Sandhills - Northeast (7211)[5]	1997	2006	2006	1 [2006]	179 [1997]	Crown – Provincial	Dune stabilization.
Great Sandhills - Central (3539)[5]	1997	2006	2006	23 [2006]	23 [2006]	Crown – Provincial	Dune stabilization.
Great Sandhills - Central (7718)[5]	1997	2012	2012	>0 [2012]	460 [1997]	Crown – Provincial	Dune stabilization.
Great Sandhills - Central (15979)	2006	2006	2006	10 [2006]	10 [2006]	Crown – Provincial	Dune stabilization.
Great Sandhills - South (15891)	2004	2004	2004	>35 [2004]	>35 [2004]	Crown – Provincial	Dune stabilization.
Seward/Webb Sandhills (8306)[*]	1996	2012	2012	>0 [2012]	55 [1996]	Crown - Federal[8]	Dune stabilization. Oil and gas activity.
Caron (4213)[4]	1956	2009	2012	0 [2012]	<10 [2002]	Private	Invasive species (*Euphorbia esula*).
Burstall Sandhills (2127)[5]	1997	2012	2012	>0 [2012]	202 [1997]	Crown – Provincial	Invasive species (*Salsola kali*). Dune stabilization. Recreation

Population Name (EO_ID)	First Observed	Last Observed	Last Survey	Recent Estimate [Year] [3]	Highest Estimate [Year] [3]	Land Tenure	Threats and Limiting Factors
							(vehicle, ATV).
South SK River Loop (3598)[4]	1981	2004	2004	<10 [2004]	<10 [2004]	Crown – Provincial	
Cramersburg (683)[4]	pre-1970	2012	2012	>0 [2012]	179 [1997]	Crown – Provincial	Oil and gas activity.
Crane Lake (1169)	2006	2006	2006	1 [2006]	1 [2006]	Crown – Provincial	Oil and gas activity (pipeline construction).
Crane Lake (15971)	1997	2008	2008	420 [2008]	420 [2008]	Crown – Provincial	Oil and gas activity (pipeline construction).
Piapot (2662)[4]	1983	2006	2006	47 [2006]	47 [2006]	Crown-Provincial	Oil and gas activity (pipeline construction).
Piapot Creek (15977)	2012	2012	2012	20 [2012]	20 [2012]	Private	Oil and gas activity (pipeline construction).
Big Stick (3852)[5]	1998	2012	2012	>0 [2012]	54 [1998]	Private, Crown - Federal[8]	Oil and gas activity (pipeline construction).
Big Stick Sandhills (6814)	1997	2006	2006	38 [2006]	80 [1997]	Crown – Provincial	Oil and gas activity.
Big Stick (15978)	2012	2012	2012	>0 [2012]	>0 [2012]	Crown - Federal[8]	Oil and gas activity.
Big Stick Sandhills (16002)	2012	2012	2012	>0 [2012]	>0 [2012]	Crown - Federal[8]	Oil and gas activity.
Beaver Creek (762)[6]	1951	2004	2012	0 [2012]	1 [2004]		Dune stabilization.
Bitter Lake (8295)[6]	1997	1997	1997	11 [1997]	11 [1997]		Dune stabilization.
Tompkins (3851)[6]	1997	1997	1997	21 [1997]	21 [1997]		
Patience Lake[6,7]	1986	1986	1986	>0 [1986]	>0 [1986]		Potash mining. Acreage development.
Dunblane (4974)[6]	1961	1961	1997	0 [1997]	>0 [1961]		Cultivation. Gravel extraction. Flooding – extirpated?
Seward/Webb Sandhills (1170)[6]	1997	2006	2006	>0 [2006]	80 [1997]		Dune stabilization. Oil and gas activity.
Seward/Webb Sandhills (4963)[6]	1996	2004	2004	1133? [2004]	1133? [2004]		Dune stabilization. Oil and gas activity.

Population Name (EO_ID)	First Observed	Last Observed	Last Survey	Recent Estimate [Year] [3]	Highest Estimate [Year] [3]	Land Tenure	Threats and Limiting Factors
ALBERTA							
South SK River AB Loop (15225)	2004	2004	2004	1 [2004]	1 [2004]	Crown-Provincial	Invasive species (*Salsola kali*). Dune stabilization. Cultivation.
South SK River SK Loop (21655)	2004	2004	2004	38 [2004]	38 [2004]	Crown-Provincial	Invasive species (*Salsola kali*). Dune stabilization.
Lost River Valley (22063)[4]	1985	2012	2012	>0 [2012]	35 [2004]	Crown – Federal[8]	Invasive species *(Salsola kali, Agropyron cristatum*). Dune stabilization.
Pakowki Lake Sandhills West (8377)	1980	1999		2 [1988]	2 [1988]	Crown-Provincial	Invasive species (*Agropyron cristatum, Gypsophila paniculata*). Dune stabilization.
Pakowki Lake Sandhills East (22064)	1987	2012		27 [2012]	2 [1988]	Crown-Provincial	Dune stabilization.
CFB Suffield NWA Ypres (22060)	2010	2012	2012	5719 [2012]	5719 [2012]	Crown - Federal	Invasive species (access roads). Oil and gas activity. Dune stabilization.
CFB Suffield NWA Amiens (22061)	2011	2012	2012	6 [2012]	6 [2012]	Crown - Federal	Invasive species (access roads). Oil and gas activity. Dune stabilization.
CFB Suffield NWA Amiens (23433)	2012	2012	2012	21 [2012]	21 [2012]	Crown - Federal	Invasive species (access roads). Oil and gas activity. Dune stabilization.
CFB Suffield NWA Casa Berardi (21649)	2010	2012	2012	11 [2012]	23 [2010]	Crown - Federal	Dune stabilization
CFB Suffield NWA Fish Creek (22062)	2011	2012	2012	1353 [2012]	1353 [2012]	Crown - Federal	Dune stabilization. Erosion/slumping into river.
Purple Springs (23469)	1987	2012	2012	>0 [2012]	30 [1988]	Crown - Provincial	Invasive species (*Euphorbia esula, Bromus tectorum* - in adjacent dunes). Dune stabilization.
Turin (22066)	1986	2012	2012	100s [2012]	100s [2012]	Crown - Provincial	Invasive species *(Euphorbia esula*). Dune stabilization. Oil and gas activity. Alteration to grazing

Population Name (EO_ID)	First Observed	Last Observed	Last Survey	Recent Estimate [Year] [3]	Highest Estimate [Year] [3]	Land Tenure	Threats and Limiting Factors
							regimes (dugout; trampling).
Cavendish (8378)[6]	1987	1987	2012	0 [2012]	>0 [1987]		Dune stabilization.
Barnwell[6]	1988	1988	1988	8 [1988]	8 [1988]		Invasive species (*Agropyron cristatum, Melilotus* spp). Dune stabilization.
Hilda (8381)[6]	1987	1987	2012	0 [2012]	3 [1988]		Invasive species (*Agropyron cristatum*). Dune stabilization.
Lonesome Lake (8382)[6]	1987	1987	2012	0 [2012]	1 [1987]		Alteration to grazing regimes (dugout, browsing, trampling).
Medicine Lodge Coulee[6,7]	1995	1995	1995	>0 [1995]	>0 [1995]		
BRITISH COLUMBIA							
Wasa Lake (8871)	2009	2009	2009	2 [2009]	2 [2009]	Crown - Provincial Park	Recreation (hiking, beach use/trampling), flooding.

[1] Note that most estimates or counts are frequently from only a few occurrences at each population, and therefore values presented here should not be interpreted as an estimate for the entire population. In addition, the data show that often counts or estimates are taken at different occurrences in subsequent years, or new occurrences are found in subsequent visits and those are added on to the estimates for a population. Therefore, it is difficult to compare estimates among years. Estimates or counts also vary among years depending on factors discussed in Sec 3.2 such as yearly fluctuations in annuals and use of different census techniques. Values and occurrences in the table are those known to Environment Canada as of Sept 2013; however, 2013 data had not yet been submitted to the CDC or EC so 2013 data was not included.

[2] Sources: ACIMS (pers. comm. and unpubl. data 2013), AESRD (pers. comm. and unpubl. data 2013), MB CDC (pers. comm. and unpubl. data 2013), SK CDC (pers. comm. and unpubl. data 2013), COSEWIC (2006), Diana Bizecki Robson (pers. comm, and unpubl. data 2012), Environment Canada (unpubl. data).

[3] If no counts or estimates were provided (e.g. surveyors collected area of occupancy information instead, or simply confirmed presence of plants and habitat), it is recorded here as >0 to indicate presence of Smooth Goosefoot plants.

[4] There are some unconfirmed and historic occurrences within this population. These unconfirmed and historic occurrences are not being considered as part of the population and distribution objectives or for critical habitat at this time.

[5] There are some unconfirmed occurrences within this population. These unconfirmed occurrences are not being considered as part of the population and distribution objectives or for critical habitat at this time.

[6] All occurrences within this population are historic and/or unconfirmed. This entire population is not being considered for as part of the population and distribution objectives or for critical habitat at this time.

[7] Identification of specimens collected from this occurrence are questionable.

[8] The federal land referred to here is an AAFC-AESB Community Pasture, or in the case of Lost River Valley, an AAFC Research Substation (Onefour). Federal community pastures and research stations consist of a mixture of federal and provincial land. Over the period 2013-2018, the federal government will cease pasture operations on provincially-owned land, which comprises more than 90% of the lands within the federal pastures. Operations will also cease on the Onefour Research Substation. Future administration and control of these lands will be the responsibility of Provincial Government.

APPENDIX B: CRITICAL HABITAT MAPS FOR SMOOTH GOOSEFOOT IN CANADA

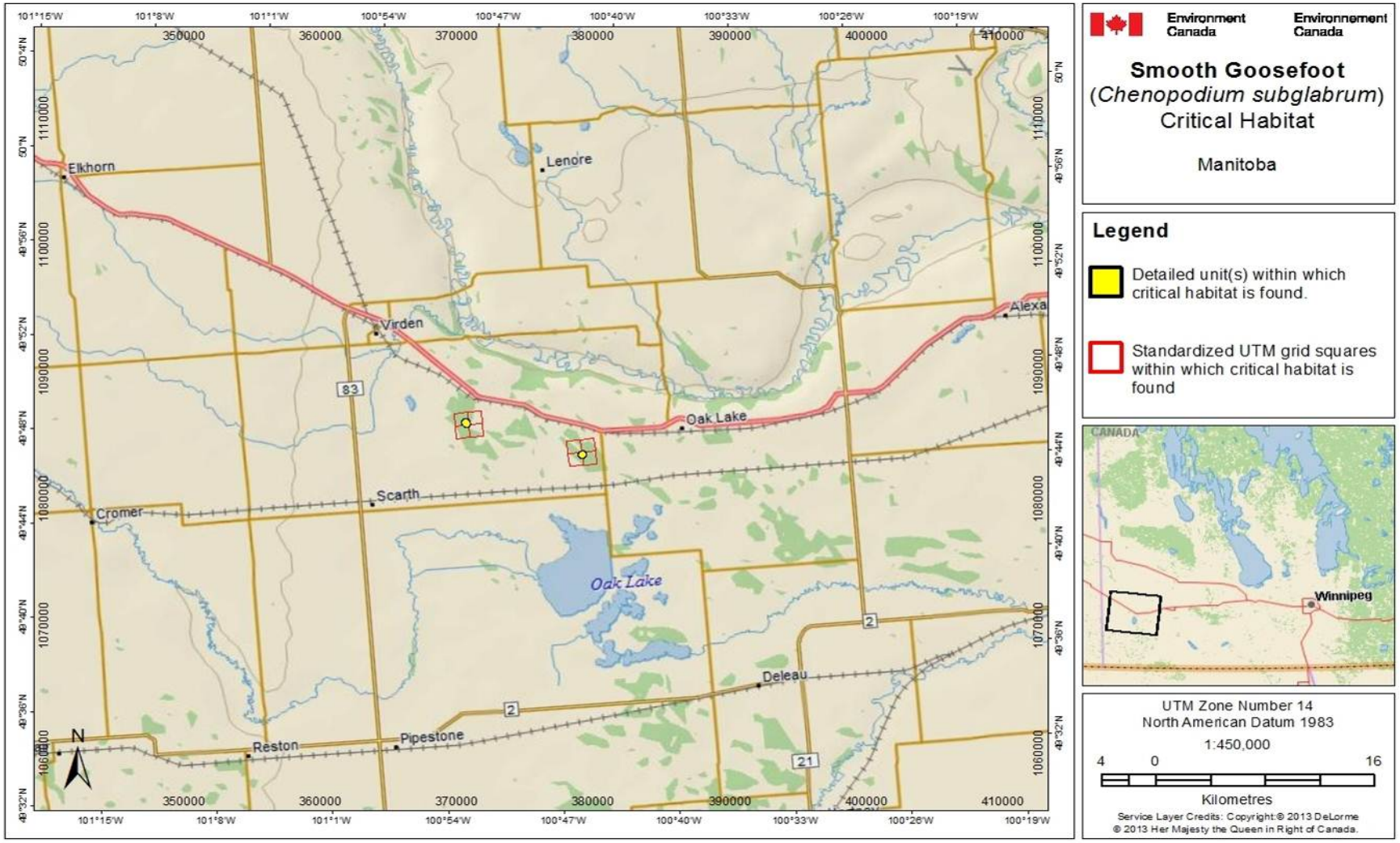

Figure B1. Critical habitat for Smooth Goosefoot in Manitoba (Routledge, Oak Lake) is represented by the yellow shaded units, where the criteria set out in Section 7.1 are met. The 1 km x 1 km UTM grid overlay shown on this figure is a standardized national grid system that indicates the general geographic area containing critical habitat.

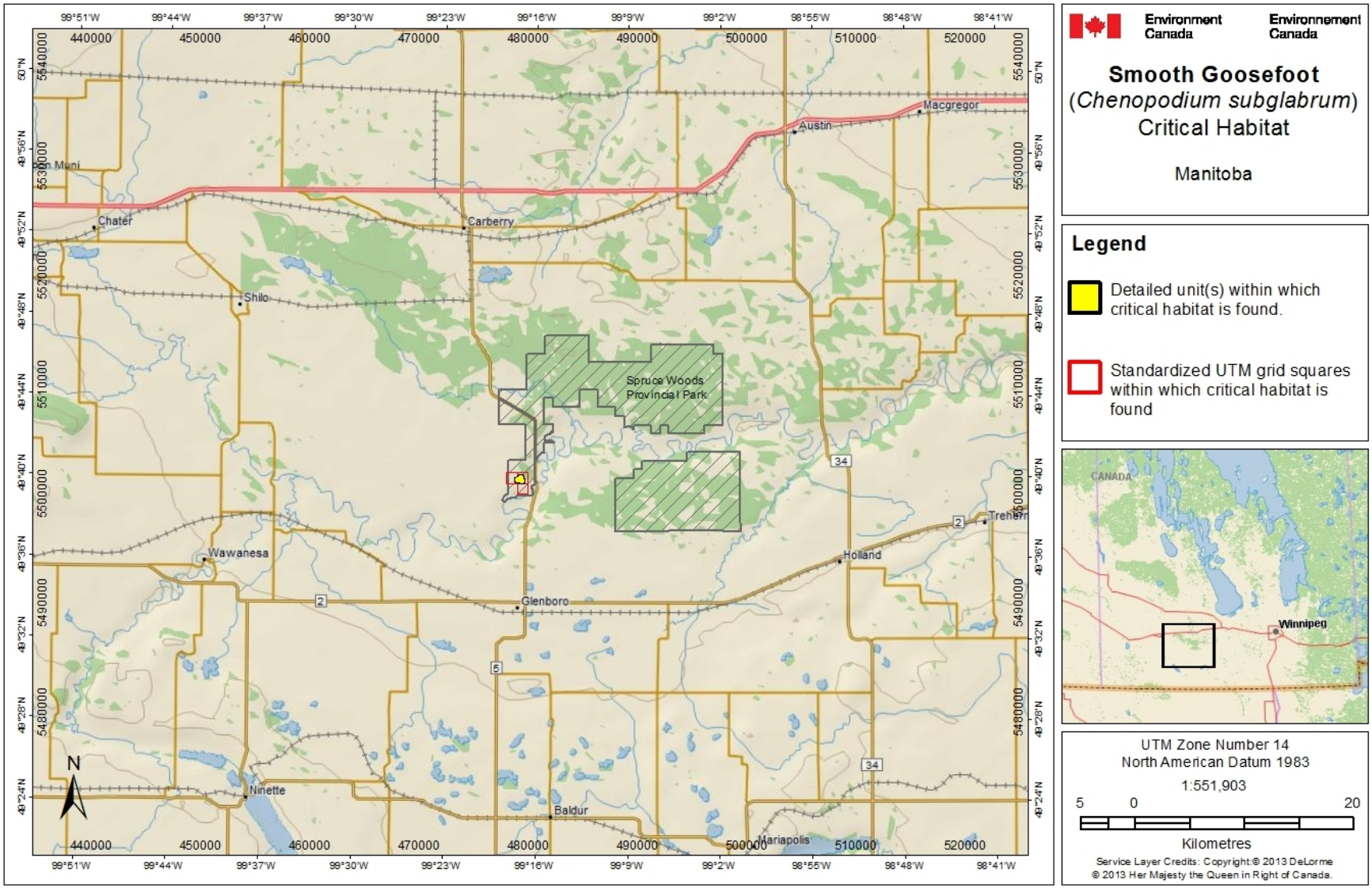

Figure B2. Critical habitat for Smooth Goosefoot in Manitoba (Spruce Woods) is represented by the yellow shaded units, where the criteria set out in Section 7.1 are met. The 1 km x 1 km UTM grid overlay shown on this figure is a standardized national grid system that indicates the general geographic area containing critical habitat.

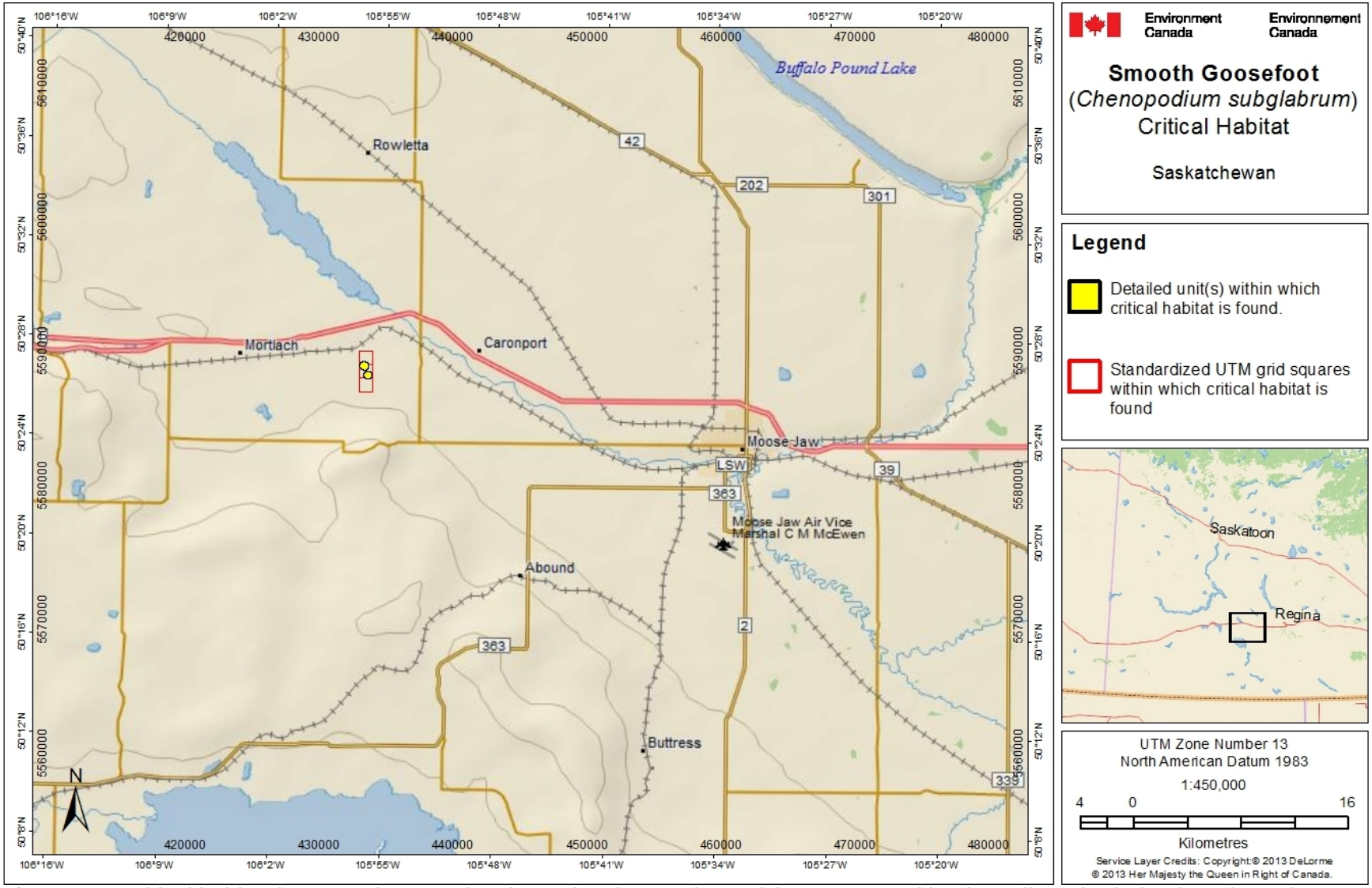

Figure B3. Critical habitat for Smooth Goosefoot in Saskatchewan (Caron) is represented by the yellow shaded units, where the criteria set out in Section 7.1 are met. The 1 km x 1 km UTM grid overlay shown on this figure is a standardized national grid system that indicates the general geographic area containing critical habitat.

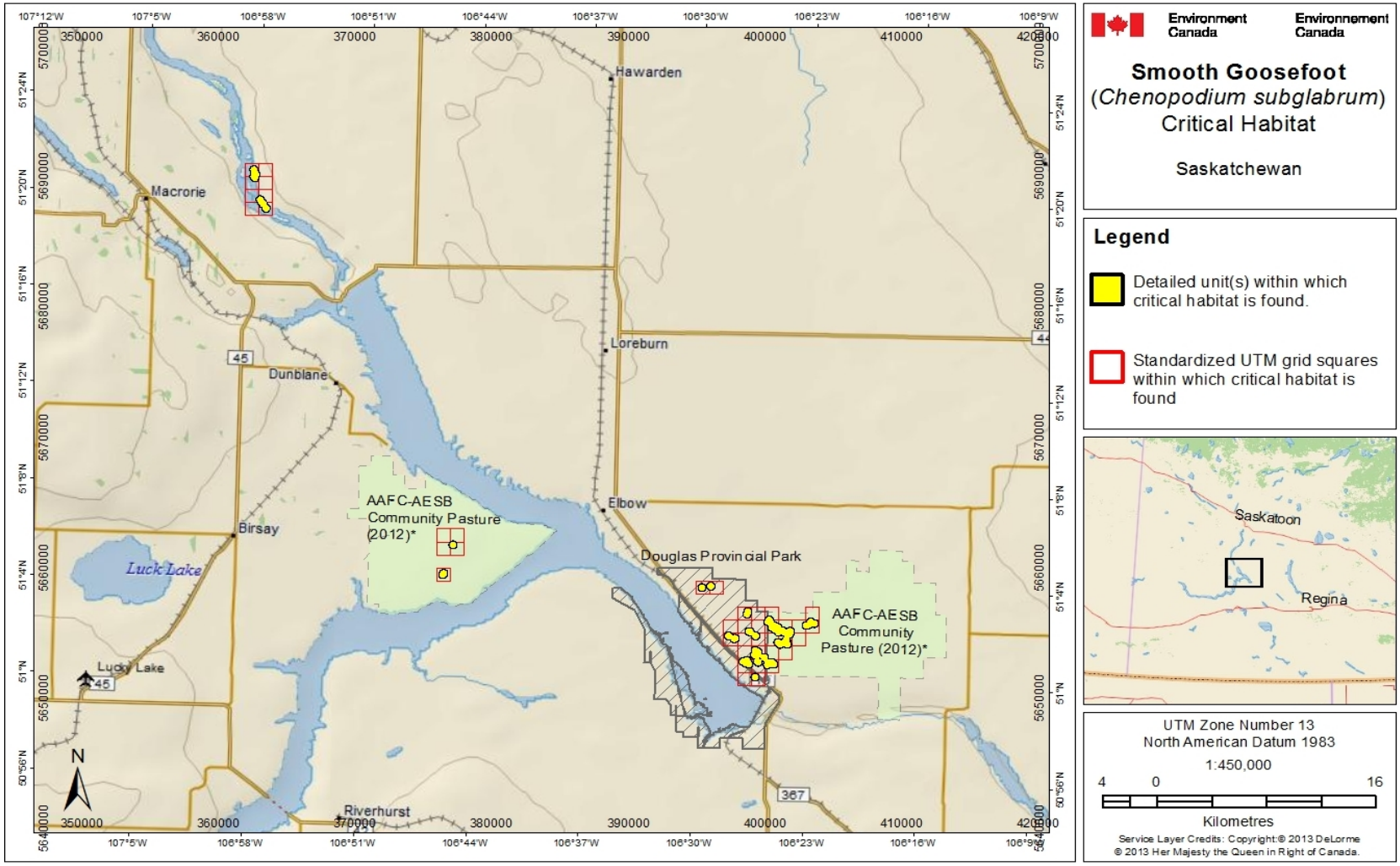

Figure B4. Critical habitat for Smooth Goosefoot in Saskatchewan (Coteau, Elbow, Lake Diefenbaker) is represented by the yellow shaded units, where the criteria set out in Section 7.1 are met. The 1 km x 1 km UTM grid overlay shown on this figure is a standardized national grid system that indicates the general geographic area containing critical habitat.

** Federal AAFC-AESB community pastures and research stations consist of a mixture of federal and provincial land. Over the period 2013-2018, the federal government will cease pasture operations on provincially-owned land, which comprises more than 90% of the lands within the federal pastures. Operations will also cease on the Onefour Research Substation. Future administration and control of these lands will be the responsibility of Provincial Government.*

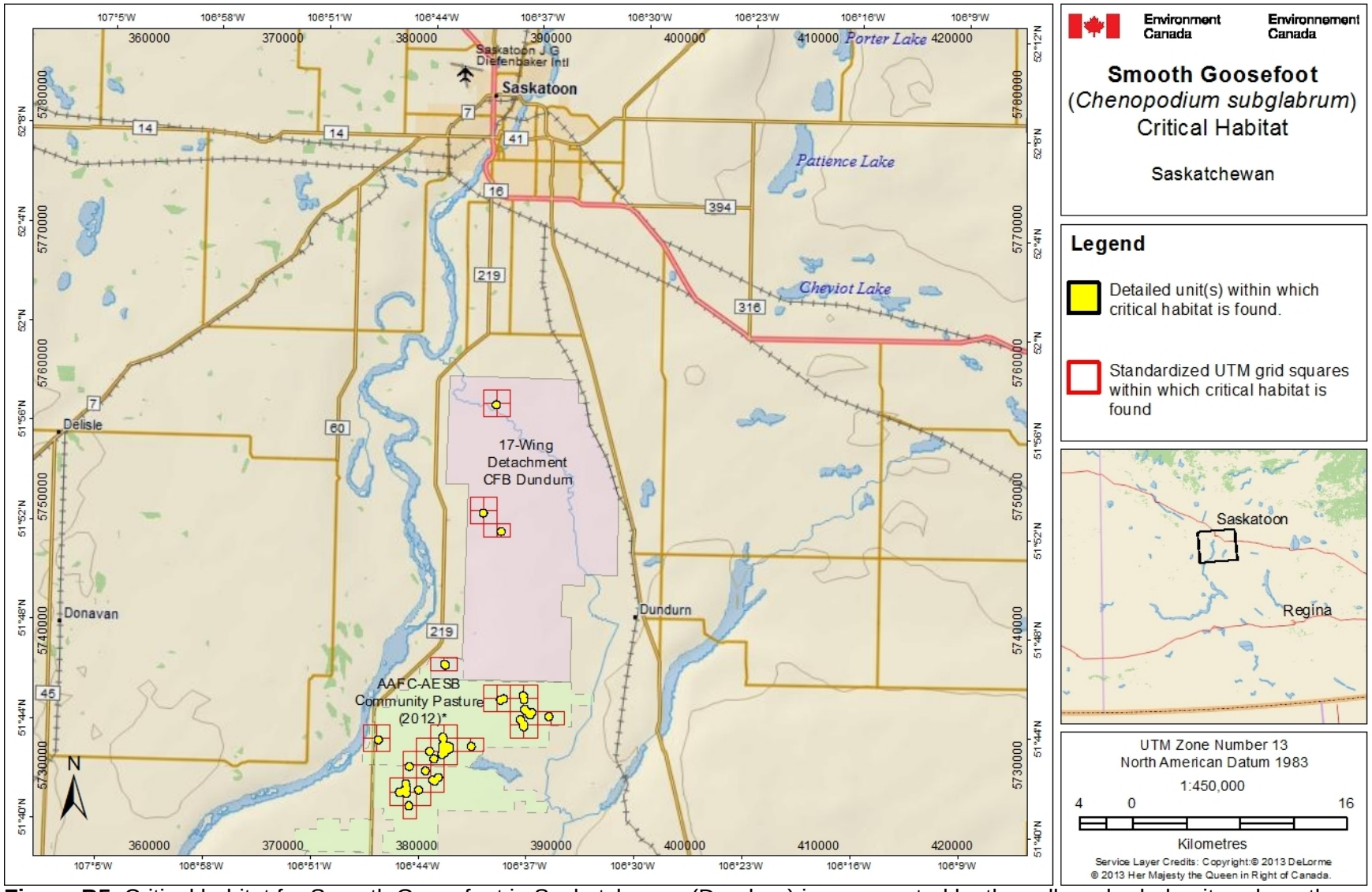

Figure B5. Critical habitat for Smooth Goosefoot in Saskatchewan (Dundurn) is represented by the yellow shaded units, where the criteria set out in Section 7.1 are met. The 1 km x 1 km UTM grid overlay shown on this figure is a standardized national grid system that indicates the general geographic area containing critical habitat.

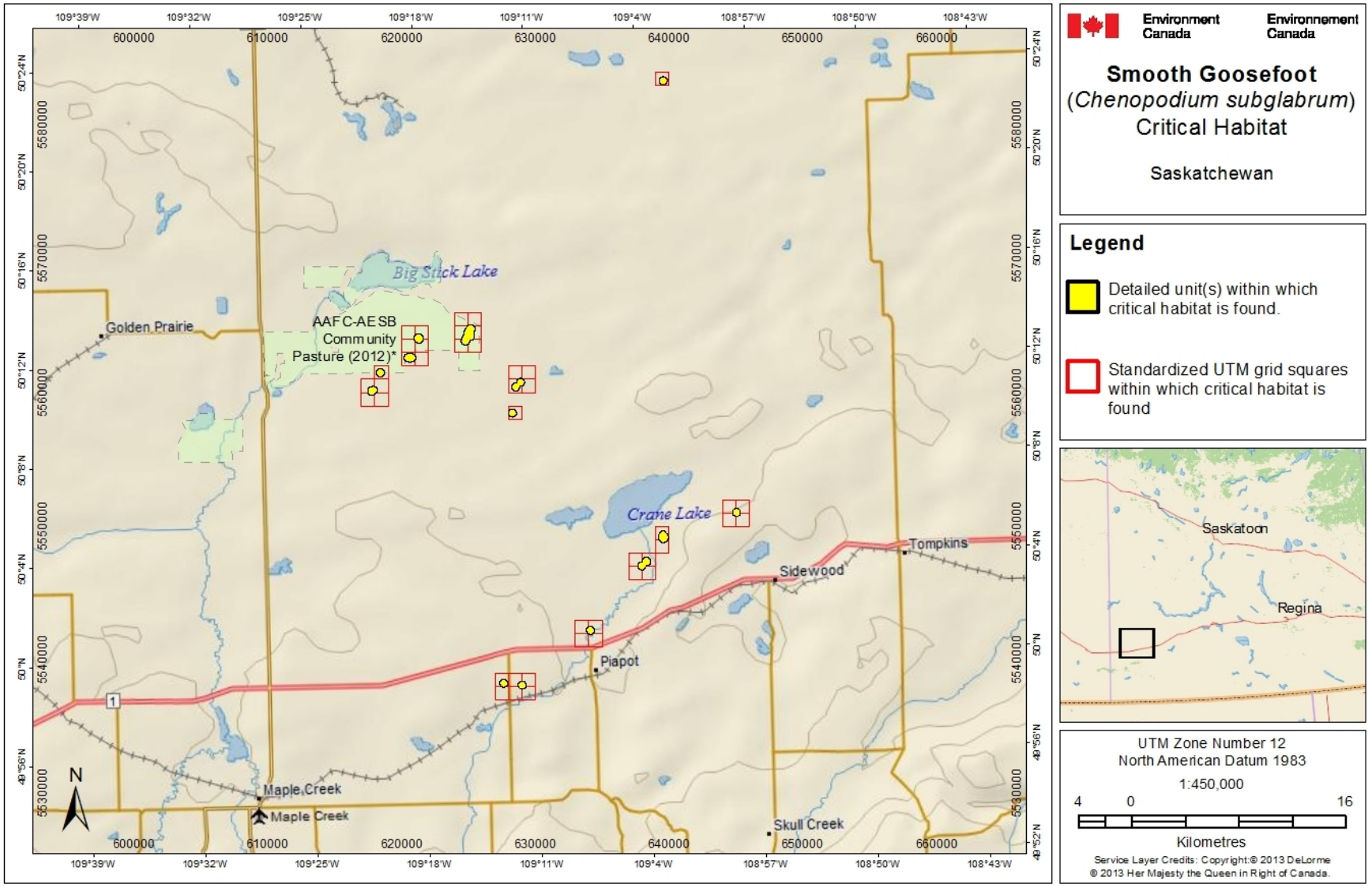

Figure B6. Critical habitat for Smooth Goosefoot in Saskatchewan (Bigstick, Crane Lake, Piapot) is represented by the yellow shaded units, where the criteria set out in Section 7.1 are met. The 1 km x 1 km UTM grid overlay shown on this figure is a standardized national grid system that indicates the general geographic area containing critical habitat.

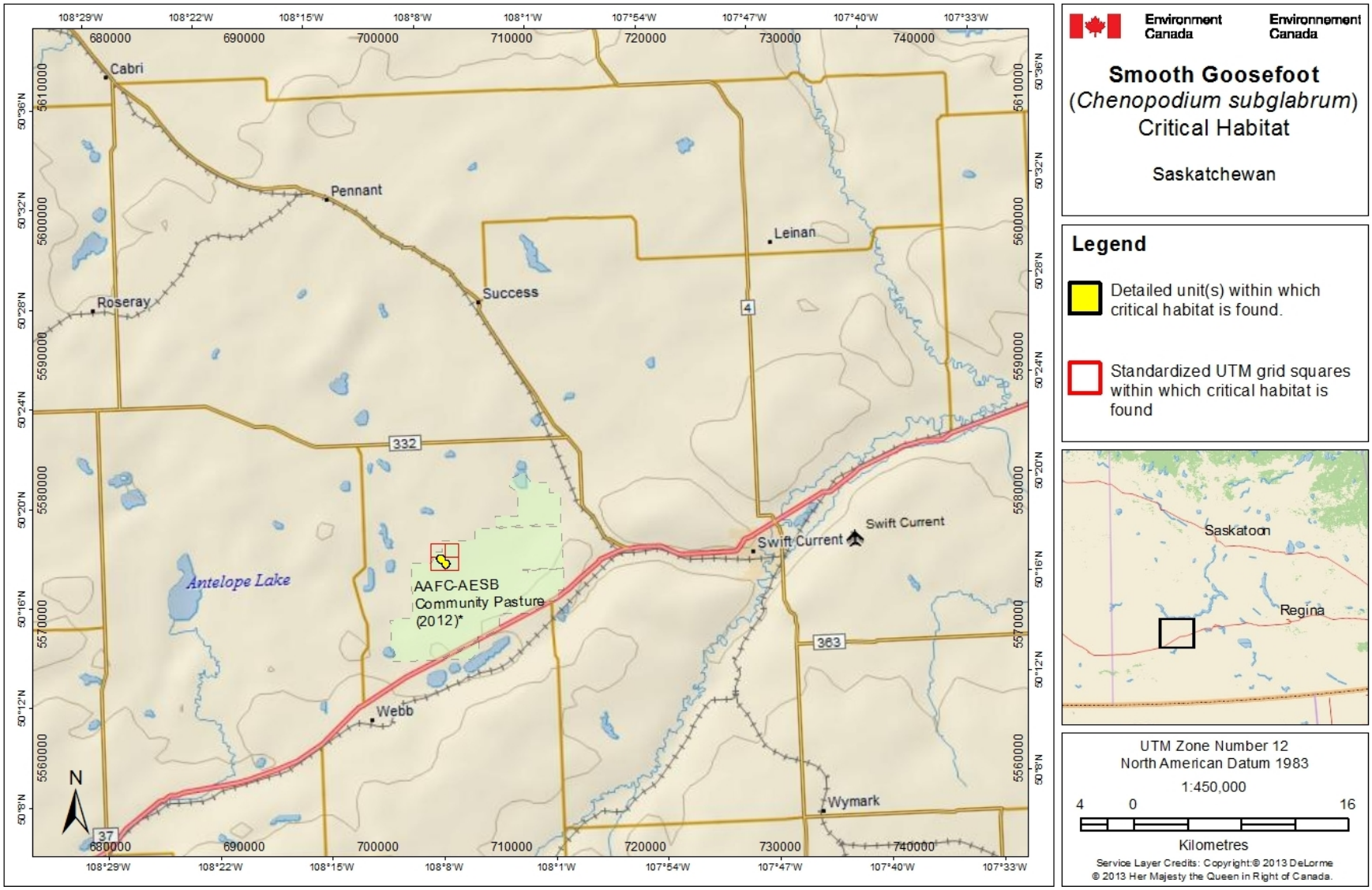

Figure B7. Critical habitat for Smooth Goosefoot in Saskatchewan (Webb) is represented by the yellow shaded units, where the criteria set out in Section 7.1 are met. The 1 km x 1 km UTM grid overlay shown on this figure is a standardized national grid system that indicates the general geographic area containing critical habitat.

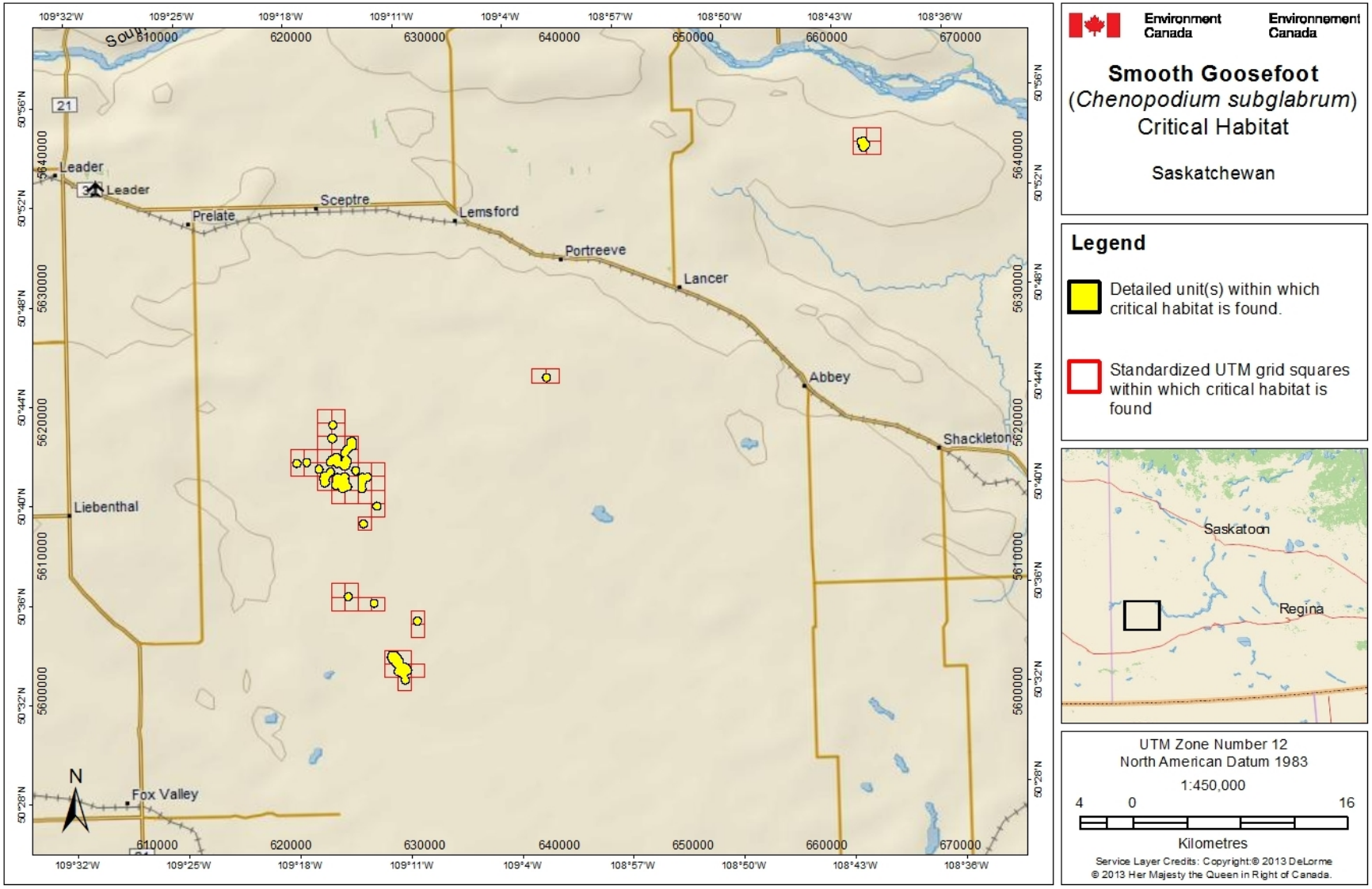

Figure B8. Critical habitat for Smooth Goosefoot in Saskatchewan (Great Sandhills, Cramersburg) is represented by the yellow shaded units, where the criteria set out in Section 7.1 are met. The 1 km x 1 km UTM grid overlay shown on this figure is a standardized national grid system that indicates the general geographic area containing critical habitat.

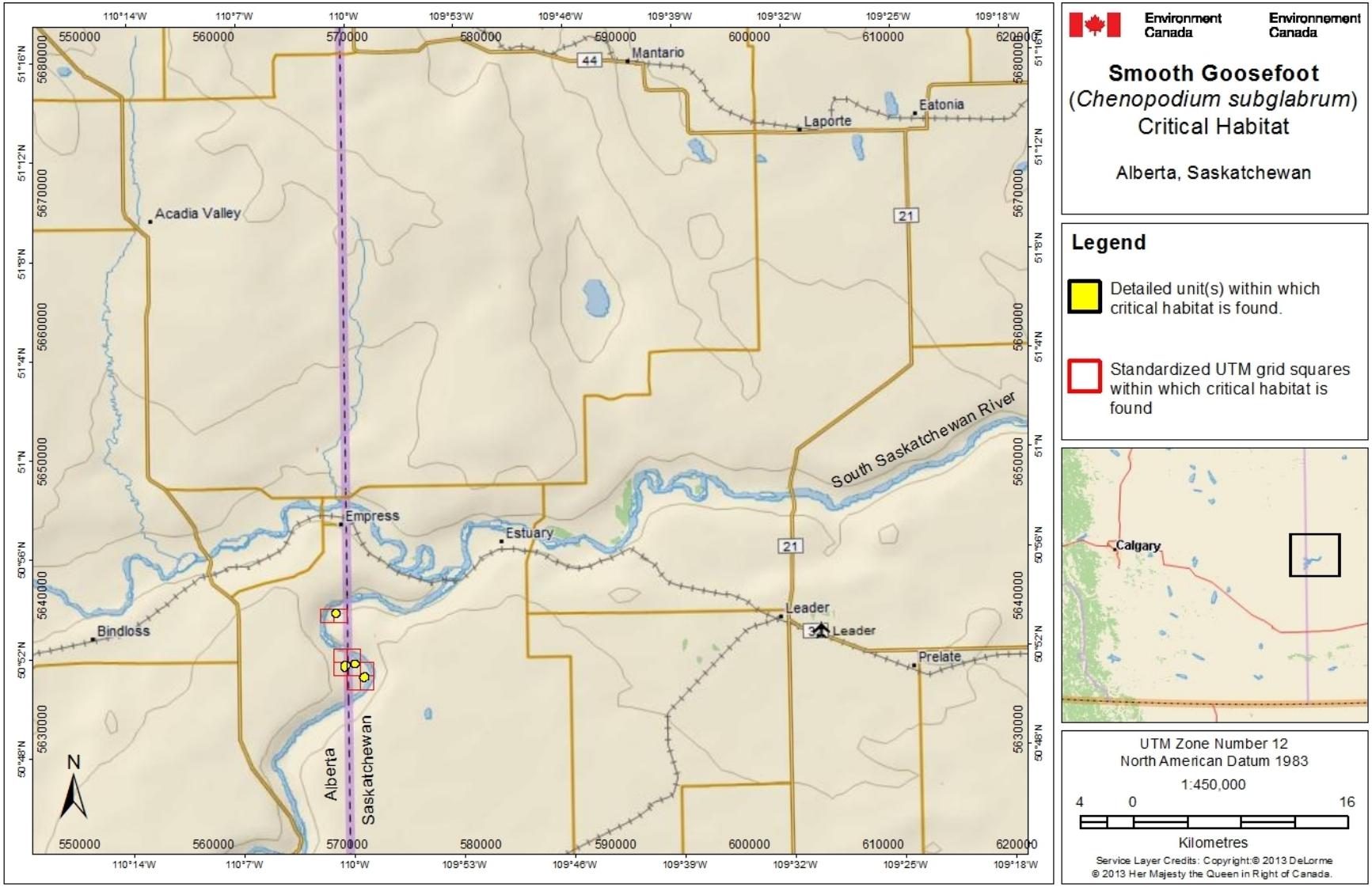

Figure B9. Critical habitat for Smooth Goosefoot in Saskatchewan and Alberta (S SK River Loop) is represented by the yellow shaded units, where the criteria set out in Section 7.1 are met. The 1 km x 1 km UTM grid overlay shown on this figure is a standardized national grid system that indicates the general geographic area containing critical habitat.

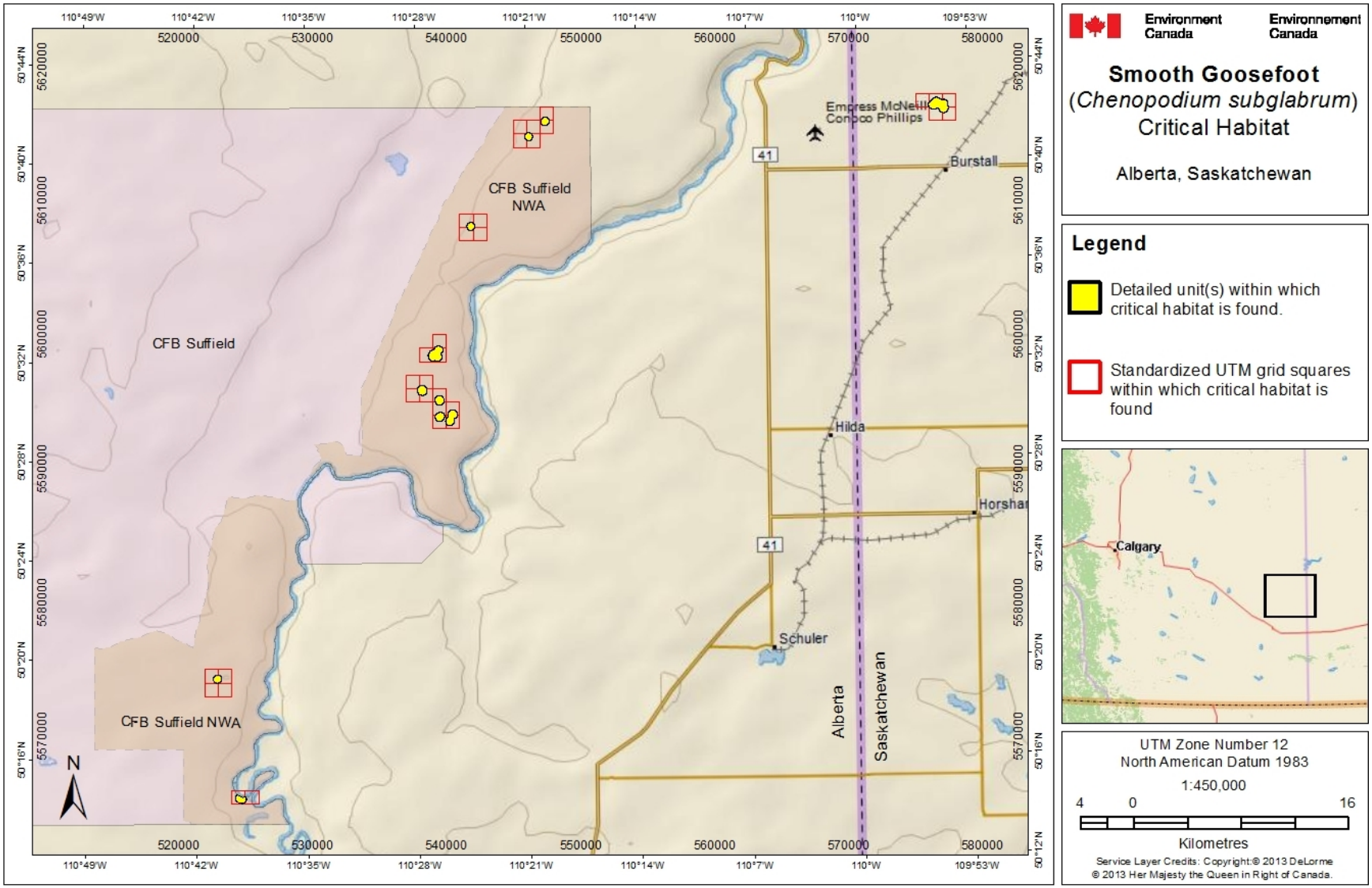

Figure B10. Critical habitat for Smooth Goosefoot in Saskatchewan and Alberta (CFB Suffield NWA, Burstall) is represented by the yellow shaded units, where the criteria set out in Section 7.1 are met. The 1 km x 1 km UTM grid overlay shown on this figure is a standardized national grid system that indicates the general geographic area containing critical habitat.

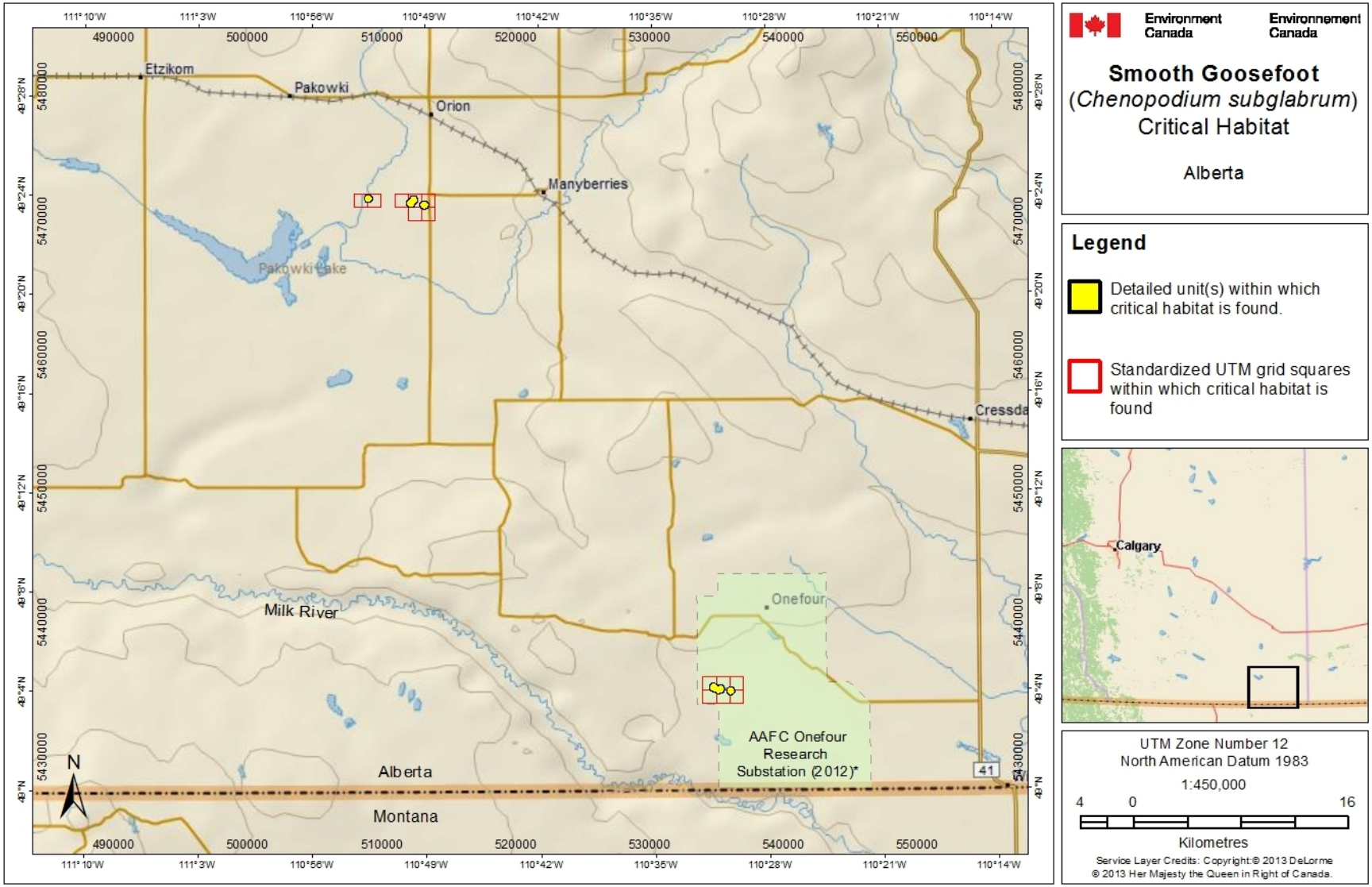

Figure B11. Critical habitat for Smooth Goosefoot in Alberta (Lost River Valley) is represented by the yellow shaded units, where the criteria set out in Section 7.1 are met. The 1 km x 1 km UTM grid overlay shown on this figure is a standardized national grid system that indicates the general geographic area containing critical habitat.

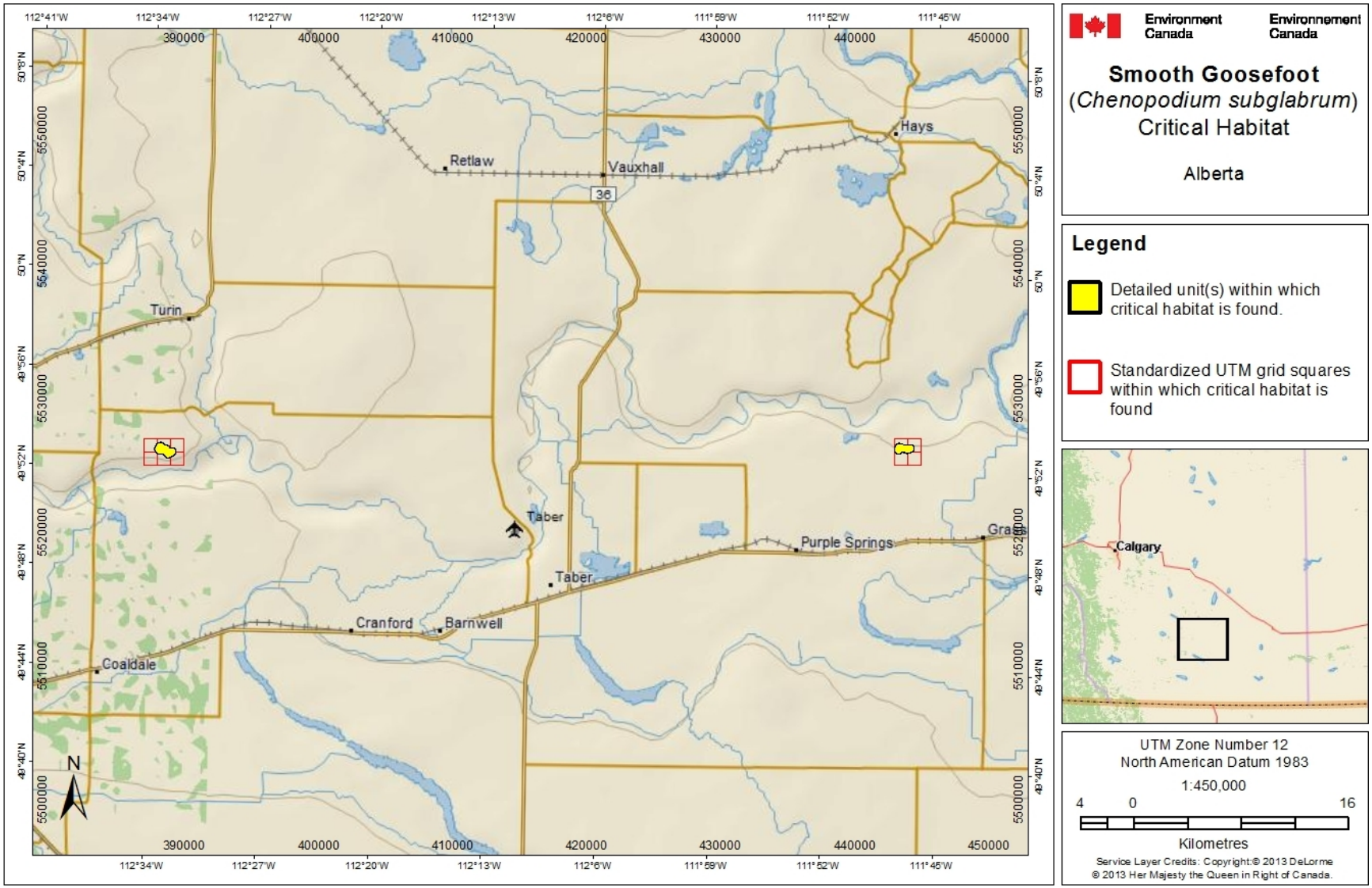

Figure B12. Critical habitat for Smooth Goosefoot in Alberta (Purple Springs, Turin) is represented by the yellow shaded units, where the criteria set out in Section 7.1 are met. The 1 km x 1 km UTM grid overlay shown on this figure is a standardized national grid system that indicates the general geographic area containing critical habitat.

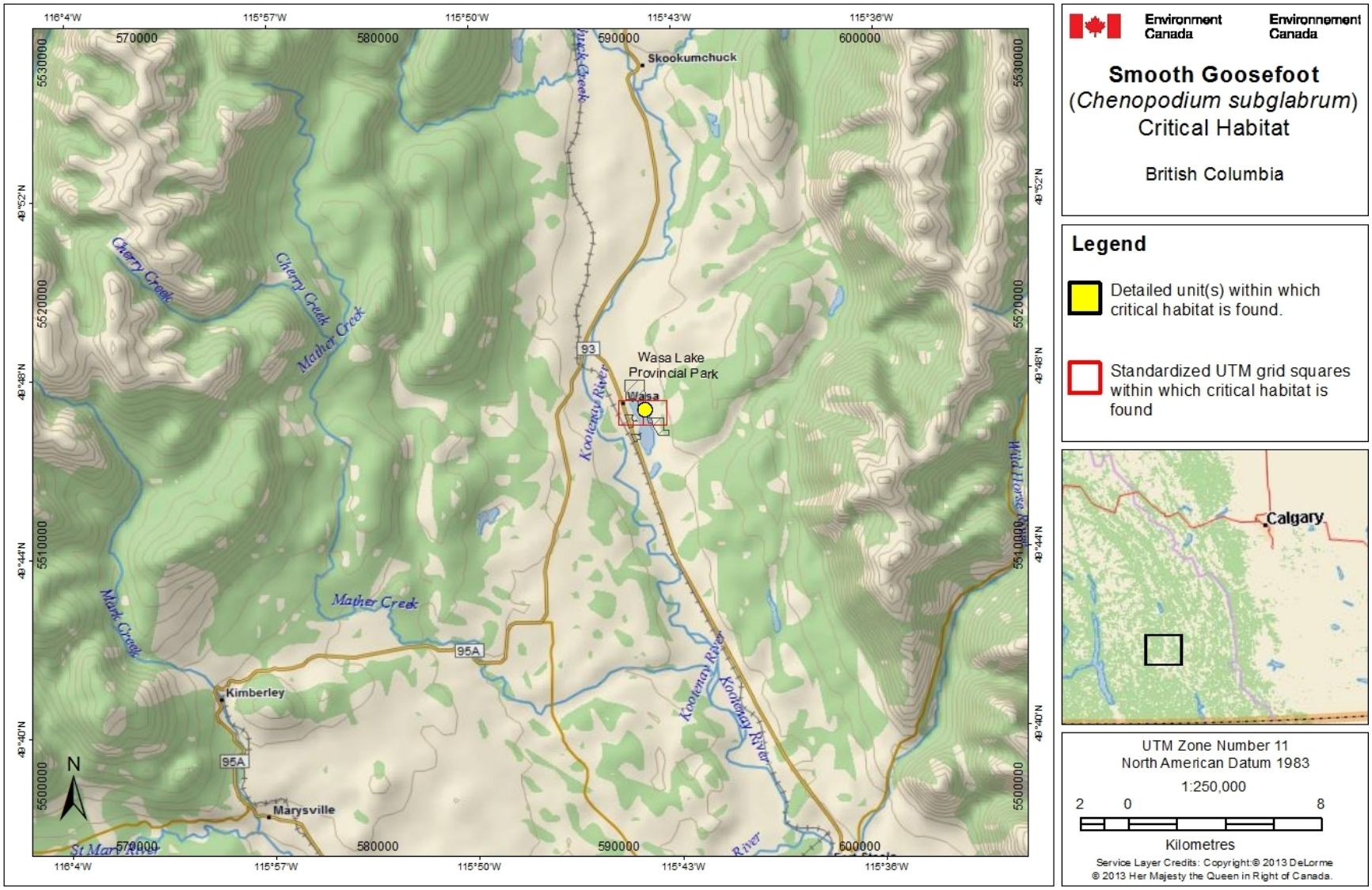

Figure B13. Area within which critical habitat for Smooth Goosefoot in British Columbia (Wasa Lake) is represented by the yellow shaded units, where the criteria set out in Section 7.1 are met. The 1 km x 1 km UTM grid overlay shown on this figure is a standardized national grid system that indicates the general geographic area containing critical habitat.

APPENDIX C: 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[12] (FSDS) goals and targets.

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.

A number of species rely on sand dunes for their survival, including other species at risk (Table C1) and provincially rare species that co-occur with Smooth Goosefoot. Most, if not all, of these species should benefit from recovery activities and management of threats intended to maintain dune ecosystems for the benefit of Smooth Goosefoot. The potential for the strategy to inadvertently lead to adverse effects on other species was considered. Some management activities, including prescribed burns and some forms of integrated weed management, have the potential to harm some species, at least in the short term. As a general rule, management actions that incorporate or mimic natural disturbance regimes (e.g., fire and grazing) are natural components of prairie ecosystems and are not likely to negatively impact the persistence of other native species particularly if the timing, intensity and frequency mimic natural processes (Samson and Knopf 1994). Recovery activities and beneficial management plans should strive to benefit as many species as possible and the ecological risks of any action must be considered before undertaking them in order to reduce possible negative effects. Efforts should be coordinated with other recovery teams and organizations working in the dune ecosystem to ensure the most efficient use of resources and to prevent duplication of effort and conflicts with research. The broad strategies described in this recovery strategy are expected to benefit the environment and not entail any significant adverse effects on other species at risk or biodiversity of sand dune ecosystems.

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

Table C1. Species at risk which co-occur in areas occupied by Smooth Goosefoot.

Species Name	SARA Designation
Mammals	
Swift Fox (*Vulpes velox*)	Endangered
Ord's Kangaroo Rat (*Dipodomys ordii*)	Endangered
American Badger jeffersonii subspecies (*Taxidea taxus jeffersonii*)	Endangered
Birds	
Greater Sage Grouse (*Centrocercus urophasianus*)	Endangered
Loggerhead Shrike (*Lanius ludovicianus*)	Threatened
Common Nighthawk (*Chordeiles minor*)	Threatened
Sprague's Pipit (*Anthus spragueii*)	Threatened
Ferruginous Hawk (*Buteo regalis*)	Threatened
Reptiles	
Prairie Skink (*Plestiodon septentrionalis*)	Endangered
Amphibians	
Great Plains Toad (*Anaxyrus cognatus*)	Special Concern
Invertebrates	
Gold-edged Gem (*Schinia avemensis*)	Endangered
Dusky Dune Moth (*Copablepharon longipenne*)	Endangered
White Flower Moth (*Schinia bimatris*)	Endangered
Pale Yellow Dune Moth (*Copablepharon grandis*)	Special Concern
Vascular Plants	
Small-flowered Sand-verbena (*Tripterocalyx micranthus*)	Endangered
Tiny Cryptantha (*Cryptantha minima*)	Endangered[1]
Hairy Prairie-clover (*Dalea villosa* var. *villosa*)	Threatened[1]
Slender Mouse-ear-cress (*Halimolobos virgata*)	Threatened
Western Spiderwort (*Tradescantia occidentalis*)	Threatened

[1]These species were recently reassessed by COSEWIC and downlisted to Threatened status for Tiny Cryptantha and Special Concern status for Hairy Prairie-clover but amendments have not been made to Schedule 1 of the *Species at Risk Act* yet to reflect this.

APPENDIX D. BENEFICIAL OR BEST RANGELAND MANAGEMENT PRACTICES

Smooth Goosefoot occupies a variety of locations that vary in ecology, land use history, and land tenure in four provinces. For these reasons, it is not possible to propose a general set of beneficial management plans that would be appropriate to encompass all habitat. Instead, specific recommendations will be made in one or more action plans or beneficial management plans at scales appropriate for general recommendations and application. At this time only a few general statements can be made regarding on-going activities that benefit Smooth Goosefoot.

Careful and deliberate application of grazing by one or more classes of livestock may help maintain open sandy habitats needed by Smooth Goosefoot. Management of these livestock requires occasional and randomly dispersed overland access on-foot, on-horseback, by all-terrain vehicle, or on existing trails by vehicles up to 1 tonne. In light of these facts, no changes are recommended at this time to current stocking rates, grazing seasons, classes of livestock, or access methods used by property owners with Smooth Goosefoot on their land. Research is needed to determine if alternative grazing systems could enhance habitat, reproductive output, or dispersal of Smooth Goosefoot.

Integrated weed management to control invasive alien species like Leafy Spurge, Baby's-breath, Downy Brome, and Crested Wheatgrass invasion could directly reduce competition with Smooth Goosefoot, or indirectly change ungulate grazing behaviour or fuel quality for carrying fire that would otherwise improve habitat for Smooth Goosefoot. Approaches used to reduce the occurrence and density of invasive alien species Smooth Goosefoot habitat need to be dealt with on a site-specific basis or in one or more action plans.

Fires resulting from accidental or deliberate ignition by people will not destroy Smooth Goosefoot habitat nor harm individual plants under most circumstances. In fact, prescribed burns that are carefully managed and that mimic the timing, frequency and intensity of natural processes can improve habitat by reducing or preventing invasion of woody vegetation, grass litter, insect pests and pathogens.

Environment Canada will work with all of its partners to define and improve best practices for conserving the Smooth Goosefoot across its range and to incorporate multi-species requirements and management in these sand dune ecosystems.