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# Alberta Slender Mouse Ear Cress Recovery Plan

Alberta Species at Risk Recovery Plan No. 39



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# Recovery Planning in Alberta

Albertans are fortunate to share their province with an impressive diversity of wild species. Populations of most species of plants and animals are healthy and secure. However, a small number of species are either naturally rare or are now imperiled because of human activities. Alberta Species at Risk recovery plans establish a basis for cooperation among government, industry, conservation groups, landowners, Indigenous communities, and other stakeholders to ensure these species and populations are restored or maintained for future generations of Albertans.

Alberta has a robust provincial recovery program to support its commitment to the federal/provincial *Accord for the Protection of Species at Risk* and the *National Framework for the Conservation of Species at Risk*, and its requirements established under Alberta's *Wildlife Act* and the federal *Species at Risk Act*. An overall goal of the program is to restore species identified as Threatened or Endangered to viable, naturally self-sustaining populations within Alberta.

Alberta Environment and Parks is committed to providing opportunities for Indigenous communities, stakeholders, and the Alberta public to provide their perspectives and influence plan content during the recovery planning process. The process for how Albertans are engaged can vary based on the socio-economic and conservation issues and the level of interest expressed. Draft recovery plans undergo a review by the Fish and Wildlife Stewardship Branch and are then posted online for public comment for at least 30 days. Following public review, Alberta's Endangered Species Conservation Committee reviews draft plans and provides recommendations on their acceptability to the Minister of Environment and Parks. Plans accepted and approved for implementation by the Minister are published as a provincial government recovery plan. Approved plans are a summary of the Ministry of Environment and Park's commitment to work with involved stakeholders to coordinate and implement conservation actions necessary to restore or maintain vulnerable species.

Recovery plans include two main sections: (1) a situational analysis that highlights the species' distribution and population trends, threats, and conservation actions to date; and (2) a recovery section that outlines goals, objectives, associated broader strategies, and specific priority actions required to maintain or recover Threatened or Endangered species. Each approved recovery plan undergoes regular review and at that time progress on implementation is evaluated. Implementation of each plan is subject to internal and external resource availability.

Recovery plans will be systematically reviewed every 5 years. Where there are large changes in the goals, objectives, or strategy sections due to a new understanding or circumstance, a plan may need to be redrafted, consulted on, reviewed by the Endangered Species Conservation Committee, and the changes approved by the Minister.

# Executive Summary

In 2011, Alberta's Minister of Environment and Parks approved the listing of slender mouse-ear-cress as *Endangered* in Alberta, based on recommendations from the Scientific Sub-Committee of the Endangered Species Conservation Committee. The designation is based on a small area of occupancy, small extent of occurrence and small population size, combined with extreme population fluctuations due to climatic conditions, decreasing population inferred from decline in habitat quality, and isolation of populations in Alberta from those in other jurisdictions (i.e., Saskatchewan and Montana).

Slender mouse-ear-cress belongs to the mustard family and is typically considered a biennial plant; however, it may complete its growth cycle in one year (annual) or two years (perennial). Slender mouse-ear-cress is generally found growing in loam to sandy-loam textured soils on gently undulating sites. Currently, 16 subpopulations make up the known population in Alberta, and distribution is limited to the areas near Cavendish, Bindloss, McNeill, Empress, and the northeast corner of Canadian Forces Base (CFB) Suffield. Overall provincial population size is estimated to be in the order of 3 000–7 000 individuals.

The slender mouse-ear-cress population is susceptible to localized threats due to its limited distribution in the province. Potential threats include invasion by non-native plant species, oil and gas development, urban expansion, agricultural practices, wind energy development, sand and gravel extraction, altered grazing and fire regimes, and climate change.

The goal of the recovery plan is that all naturally occurring populations of slender mouse-ear-cress in Alberta are secured from future land-use change and invasion of non-native plant species. Strategies for the maintenance of slender mouse-ear-cress in Alberta focus on addressing the threats to the species and its habitat: the three strategies focus on managing and controlling invasive species that threaten its persistence, habitat securement through management and protection, and information dissemination and education. The recovery plan presents action items corresponding to each strategy moving forward.



# 1.0 Introduction

Slender mouse-ear-cress (*Halimolobos virgata*, also known as *Transberingia bursifolia* subsp. *virgata*) is a biennial vascular plant that occupies a unique habitat niche within the native prairie environment in southern Alberta: depressed areas that seasonally flood or are subject to water accumulation, characterized by loam to sandy-loam soils. In dry years, most, if not all, seeds may remain dormant, with little or no plant growth, making quantification challenging in some years.

This species was listed as *Endangered* in Alberta in 2011, based on a small area of occupancy, small extent of occurrence, and small population size.

## 2.0 Process for Plan Development

In May 2012, a recovery team was formed with the following members:

- Lisa Matthias, Team Co-lead (Alberta Environment and Parks) (later replaced by Cindy Kemper);
- Joel Nicholson, Team Co-lead (Alberta Environment and Parks) (later replaced by Sandi Robertson);
- Cheryl Bradley (Professional Botanist, Director of the Alberta Native Plant Council);
- Jordon Christianson (Municipal Affairs, Special Areas Board);
- Laurie Hamilton (Alberta Native Plant Council); and
- Dr. Scott Nielsen (University of Alberta).

The first and second recovery team meetings were held in September 2012 and November 2013, respectively. The draft recovery plan was posted online for public consultation for four weeks in September 2015. Comments from five respondents were received and incorporated into the draft, as appropriate. The recovery plan was reviewed at the October 2, 2018 Endangered Species Conservation Committee (ESCC) meeting, and ministerial approval of the plan was received in January 2019.

## 3.0 Situational Analysis

### 3.1 Biology

Although typically biennial, slender mouse-ear-cress may produce flowers and seeds in the first year of growth if there is ample early season moisture, or may survive more than two seasons if seed is not produced in the second year (ASRD and ACA 2009, Environment Canada 2012). An annual life strategy dominates in years with sufficient spring and early summer moisture (Nemirsky 2011), while a biennial life strategy dominates in years with insufficient spring moisture and abundant late summer moisture. If conditions during the following year are not adequate, the plant can persist an additional season. Despite possessing this adaptive ability to adjust its life strategy, slender mouse-ear-cress is unable to compete with other established native prairie plants. In addition, it occupies a unique habitat niche within the native prairie environment: depressed areas that seasonally flood or are subject to water accumulation (Nemirsky 2011, Environment Canada 2012). This unique habitat requirement likely contributes to the species' rarity, given the ephemeral nature of these habitats and high rate of conversion of these habitats in southern Alberta. Slender mouse-ear-cress grows in native mixed grassland on flat to gently undulating sand plains (ASRD and ACA 2009). It is generally found growing in loam to sandy-loam textured soils.

More detailed information on the life history of slender mouse-ear-cress can be found in ASRD (2005).

### 3.2 Population Status

Slender mouse-ear-cress (Figure 1) was assessed as *Endangered* in 2011 by the Scientific Subcommittee of the Endangered Species Conservation Committee. The *Endangered* designation was based on a small area of occupancy, small extent of occurrence, and small population size.

Nationally, the Committee on the Status of Endangered Wildlife in Canada (COSEWIC) assessed slender mouse-ear-cress as *Threatened* in 2000. In June 2001, slender mouse-ear-cress was listed as *Threatened* on Schedule 1 of the Canadian *Species at Risk Act* (SARA). A federal recovery strategy was completed in 2012.

Currently, 16 subpopulations or master element occurrences make up the known population in Alberta (ACIMS 2013) (Table 1). The number of reproductive individuals within subpopulations of slender mouse-ear-cress in Alberta, as variously defined in reports filed with ACIMS, ranges from 1 to 919 (Table 1). Overall provincial population size is estimated to be in the order of 3 000–7 000 individuals (ASRD and ACA 2009).



**Figure 1. Slender mouse-ear cress. Photos: Sandi Robertson.**

Of the 16 subpopulations of slender mouse-ear-cress in Alberta, eight are ranked extant (still persisting), six are ranked failed-to-find, one is ranked historical and one is ranked as extirpated (Table 1). A failed-to-find rank means plants have not been found during recent surveys at known locations and additional search effort is required to ascertain a status of extant (Hammerson et al. 2008). Historical indicates that the habitat is still extant but the species has not been detected at that location for a few decades. Extirpated indicates that there is persuasive evidence (such as destruction of habitat) that the species no longer exists at that location.

Status reports for slender mouse-ear-cress have been written for Alberta (ASRD 2005, ASRD and ACA 2009) and Canada (Smith 1992, COSEWIC 2000, Smith 2000). Records of slender mouse-ear-cress continue to be filed with the Alberta Conservation Information Management System and with the Saskatchewan Conservation Data Centre as standard practice by botanists conducting rare plant surveys.

Information on trends in the provincial population of slender mouse-ear-cress is lacking. To ascertain distribution and population trends in slender mouse-ear-cress, known locations must be revisited for three or more years, preferably with appropriate growing conditions (Environment Canada 2012). In addition, standard methods for surveying subpopulations are required if trends in data over multiple years are to be reliably interpreted.

**Table 1. Summary of slender mouse-ear-cress subpopulations in Alberta. Data are from the Alberta Conservation Information Management System database of rare plant occurrences (ACIMS 2021).**

Subpopulation Name (Master EO/EO i.d.) <sup>1</sup>	EO Rank	First Obs.	Most Recent Survey (Year)	Land Tenure, Land Use, Potential Threats
<b>Rosedale</b> N of Red Deer R. (033/18064)	H	1914	1914	Unknown.
<b>Duchess Pasture</b> Matzhiwin Creek (009/8117)	F	1997	2008	Private land; Irrigation District land under grazing lease. Oil and gas activity including large pipeline corridor. Invasion of non-native plant species.
<b>W of Remount Pasture</b> N Boundary CFB Suffield (015/17811)	E	2008	2011	AB public land under grazing lease. Oil and gas activity, including active wellsite. Large power line corridor. Invasion of non-native plant species.
<b>Remount Pasture NW</b> Cavendish (018/17814)	E	2008	2011	AB public land in Special Areas Community Pasture. Oil and gas activity including active well sites. Old cultivation nearby. Public highway nearby. Invasion of non-native plant species.
<b>Remount Pasture SE</b> N Boundary CFB Suffield (055/22479)	E	1997	2014	AB public land in Special Areas Community Pasture. Oil and gas activity including large pipeline corridor. Invasion of non-native plant species.
<b>Bindloss W</b> Minor Ranch (060/25206) <sup>5</sup>	E	2014	2014	AB public land under grazing lease. Oil and gas activity, including large pipeline corridor.
<b>Bindloss W</b> Remount Pasture (052/22428)	E	2007	2018	AB public land in Special Areas Community Pasture and AB public land under grazing lease. Oil and gas activity, including large pipeline corridor. Near public highway and old railway.
<b>Empress 1</b> Big Loop S. Sk. R. (016/17812)	F	2008	2011	AB public land under grazing lease. Oil and gas activity including active gas well. Cultivation nearby. New public gravel road construction nearby.
<b>Empress 2</b> Big Loop S. Sk. R. (017/17813)	E	2008	2011	AB public land under grazing lease. Oil and gas activity. Cultivation nearby. Invasion of non-native plant species.

<b>Linstead Flats</b> CFB Suffield NWA (001/8109)	F	1995	2017	National Wildlife Area. Oil and gas activity begun prior to NWA designation.
<b>S Sk. R. pipeline crossing</b> Social Plains (005/8113) <sup>3</sup>	F	1997	2014	AB public land under grazing lease. Oil and gas activity including large pipeline corridor.
<b>Sandy Point</b> Hwy 41 at S. Sk. R. (002/8110) <sup>4</sup>	F	1978	2002	Private land used for grazing. Adjacent to public highway. Non-native plant species invasion.
<b>McNeill 1</b> (004/8112)	E	1997	016	AB public land under grazing lease and private land used for grazing. Oil and gas activity including large pipeline corridor. Transected by public gravel road.
<b>McNeill 2</b> S. Sk River overlook (019/17843)	E	2008	2008	AB public land under grazing lease. Oil and gas activity including large pipeline corridor.
<b>Police Point</b> Medicine Hat (008/8116)	X	1884	2002	Land ownership unknown since exact location uncertain. Residential development and non-native species invasion.
<b>Bull Pen</b> CFB Suffield NWA (24397)	E	2013	2017	National Wildlife Area. Oil and gas activity begun prior to NWA designation.

<sup>1</sup> Subpopulation is equated with master element occurrence (EO) as defined by the Alberta Conservation Information System (ACIMS). Master EO# is provided by ACIMS. Subpopulations (or master EOs) are separated by at least 1 km, reflecting NatureServe's default criteria in the absence of detailed data on population biology and dispersal (NatureServe 2004, M. Meijer pers. comm.).

<sup>2</sup> Element Occurrence (EO) Rank: E=extant; F=failed-to-find; H=historical; X=extirpated. See Hammerson et al. (2008) for definitions.

<sup>3</sup> Referred to as "South SK River, W side" in the federal recovery strategy (Environment Canada 2012).

<sup>4</sup> Referred to as "South SK River, Hwy 41" in the federal recovery strategy (Environment Canada 2012).

<sup>5</sup> New Element Occurrence detected since status report (ASRD 2009).

### 3.3 Distribution and Habitat

All reports of slender mouse-ear-cress in Alberta are within the Dry Mixedgrass Natural Subregion of the Grassland Natural Region, more specifically in the watersheds of the Red Deer River below Drumheller and the South Saskatchewan River downstream of Medicine Hat (Figure 2).

The location and density of annual and biennial plants such as slender mouse-ear-cress are affected by seed dispersal in previous years and whether, in a survey year, precipitation is sufficient to stimulate seed germination and plant growth. In dry years, most, if not all, seed may remain dormant in the soil, and the few individual plants that do grow may be difficult to detect (Environment Canada 2012). Over the last few decades, considerable search effort for rare plants has occurred in southeastern Alberta in habitat apparently suitable for slender mouse-ear-cress. The large majority of search effort failed to find slender mouse-ear-cress (ASRD and ACA 2009).

### 3.4 Conservation Actions to Date

A number of measures have been taken in recent years to understand and conserve slender mouse-ear-cress in Alberta, including the following:

- Collaboration with industry to mitigate impacts of pipeline construction on slender mouse-ear-cress populations;
- University of Alberta research project concerning the identification of critical habitat at the microsite level for slender mouse-ear-cress and determination of a setback distance for pipeline disturbance;
- University of Alberta research project concerning the impacts of pipeline construction on slender mouse-ear-cress and its habitat;
- Development of beneficial grazing management practices for slender mouse-ear-cress;
- Development of a range layer within Alberta Environment and Parks' Landscape Analysis Tool (LAT) to guide where surveys and mitigation for slender mouse-ear-cress are required for proposed land use developments; and
- Twenty sites in eighteen quarter sections surveyed for slender mouse-ear-cress, during which four new sub-populations were located (Table 1).

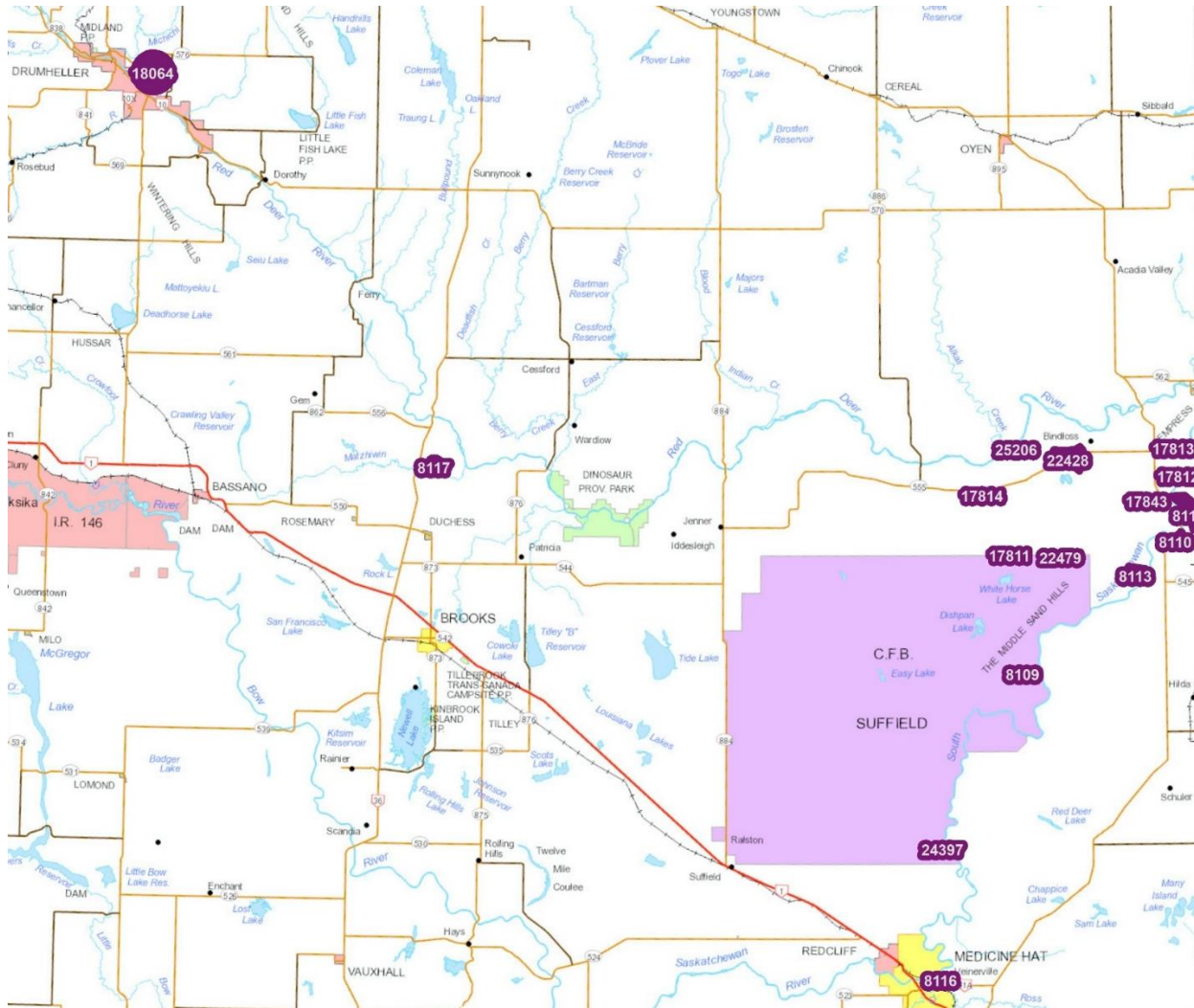


Figure 2. Subpopulations of slender mouse-ear-cress in Alberta. Numbers correspond to ACIMS master element occurrences (Table 1).



## 3.5 Threats

Threats adversely affect the ability of slender mouse-ear-cress to persist in Alberta, both indirectly through decline in habitat quality and availability, and directly by affecting plant and seed survival, or removing plants and seed sources. Threats may be cumulative. Much more detailed information on threats to slender mouse-ear-cress can be obtained from the provincial status report (ASRD and ACA 2009) and the federal recovery strategy (Environment Canada 2012). Threats to slender mouse-ear-cress in Alberta are classified under four categories: habitat loss and degradation, changes in ecological dynamics or natural processes, invasive and introduced plant species, and climate change (Table 2). Discussion of the individual threats follows, in order of importance.

**Table 2. Threats to slender mouse-ear-cress.**

Threats & Potential Effects/Stress	Threat Category
Invasion of habitat by non-native plant species (e.g., crested wheat grass, leafy spurge, Russian thistle, etc.) <sup>1,2,3,4</sup>	Invasive and introduced plant species
Oil and gas development <sup>4,5,6,7</sup>	Habitat loss and degradation
Cultivation and conversion to tame pasture <sup>4,5,6,7</sup>	Habitat loss and degradation
Sand and gravel extraction <sup>4,5,6,7</sup>	Habitat loss and degradation
Urban development <sup>3,4,5,6,7</sup>	Habitat loss and degradation
Alteration of natural fire regime (fire suppression) <sup>1,2,3,4</sup>	Changes in ecological dynamics or natural processes
Drought <sup>1,8,6</sup>	Climate change
Wind energy development <sup>4,5,6,7</sup>	Habitat loss and degradation
Military activities <sup>4,5,6</sup>	Habitat loss and degradation
Alteration to natural grazing regime <sup>1,2,3,4</sup>	Changes in ecological dynamics or natural processes

Potential effects/stresses include:<sup>1</sup> Reduced seed production; <sup>2</sup>Reduced seed germination; <sup>3</sup>Increased plant mortality; <sup>4</sup>Reduced population size; <sup>5</sup>Plant and seed mortality; <sup>6</sup>Local Extinctions; <sup>7</sup>Altered hydrology; <sup>8</sup>Increased seed dormancy, <sup>9</sup>Reduced fitness or productivity

### 3.5.1 Invasion by non-native species

A modified plant community is associated with anthropogenic disturbances in mixedgrass prairie, not only in areas where vegetation and soil have been directly affected by the land use but also indirectly through invasion of non-native species into adjacent areas of native vegetation (Bradley 2003, Great Sand Hills Advisory Committee 2007, Henderson 2007, Rowland 2008). Invasive, non-native species commonly found in mixed-grass prairie in southern Alberta include crested wheatgrass (*Agropyron cristatum*), Kentucky bluegrass (*Poa pratensis*), smooth brome (*Bromus inermis*), downy brome (*Bromus tectorum*), leafy spurge (*Euphorbia esula*) and baby's breath (*Gypsophila paniculata*). Once established, these invasive species persist. Invasive species affect

slender mouse-ear-crec by shading, usurping available water and nutrients, and through plant toxins that prevent the growth of other plants underneath and around them (National Park Service 2003).

Invasion of native plant communities by crested wheatgrass was noted at the locations of seven subpopulations of slender mouse-ear-crec (Table 1) (Bradley 2008, ASRD and ACA 2009). One of these subpopulations is ranked as historical, three as failed-to-find and three as extant. Leafy spurge invasion has been noted at the location of one subpopulation of slender mouse-ear-crec.

Surveys in slender mouse-ear-crec habitat in Alberta have failed to detect plants on disturbed sites infested with non-native plants such as crested wheatgrass (Smith 2000, Bradley 2008). In Saskatchewan the species has been observed in pastures that have been invaded or seeded with crested wheatgrass and Kentucky bluegrass (Environment Canada 2012, C. Neufeld pers. comm.). It is not known whether or not slender mouse-ear-crec continues to persist on these sites.

### **3.5.2 Oil and Gas Development**

Crude oil and natural gas (conventional and shallow) are the two most common petroleum resources extracted in the Dry Mixedgrass Natural Subregion of Alberta. Oil and gas activities include exploration, drilling, completion, production and transportation, abandonment, and reclamation. Associated activities include driving overland with heavy (>1 tonne) trucks; developing access routes and well pads for heavy equipment, drill rigs, and workers' vehicles; and land spraying of waste drilling fluids. Potential impacts to plants include surface disturbance (small footprints for natural gas wells to extremely large footprints for compressor stations and gas plants), invasive species, dust contamination, soil contamination, and soil compaction.

Since 1970, linear disturbance has increased 93% (from 2.7 km/km<sup>2</sup> to 5.2 km/km<sup>2</sup>) in a study area that encompasses all of the provincial range of extant slender mouse-ear-crec subpopulations (Environment Canada 2008). Pipelines and access roads and trails associated with oil and gas activities are a large component of this linear disturbance. The energy sector footprint has been increasing at a rate of about 9 000 hectares per year across the Grassland Natural Region over the past five decades (Prairie Conservation Forum 2008). Habitat for nine subpopulations (56% of subpopulations) of slender mouse-ear-crec in Alberta has been altered within the last few decades by gas field and major pipeline corridor development (ASRD and ACA 2009). As the amount of anthropogenic edge and access in native prairie habitats increases, the potential for invasion of non-native plant species and permanent alteration of native plant communities increases.

Research conducted on the impacts of pipeline construction on slender mouse-ear-cress in Alberta found that plants persisted at only one of two sites along the right-of-way four years after construction (Nemirsky 2011, Nannt 2014). Interestingly, slender mouse-ear-cress plants were found growing through soil erosion control matting on the off-trench portion of the right-of-way one year after construction (Nemirsky 2011). It was suggested that increased moisture under the matting may have encouraged expression of the seed bank (Nemirsky 2011). Despite this, surveys at this location in 2012 and 2013 failed to detect slender mouse-ear-cress plants persisting at the site (Nannt 2014). Soil compaction is likely the main negative effect of pipeline construction on growth and persistence of slender mouse-ear-cress (Nannt 2014).

### **3.5.3 Cultivation and Conversion to Tame Pasture**

Cultivation for crop production and conversion to tame pasture has likely reduced overall habitat availability, population size, and genetic diversity of slender mouse-ear-cress in Alberta (Environment Canada 2012). Approximately 50% of the Dry Mixedgrass Natural Subregion in Alberta has been converted from native prairie primarily to cultivation (Alberta Environmental Protection 1997, ASRD 2000, Gauthier et al. 2003). In addition, native grasslands adjacent to cultivated fields and tame pastures experience changes in plant species composition as a result of non-native species invasion and drift of agricultural herbicides and fertilizers as well as altered drainage. Further fragmentation could threaten seed dispersal and gene flow within and between remaining subpopulations; however, further conversion of slender mouse-ear-cress habitat to cropland is unlikely because it is considered unsuitable for crop production.

### **3.5.4 Sand and Gravel Extraction**

The sandy substrate on which slender mouse-ear-cress grows has the potential for extraction. Removal of substrate would destroy plants, remove seed bank and create a disturbance on which invasive non-native plants could establish. In Alberta, a sand and gravel pit near the historical Sandy Point subpopulation may be in suitable habitat for slender mouse-ear-cress (C. Bradley pers. obs.). In Saskatchewan, sand and gravel extraction has resulted in invasion by Kentucky bluegrass in habitat supporting slender mouse-ear-cress (Environment Canada 2012).

### **3.5.5 Urban Development**

Urban development, including construction of residences outside of the boundaries of urban municipalities, results in direct, irreversible damage to plants and their habitat. Indirect damage to plant populations and their habitat adjacent to the direct disturbance can occur from the loss of a large portion of the seed bank, invasion by non-native species, and changes to vegetation from increased water runoff that may contain nutrients and herbicides. A subpopulation of slender mouse-ear-cress reported in 1884 at Police Point (Record 008 in Table 1) has not been relocated

and is considered destroyed as a result of development of Medicine Hat. Urban developments are effectively permanent, and there is little or no opportunity to mitigate this type of disturbance.

### **3.5.6 Altered Fire Regime**

A fire regime that operated for thousands of years in the mixedgrass prairie of Alberta changed dramatically with colonization by settlers in the late 1800s. Today, fire is absent from most of the provincial range of slender mouse-ear-cress as a result of aggressive fire suppression; the notable exception is within CFB Suffield where military activities frequently ignite fires. Absence of fire over the last century and a half has likely affected and continues to affect the slender mouse-ear-cress population in Alberta; however, the full impacts are likely to remain undetermined.

### **3.5.7 Drought/Climate Change**

Slender mouse-ear-cress occurs in that part of Alberta with the highest potential for significant moisture deficits during the growing season (Natural Regions Committee 2006). Predictions are that this area will experience up to a 4°C increase in mean annual temperature by the 2020s, mostly occurring in winter and spring, and up to a 20% increase in mean annual precipitation mostly occurring in winter and spring (Sauchyn and Kulshreshtha 2007); however, summers will be especially dry. A trend of increased aridity will most likely be realized through a greater frequency of dry years. Also predicted are increased climate variability and more frequent extreme events, including a greater frequency of flooding and severe drought.

The Alberta Biodiversity Monitoring Institute predicts that impacts of climate change on slender mouse-ear-cress will be mixed (ABMI 2014). Higher precipitation in spring may benefit growth of slender mouse-ear-cress. Conversely, as land cover shifts, dispersal may be challenging as there are no wings on seeds of slender mouse-ear-cress, somewhat limiting mobility. Further, increased summer drought may negatively affect seed production and survival. The prairie population of slender mouse-ear-cress in Alberta and Saskatchewan has survived drought in the past, including that of the 1930s. However, occurrences in the United States are at considerably higher elevations, 1 000 – 3 600 m, compared to elevations of 600 – 750 m in Canada, suggesting an affinity for cooler and moister growing season conditions than are predicted for the mixedgrass prairie region with climate change (ASRD and ACA 2009).

### **3.5.8 Wind Energy Development**

Wind energy development is a rapidly growing industry in southern Alberta. There is potential for wind energy projects to be sited in habitat for slender mouse-ear-cress. Activities include installation of turbine towers, control buildings, transformer pads, electric substations, and other ancillary structures (Bradley and Neville 2010). Construction of roads is also required to provide

access for heavy equipment during installation, and standard wheeled vehicles during operations. Associated with a wind energy project is construction of transmission lines. Effects of construction and operation of wind energy projects and associated transmission lines on slender mouse-ear-cress may include removal of plants and seed bank, soil disturbance, soil compaction, soil erosion, change in hydrology, accidental release of contaminants, and promotion of invasion by non-native species.

### 3.5.9 Military Activities

Although slender mouse-ear-cress has been found only within Canadian Forces Base (CFB) Suffield National Wildlife Area where no military activities occur, there is the potential for it to occur in the adjacent military training area that has similar habitat characteristics. Military activities have been conducted at CFB Suffield since its establishment in 1941. Activities include construction of facilities, road construction, on- and off-road movements by wheeled support vehicles and heavy tracked vehicles, troop movements on foot, trenching, exploding munitions, pyrotechnics (smoke/flares), and helicopter flights and landing. Environmental effects include soil disturbance, soil and seed bed compaction, alteration of hydrology, physical damage to vegetation, fire, accidental release of contaminants, spread of non-native plant species, and altered plant community composition (Dillon Consulting Ltd. 2006, Warren et al. 2007). Minor disturbances from military activities may benefit populations of slender mouse-ear-cress by forming seed beds through formation of temporary shallow depressions and reducing competition from dominant perennial grasses through fire.

### 3.5.10 Altered Grazing Regime

The natural grazing regime that had persisted for thousands of years throughout the mixedgrass prairie changed abruptly in the late 1800s with the elimination of bison and elk and the introduction of domestic livestock. Through wallowing, a behaviour that involves rolling and dust-bathing, bison may have played a role in formation of shallow depressions that provided suitable habitat for slender mouse-ear-cress (Coppedge et al. 1999, Nemirsky 2011). Considering the great herds of bison that historically roamed the prairies, temporary shallow depressions on sandy plains may have been a common and recurring patch disturbance that was readily colonized by annual and biennial plant species, including slender mouse-ear-cress. Wallowing is not a commonly observed behaviour in domestic cattle. However, cattle likely function to reduce vegetation, and hoof action likely creates microsites with bare soil (Nemirsky 2011).

Light to heavy grazing regimes are beneficial to slender mouse-ear-cress (ASRD 2005). A lack of grazing or change in grazing patterns is a threat to the population. In Wyoming, slender mouse-

ear-cress has prospered under a modest grazing regime (ASRD 2005). Slender mouse-ear-cress was observed to proliferate in native big sagebrush (*Artemisia tridentatae*) pastures degraded by cattle grazing in Montana (Lesica and Vanderhorst 1995).

### **3.5.11 Cumulative Environmental Effects**

Cumulative effects arise when unmitigated environmental effects from a variety of human activities overlap in time or in space with environmental effects from other activities. Most modern anthropogenic disturbances, including cultivation, oil and gas development, urban development, road construction, uniform range management and fire suppression result in homogeneously manipulated and fragmented landscapes and net effects on native habitats that are widespread, severe and of long duration. Slender mouse-ear-cress appears to be a species with an affinity for native landscapes that have experienced disturbances that are heterogeneous in both a spatial and temporal nature, severity, and duration (Warren et al. 2007). The cumulative effects of human activities and intervention in natural processes at a landscape scale pose significant risk for slender mouse-ear-cress. The provincial population of slender mouse-ear-cress would benefit from regional approaches to land use planning including conservation of a network of large blocks of native grasslands and connecting corridors (Prairie Conservation Forum 2011, South Saskatchewan Regional Advisory Council 2011).

## 4.0 Recovery Goals and Objectives

### 4.1 Biological and Technical Feasibility of Recovery

Maintaining slender mouse-ear-cress in Alberta is feasible, both biologically and technically, under the normal range of environmental conditions. Although historical population size and distribution for the species is unknown, reproducing individuals have been reported within the last decade for ten of sixteen subpopulations and there is likely a viable soil seed bank given that habitat remains suitable. Continued viability is uncertain for three subpopulations where habitat appears to remain suitable but where plants have not been reported in over a decade despite search effort (Duchess Pasture, Linstead Flats, South Saskatchewan River pipeline crossing). Plants have not been reported for over two decades for three subpopulations where there are indications that habitat may be significantly altered (Police Point, Sandy Point, Rosedale). Maintaining all previously recorded subpopulations may not be feasible and additional search effort would be required to ascertain this.

Recovery requires that native mixedgrass prairie be conserved and managed to provide suitable habitat. Activities and actions that address threats to slender mouse-ear-cress can be feasibly implemented. Regional conservation planning will be important to avoid further loss, fragmentation, and cumulative effects on native mixedgrass prairie that puts at risk genetic exchange between subpopulations of slender mouse-ear-cress. For the eleven subpopulations on public land, government commitment to maintain native prairie and manage human activities appropriately will need to be reflected in land use policy and planning. For the two subpopulations on private property, stewardship agreements with landowners may be required to secure habitat. Range management on both private and public land will need to consider grazing and fire regimes that benefit slender mouse-ear-cress, as well as control of invasive non-native plant species.

### 4.2 Recovery Goals and Objectives

Alberta populations of slender mouse-ear-cress represent the northern extent of this species' North American range, and there is no evidence to suggest that this species was substantially more widespread or numerous in the province than existing populations. Active re-establishment of slender mouse-ear-cress at historical and extirpated sites is not likely feasible during the lifespan of this recovery plan. As such, a maintenance goal for slender mouse-ear-cress is most appropriate.

The maintenance goal for slender mouse-ear-cress in Alberta is as follows:

**All naturally occurring populations of slender mouse-ear-cress in Alberta are maintained, and secured from future land use change and invasion of non-native plant species** (Note: Naturally occurring refers to known and newly documented subpopulations. It excludes horticultural subpopulations or those that are dispersed by humans and establish themselves in unnatural habitats).

**Objective 1:**

The extent of occurrence of invasive species at known slender mouse-ear-cress sites is significantly reduced by 2025.

**Indicator:**

- Change in area occupied by invasive species at known slender mouse-ear-cress populations.

**Objective 2:**

Protective designations, mitigation measures and approval standards, voluntary stewardship agreements, and easements have been applied to all known slender mouse-ear-cress populations to protect them from human disturbance.

**Indicator:**

- The percentage of slender mouse-ear-cress populations that have protective mechanisms in place. Note, this does not necessarily include historical populations.

**Objective 3:** Slender mouse-ear-cress populations are re-established at extant or failed-to-find sites.

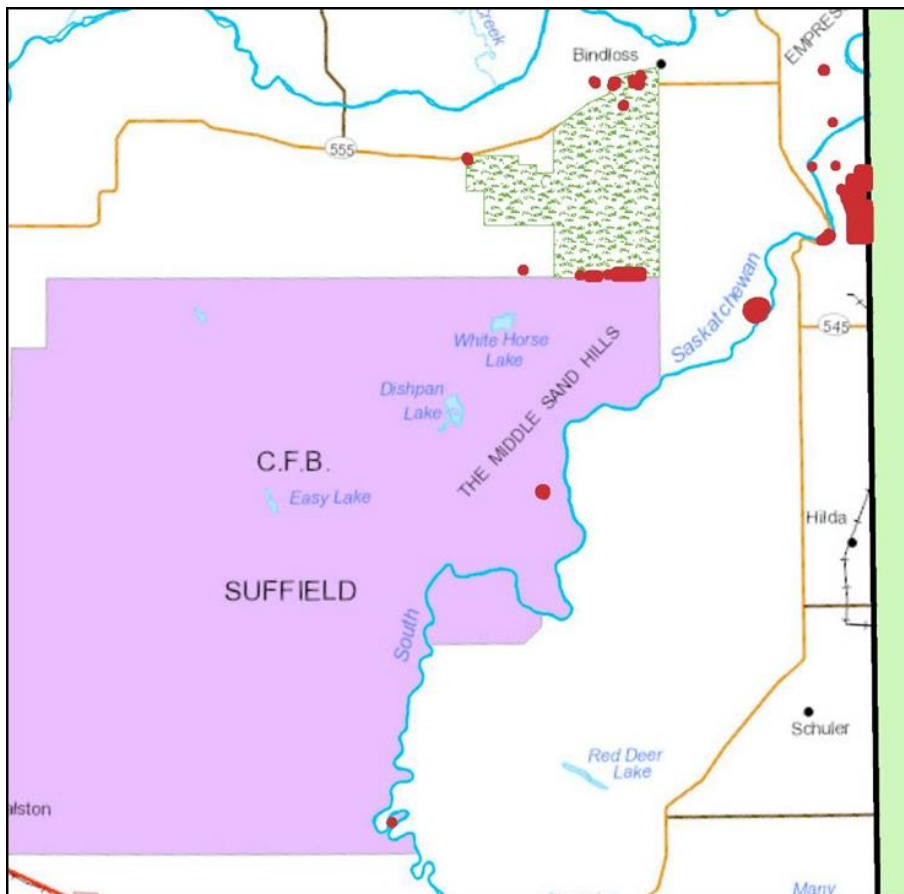
**Indicator:**

The number of sites currently labelled extant or failed-to-find where occupancy of slender mouse-ear-cress has been demonstrated at least once during the lifespan of this recovery plan.



## 5.0 Habitat Needed to Support Recovery

In order to achieve the maintenance goal for slender mouse-ear-cress, the area of occupancy of all populations classified as extant or failed-to-find, as well as all natural landform, soil and vegetation features immediately surrounding these populations, must be secured and protected from future threat (Figure 3).



**Figure 3. Habitat needed to support recovery on provincial crown land and federal land is shown in red. The map displays the known locations, buffered by 300 m.**

The definition of habitat needed to support recovery may be further refined as more knowledge is gained on the habitat requirements of this species. Figure 3 includes sites identified as critical habitat in the federal recovery strategy (Environment Canada 2012), as well as those discovered since the federal strategy was prepared.

## 6.0 Recovery Strategies and Actions

There are three key strategies necessary for the maintenance and conservation of Alberta's slender mouse-ear-cress population. Actions to be accomplished over the next ten years fall under the strategies described below. The effectiveness of strategies and actions for slender mouse-ear-cress will be assessed by monitoring subpopulations at least once every five years, and more often as resources allow. Survey methods will be based on those defined by Bradley (2008) and Henderson (2009). Immediate recovery priorities are identified as follows:

### Recovery Priorities

- Management of Invasive Species
- Slender Mouse-ear-cress Habitat Maintenance and Protection
- Information Dissemination, Education and Recovery Coordination

## 6.1 Improved Site Management to Maintain Populations and Reduce Invasive Species

Competition from exotic invasive species is a serious threat to slender mouse-ear-cress subpopulations. Understanding the extent of establishment of invasive species at each location will be key to developing programs to manage this threat on a site-specific basis. Management programs will require the cooperative involvement of municipal, provincial and federal governments, the Special Areas boards, land managers, and other relevant parties, in order to be successful and keep this threat under control.

### Desired Outcomes:

1. The presence, composition and persistence of invasive plant species at all slender mouse-ear-cress occurrences is assessed every five years, and invasive species management is adaptively applied at each site as necessary.
2. Each slender mouse-ear-cress population currently identified as extant or failed-to-find has a population survey at least once every five years.

### Progress Measures:

1. The number of sites monitored.
2. The number of sites with weed control and management programs implemented.
3. The number of sites with low to no invasive plant species detected.

**Recovery Actions:**

1. Survey slender mouse-ear-cress subpopulations for the species, as well as presence and persistence of invasive plant species.
2. Work collaboratively with provincial agrologists, biologists, the Special Areas Boards, municipal governments, the federal government, land managers, and any other relevant parties to develop weed control and management programs that are specific to local populations.

## 6.2 Protect and Maintain Slender Mouse-ear-cress Habitat

Habitat of slender mouse-ear-cress faces potential threat from cultivation, industrial and urban development, and military activities. Ensuring that the habitat necessary for the persistence of this species is protected from these threats will be a key component of the recovery of this species.

Securement of habitat will be a cooperative effort between government, industry, Special Areas boards, and other land managers. It will take the form of protective mechanisms, beneficial management practices, conservation management areas within regional planning, and legislation.

**Desired Outcome:**

- Slender mouse-ear-cress habitat is secured through regional planning, protective mechanisms and/or private land conservation tools.

**Progress Measure:**

- Proportion of slender mouse-ear-cress habitat that is secured through a protective mechanism.

**Recovery Actions:**

1. Work collaboratively with provincial agrologists, biologists, Special Areas Boards, grazing associations and land managers to follow recommended grazing practices, as outlined in the report entitled *Beneficial Grazing Management Practices for Species at Risk Plant Habitat* (Lancaster 2015).
2. Work collaboratively with Special Areas boards, industry representatives and land managers to adhere to survey requirements and recommended land use guidelines to protect slender mouse-ear-cress plants and habitat from direct and indirect impacts of development.

3. Apply protective mechanisms to public and private lands with slender mouse-ear-crec (e.g. Special Areas Management System (SAMS) designation, protective notation, conservation easements, etc.).
4. Ensure slender mouse-ear-crec habitat is included within conservation management areas under the Red Deer Regional Plans and subplans, as appropriate.

## 6.3 Engage Industry and Local Land Managers in Slender Mouse-ear-crec Stewardship

Effective maintenance of slender mouse-ear-crec populations over the long term will depend in part on stewardship initiatives by lease holders, industrial partners and private landowners. As such, it is important that information on threats to this species, management practices that address these threats, and opportunities for collaboration are clearly communicated to those involved in stewardship and protection.

Some historical populations are located on federal land and, as such, recovery activities for those populations will be conducted at the national level. Consistent communication and coordination of actions at both levels of government will ensure the most efficient use of resources for the conservation of slender mouse-ear-crec.

### **Desired Outcome:**

- All information on slender mouse-ear-crec and its conservation issues, including the recovery plan and associated Best Management Practices (BMPs), is easily accessible as either printed materials or web-based information.
- Throughout the life of the plan, communication between the federal and provincial government related to slender mouse-ear-crec recovery and maintenance actions and other sympatric species at risk is frequent and ongoing.
- Opportunities for collaborative partnerships and funding are explored as they arise throughout the lifespan of this recovery plan.

### **Progress Measures:**

- Proportion of land managers, lease holders, and oil and gas developers that have received information on slender mouse-ear-crec, whether through printed materials or online.
- Continuous communication between provincial and federal counterparts working on slender mouse-ear-crec recovery initiatives.

- Number of collaborative projects that are initiated to conserve slender mouse-ear-cress populations and their habitat.

**Recovery Actions:**

1. Prepare communication materials on slender mouse-ear-cress that include information on its status, biology, habitat, threats, recovery initiatives and BMPs.
2. Deliver communication materials through a variety of mechanisms to relevant audiences including landowners and grazing leaseholders, public land managers and regional planners, regulatory agencies, industries operating in or near habitat, prairie conservation organizations, professional organizations (e.g., Alberta Institute of Agrologists, Alberta Society of Professional Biologists) and the general public. Where appropriate, deliver this information together with information on other mixedgrass prairie species at risk in similar habitat.
3. The Alberta Slender Mouse-ear-cress Recovery Team lead will communicate with other federal and provincial colleagues within the species' range to ensure recovery actions complement, whenever possible, the recovery of other provincially or federally listed species at risk.

## 6.4 Engage Citizen Scientists

Citizen science is a popular approach to involving the public and inspiring them to take an interest in species recovery and contribute to conservation efforts. The recovery of species relies on information; as more people collect and share information, a better understanding is achieved.

**Desired Outcome:**

- Individuals or groups get involved and report slender mouse-ear-cress observations.
- Ranchers with native prairie habitat in the slender mouse-ear-cress range watch for the species and report observations.
- Receive up to date observations in known habitats and new location data from citizen scientists.

**Progress Measures:**

- The number of people/groups that get involved.
- The amount of new information received.

**Recovery Actions:**

1. Engage members of the public, ranchers, interest groups, and naturalists.
2. Prepare information, instructions, survey protocol and data sheet; make it publicly available.

# 7.0 Implementation Plan

## 7.1 Implementation timetable

Table 3 outlines the priorities, partners, and timing for implementation of actions.

## 7.2 Plan progress review, evaluation and amendment

Alberta Environment and Parks will conduct an annual review of activities to monitor the implementation of the plan and to determine the effectiveness of recovery actions. A summary of the results of these reviews will be submitted annually to the Fish and Wildlife Stewardship Branch of Alberta Environment and Parks. Recovery plans are considered to be “living” documents, and recovery actions can be amended during these reviews, as new information becomes available, as conditions change, or as circumstances warrant. At the end of ten years, the overall accomplishments of the plan will be reviewed, amendments to management strategies and actions will be made as appropriate, and a new plan will be drafted for the next implementation period.

**Table 3. Slender mouse-ear-cress recovery action implementation table.**

Action	Lead Agencies <sup>1</sup>	Actions by Year									
		2021-2022	2022-2023	2023-2024	2024-2025	2025-2026	2026-2027	2027-2028	2028-2029	2029-2030	2030-2031
Population assessment and invasive species monitoring surveys	AEP, CWS, NGOs	-	\$5000	-	-	-	-	\$5000	-	-	-
Invasive species management programs	Various	TBD <sup>2</sup>	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD
Implement beneficial grazing management practices	Various	Initiate	Ongoing	Ongoing	Ongoing	Ongoing	Ongoing	Ongoing	Ongoing	Ongoing	Ongoing
Adherence to survey requirements and land use guidelines	Various	Ongoing	Ongoing	Ongoing	Ongoing	Ongoing	Ongoing	Ongoing	Ongoing	Ongoing	Ongoing
Designate PNTs/SAMS	AEP, SA	In-kind	Update as needed	Update as needed	Update as needed	Update as needed	Update as needed	Update as needed	Update as needed	Update as needed	Update as needed
Incorporate habitat needs into land use planning	AEP, SA	Ongoing	Ongoing	Ongoing	Ongoing	Ongoing	Ongoing	Ongoing	Ongoing	Ongoing	Ongoing
Communication materials	AEP	-	In-kind, Develop	-	-	-	-	-	-	-	-
Plan and communication materials distribution	AEP	Initiate	Ongoing	Ongoing	Ongoing	Ongoing	Ongoing	Ongoing	Ongoing	Ongoing	Ongoing
Communication with federal and provincial counterparts	AEP	Initiate	Ongoing	Ongoing	Ongoing	Ongoing	Ongoing	Ongoing	Ongoing	Ongoing	Ongoing
Engage citizen scientists	AEP	Initiate	Ongoing	Ongoing	Ongoing	Ongoing	Ongoing	Ongoing	Ongoing	Ongoing	Ongoing
Protocol & data sheet	AEP	In-kind, develop	-	-	-	-	-	-	-	-	-

Lead agencies: AEP – Alberta Environment and Parks; CWS-Canadian Wildlife Service, NGO-Non-governmental Organizations, SA-Special Areas Board; <sup>2</sup>TBD = to be determined.



## 8.0 Socio-economic Scan

The socio-economic scan is intended to provide an overview of current and past social and economic considerations in Alberta that might be interacting with the conservation of slender mouse-ear-cress populations and the implementation of the actions in the slender mouse-ear-cress recovery plan. The purpose of the scan is to identify issues that may increase costs and benefits to stakeholders that will need to be considered during the implementation of the recovery plan. The potential impacts are scored as either positive or negative (Table 4).

**Table 4. Anticipated social and economic impacts of implementation of the slender mouse-ear-cress recovery plan.**

Strategy	Action	Socioeconomic Impacts (-) is a cost (+) is a benefit
Improved Site Management to Maintain Populations and Reduce Invasive Species	Work collaboratively with relevant parties to develop weed control and management programs that are specific to local populations.	(+) reduce spread of invasive plant species (+) improved habitat for other wildlife species (-) cost of developing and implementing programs
	Work collaboratively with Special Areas boards, industry representatives and land managers to follow recommended grazing practices and adhere to survey requirements and recommended land use guidelines.	(+) improved collaborative relationships between government and industry  (+) improved habitat for other wildlife species  (-) costs of implementing BMPs, conducting pre-development surveys, and reclamation work.

Strategy	Action	Socioeconomic Impacts (-) is a cost (+) is a benefit
Protect and Maintain Slender Mouse-ear-crec Habitat	Apply protective mechanisms to public and private lands with slender mouse-ear-crec.	(+) maintenance of an intact prairie landscape may also lead to increased recreational opportunities, such as nature viewing, hunting, and ecotourism. (+) improved non-use values (existence, bequest, altruism, etc.) (+) improved habitat for other wildlife species (-) costs of adjusting development plans (e.g., setback distances, timing) (-) limits to the type and amount of cultivation, recreational use, and industrial or residential developments allowed
	Ensure slender mouse-ear-crec habitat is included within conservation management areas under the Red Deer Regional Plans and subplans, as appropriate.	(+) improved collaborative relationships among provincial government departments (-) coordination costs
Engage Industry and Local Land Managers in Slender Mouse-ear-crec Stewardship.	Prepare communication materials on slender mouse-ear-crec that include information on its status, biology, habitat, threats, recovery initiatives and BMPs, and deliver communication materials through a variety of mechanisms to relevant audiences. Where appropriate, deliver this information together with information on other mixedgrass prairie species at risk in similar habitat.	(+) conservation benefit to other species at risk (+) improve access to information on slender mouse-ear-crec conservation (-) cost of producing and distributing materials
	The Alberta Slender Mouse-ear-crec Recovery Team lead will communicate with other federal and provincial colleagues within the species' range to ensure recovery actions complement, whenever possible, recovery of other provincially or federally listed species at risk.	(+) improvements in the efficiency of program delivery (+) increased efficiency in achieving conservation objectives (-) coordination costs

## 9.0 Effects on Other Species at Risk

Slender mouse-ear-cress is a unique prairie species and there is an inherent value in keeping it on the landscape. Implementation of action items that conserve or improve the quality of native rangelands should lead to rangelands with high native biodiversity and should help to conserve other prairie species at risk. Conservation of native prairie is also beneficial for continuing Alberta's ranching heritage and ultimately contributes to providing ecosystem services for society.

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### **Personal Communications**

Marge Meijer, Information Specialist, Parks Conservation and Recreation Planning, Alberta Environment and Parks. Edmonton AB. Email: 23 February, 2012.

Candace Neufeld, Grassland Ecologist, Canadian Wildlife Service, Environment Canada, Saskatoon SK. Email: 14 March, 2012.