



**Fish & Wildlife
Division**

RESOURCE DATA AND
SPECIES AT RISK SECTION

**Status of the
Slender Mouse-ear-crested
(*Halimolobos virgata*)
in Alberta**



Alberta Wildlife Status Report No. 55



Alberta Conservation
Association

Alberta
SUSTAINABLE RESOURCE
DEVELOPMENT

Status of the Slender Mouse-ear-creed (*Halimolobos virgata*) in Alberta

Prepared for:
**Alberta Sustainable Resource Development (SRD)
Alberta Conservation Association (ACA)**

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PREFACE

Every five years, the Fish and Wildlife Division of Alberta Sustainable Resource Development reviews the general status of wildlife species in Alberta. These overviews, which have been conducted in 1991 (*The Status of Alberta Wildlife*), 1996 (*The Status of Alberta Wildlife*) and 2000 (*The General Status of Alberta Wild Species 2000*), assign individual species “ranks” that reflect the perceived level of risk to populations that occur in the province. Such designations are determined from extensive consultations with professional and amateur biologists, and from a variety of readily available sources of population data. A key objective of these reviews is to identify species that may be considered for more detailed status determinations.

The Alberta Wildlife Status Report Series is an extension of the general status exercise, and provides comprehensive current summaries of the biological status of selected wildlife species in Alberta. Priority is given to species that are *At Risk* or *May Be At Risk* in the province, that are of uncertain status (*Undetermined*), or that are considered to be at risk at a national level by the Committee on the Status of Endangered Wildlife in Canada (COSEWIC).

Reports in this series are published and distributed by the Alberta Conservation Association and the Fish and Wildlife Division of Alberta Sustainable Resource Development. They are intended to provide detailed and up-to-date information that will be useful to resource professionals for managing populations of species and their habitats in the province. The reports are also designed to provide current information that will assist Alberta’s Endangered Species Conservation Committee in identifying species that may be formally designated as *Endangered* or *Threatened* under Alberta’s *Wildlife Act*. To achieve these goals, the reports have been authored and/or reviewed by individuals with unique local expertise in the biology and management of each species.

EXECUTIVE SUMMARY

Slender mouse-ear-cress (*Halimolobos virgata* [Nutt.] O.E. Schulz), is a member of the mustard family (Brassicaceae), and is the only species of the genus *Halimolobos* that occurs in Alberta. It has a very limited known recent range in the Dry Mixedgrass Natural Subregion of the Grassland Natural Region in the southeastern portion of Alberta. It is known from only 17 sites in nine separate general locations, with historical locations at Medicine Hat and possibly Rosedale near Drumheller, and recent locations between Duchess and McNeill. The populations have been recorded only sporadically, with records of live plants in Alberta from 1894, 1914 (unconfirmed), 1978, 1995, 1996, 1997, 1999 and 2004, and a population estimate of between 500 and 1000 plants in 1997, and 1575 in 2004. The total known area for this species is just over 3000 m² and the total potential habitat in Alberta is between 297 km² and 10 000 km².

Slender mouse-ear-cress is considered *May Be At Risk* in Alberta, according to the general status exercise conducted in 2000 by Alberta Sustainable Resource Development (Alberta Sustainable Resource Development 2000), and is ranked as S1 (Vujnovic and Gould 2002, Alberta Natural Heritage Information Centre 2003). It is listed as *Threatened* in Canada (COSEWIC 2003), and is on Schedule 1 of the federal *Species at Risk Act* (Government of Canada 2003). Outside Alberta, it occurs only in southwestern Saskatchewan, with only nine reported locations. It occurs in six western states, and is considered rare in Colorado, Utah and California.

The ecological requirements of slender mouse-ear-cress in the province are not well understood. It appears to be able to withstand, and perhaps even require, light disturbance from grazing, but it probably cannot tolerate intense competition from more aggressive plant species. As with many of the rare species in Alberta, loss of habitat probably ranks as the greatest long-term threat to this species.

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INTRODUCTION

Slender mouse-ear-cress, also called virgate halimolobos and lesser mouse-ear-cress, (*Halimolobos virgata* [Nutt.] O.E. Schulz), is a member of the mustard family (Brassicaceae), and is the only species of the genus *Halimolobos* that occurs in Alberta. It occurs very locally in the Dry Mixedgrass Natural Subregion of the Grassland Natural Region in the southeastern portion of Alberta. It is known from only 17 sites in nine separate general locations, with historical locations at Medicine Hat and Rosedale near Drumheller, and recent locations between Duchess and McNeill. The populations have been only sporadically recorded, with records of live plants in Alberta from 1894, 1914 (unconfirmed), 1978, 1995, 1996, 1997 and 1999, and a population estimate of between 500 and 1000 plants in 1997. However, at its known locations in Alberta, its populations appear to undergo considerable yearly fluctuations. It is known in Alberta from a total area of just over 3000 m², and has a total potential habitat area of between 297 km² and 10 000 km².

Slender mouse-ear-cress is currently ranked as S1 in the province (Vujnovic and Gould 2002, Alberta Natural Heritage Information Centre 2003). It also is considered *May Be At Risk* in Alberta, according to the general status exercise conducted by Alberta Sustainable Resource Development in 2000 (Alberta Sustainable Resource Development 2000). Outside Alberta, it occurs only in southwestern Saskatchewan, where it is also considered rare, and has only six recently reported locations and three historical locations. As well, it is listed as *Threatened* in Canada (COSEWIC 2003), and is on Schedule 1 of the federal *Species at Risk Act* (Government of Canada 2003). In the United States, slender mouse-ear-cress is rare (S1 or S2) in three of the seven western states in which it occurs: Utah, Colorado and California (NatureServe 2004).

* See Appendix 1 for definitions of selected status designations.

The ecological requirements of slender mouse-ear-cress are not well understood in the province. It appears to be able to withstand, and perhaps even require, light disturbance from grazing, but it probably cannot tolerate intense competition from more aggressive plant species. As with many of the rare species in Alberta, loss of habitat probably ranks as the greatest long-term threat to this species.

This report summarizes information on the species' known recent and historical locations, distribution, habitat requirements and limiting factors in Alberta, in order to assess its status and recommend conservation and management actions that may be required to protect and perpetuate the species in Alberta.

Use of scientific and common names in the text follows that of Alberta Environmental Protection (Ealey 1993) and the Alberta Natural Heritage Information Centre (2001).

HABITAT

1. Alberta – The known habitat for slender mouse-ear-cress is restricted to lightly disturbed prairie of mid-grass prairie and mixed grasslands on sand plains and open sage thickets of river slopes and basins. This habitat is found in the Dry Mixedgrass Natural Subregion of the Grassland Natural Region (ANHIC 2002a, Kershaw et al. 2001), in the southeastern portion of Alberta.

The climate of the Dry Mixedgrass Natural Subregion is characterized by a warm, dry climate during the growing season: early May to the end of October. The mean temperature during this time is 16.2°C, and maximum temperatures typically range between 30°C and 35°C, with July and August being the hottest months (Usher and Strong 1994). The mean summer precipitation of 150 mm is among the lowest observed in any of the natural subregions in Alberta. Most of the precipitation falls between May and late July. The drought

conditions from 2000 through early 2002 had notably reduced the precipitation in the known provincial range of slender mouse-ear-cress, with the overall effect being that the driest southern portion of the Palliser Triangle, which normally extends in eastern Alberta between the Canadian border and Medicine Hat, had shifted northward (H.D.J. McLean, pers. comm.). In 2002, the summer precipitation across the known range of slender mouse-ear-cress in Alberta was only 40% to 60% of its normal 100 mm to 200 mm (Alberta Environment 2003), and in 2003 only between 40% and 80% of the normal rainfall was achieved (Agriculture and Agri-Food Canada 2003). In 2004, however, the region received its normal rainfall (H.D.J. McLean, pers. comm.).

Most of the known locations for slender mouse-ear-cress occur on gently rolling prairies. The prairie locations have landforms and substrate materials that include undulating glaciofluvial (glacial river-deposited) sands and sandy loams with overlying aeolian (wind-deposited) sands and low dunes or significant inclusions of aeolian and lacustrine (lake-deposited) sand or sandy loams, and hummocky to undulating moraines with till and fluvial sandy loams and sands. The soils in these general locations include the sands and sandy loams of orthic chernozemic, orthic brown chernozemic, orthic regosol, rego chernozemic and rego brown chernozemic soil types in eight soil series (Alberta Soil Survey, no date). The habitat conditions of the plants are a subxeric (moderately dry) to occasionally xeric (very dry) moisture regime situated on flat to very gently undulating sand plain, often associated with low sand dune edges, although not actually on the dune slopes, or in dry to vernal (during the spring) moist low depressions with level to usually less than 5% slope at variable aspects. The associated vegetation includes June grass (*Koeleria macrantha*), needle-and-thread grass (*Stipa comata*), western porcupine grass (*Stipa curtisetata*), slender wheat grass (*Agropyron* [= *Elymus*] *trachycaulum*), western wheat grass (*Agropyron* [= *Pascopyrum*] *smithii*), low sedge

(*Carex stenophylla*), goosefoot (*Chenopodium pratericola*), reflexed rock cress (*Arabis holboellii* var. *retrofracta*) and whitlow-grass (*Draba reptans*), or a low shrubby prairie or thicket cover of silver sagebrush (*Artemisia cana*) and prickly pear (*Opuntia polyacantha*). In marginal sites, the species occurred with common wild rose (*Rosa woodsii*), buckbrush (*Symphoricarpos occidentalis*) and, occasionally, silverberry (*Elaeagnus commutata*) that may have provided wind shelter or moisture sinks (Smith 1999, Macdonald 1997).

Three valley locations for the species in the valleys of the South Saskatchewan and Red Deer rivers have dissected and steeply inclined undifferentiated (very mixed) materials or recent alluvial (river-deposited) sand and gravels, with rough broken, cumulic regosol and recent sand and gravel alluvium soils (Alberta Soil Survey, no date). The reported habitats of slender mouse-ear-cress here have a submesic (moderately moist) moisture regime with a 3% to 8% slope at a southerly aspect. The species occurred in association with shrubby sage grassland where there was at least light grazing disturbance. The two historical river valley locations have little or no habitat information, and the single recent location was reported to have had a shrubby grassland of silver sagebrush, with a herb cover of reflexed rock cress, prairie onion (*Allium textile*) and western bluebur (*Lappula occidentalis*) in the late 1970s (Smith 1991); however, the area has since become infested with a dense herb cover consisting exclusively of crested wheat grass (*Agropyron pectiniforme*) (Macdonald 2002). See Appendix 2 for a complete list of species with which slender mouse-ear-cress has been found in Alberta.

2. Other Areas – In Saskatchewan, the variety of habitats for slender mouse-ear-cress includes plains and ravines in the Mixed Grassland Ecoregion (Saskatchewan Conservation Data Centre 2003). Between the Alberta border and Diefenbaker Lake, the species occurs on the upland plain subxeric short-grass and mixed-grass prairies on slightly disturbed grassy flats

or overgrazed prairie with a high association of ephemeral annuals including annual whitlow-grass (*Draba nemorosa*), western bluebur and reflexed rock cress. In ravines and benches, it occurs with very slight cover of June grass, Sandberg bluegrass (*Poa sandbergii*), western bluebur, narrow-leaved goosefoot (*Chenopodium leptophyllum*) and narrow-leaved milk-vetch (*Astragalus pectinatus*). On the south-facing slopes of ravine sites, it was found on clay in overgrazed prairie with low sedge, prairie selaginella (*Selaginella densa*) and early bluegrass (*Poa cusickii*); at one xeric south-facing slope base it was found with prairie onion, western fairy candelabra (*Androsace occidentalis*) and annual whitlow-grass; and at a reservoir shore site it occurred in mixed grass prairie with reflexed rock cress (Smith 1991). At the historical sites from the mid-1890s in the Cypress Upland Ecoregion at the Cypress Hills and Wood Mountain areas, it was recorded only from “meadows” (Smith 1991).

Although the species has been recorded from only plains habitats in Alberta, toward the southern portion of its range in the United States its diversity of habitats expands to include river backshores, granitic gravel deposits and woodlands. In the adjacent state of Montana, the species generally occurs in dry grassland regions in the prairies, and in foothill and lower montane areas of its Rocky Mountain sites (Booth and Wright 1959). It is notable that the species occurs in an open grassland habitat on the north-facing lower slopes of the Sweetgrass Hills’ East Butte, which is within 10 km of the Alberta border (B. Heidel, pers. comm.). In Wyoming, W. Fertig reported slender mouse-ear-cress from a wider variety of habitats in montane and prairie habitats, especially in rocky limestone outcrops or calcareous soils in sagebrush communities, as well as on grassy rocklands with granitic, sandstone and shale substrates, clay and alkaline flats, and ravines (Dorn 1977, B. Heidel, pers. comm.). Similarly, it has been reported in Utah between elevations 2100 m and 2700 m in granitic alluvial gravels,

creek bottoms, moist meadows on clay loam soils, and even a “sheep bedding ground” on a windswept ridge (New York Botanical Garden 2002, Welsh et al. 1987). Along the southwestern limits of its range in California, it is reported from “meadows, near aspen groves, pinyon/juniper woodland [at] 2000 m to 3000 m” (Hickman 1993).

CONSERVATION BIOLOGY

Slender mouse-ear-cress is a biennial herb (possibly flowering in the first year) that is characterized by the following technical features (see footnote* for definitions of botanical terms): tap root; basal leaf rosette is of oblanceolate, denticulate to dentate, 2–6 cm-long and 3–20 mm-wide leaves; stem is erect and 25–50 cm tall; cauline leaves are auriculate or sessile and become reduced upwards; inflorescence is of single or a series of open racemes; pedicels are 6–12 mm long and extend from the stem at a 45° angle; petals are white and pinkish-veined, erect and small (3–4.5 mm long); fruits are distinctive glabrous, subquadrangular to terete siliques, 15–40 mm long and 1–1.5 mm wide, with irregularly biseriate, wingless seeds, and a persistent 0.2–0.5 mm-long style (Moss 1983, Douglas et al. 1998b, Scoggan 1978, Hitchcock et al. 1964).

***Definitions of botanical terms used in this section:** Oblanceolate = spoon-shaped; denticulate = toothed; dentate = with teeth pointed outward; cauline = along the stem; auriculate = with ear-like lobes at the base; sessile = without a stalk; inflorescence = flowering head; raceme = narrow, wand-like flowering head; pedicel = the stalk of a single flower in a cluster; glabrous = hairless; subquadrangular = almost square-shaped in cross section; terete = circular in cross-section; silique = pod-like fruit that has its sides attached to a central wall; biseriate = in two rows; style = the structure connecting the ovary/fruit and the pollen receptacle.

The species appears to be closely related to several other members of the mustard family, notably in the genera *Arabis*, *Sisymbrium* and *Hesperis*, and it has had a variety of synonyms, including *Sisymbrium virgatum* Nutt ex Torrey and Gray, *Pilosella virgata* (Nutt.) Rydb., *Pilosella stenocarpa* (Rydb.) Rydb., *Stenophragma virgatum* (Nutt.) Greene, *Arabidopsis virgata* (Nutt.) Rydb., *Arabis brebneriana* A. Nels., and others (Scoggan 1978, Welsh et al. 1987, Dorn 1977, Kershaw et al. 2001, Kartesz 1994a, 1994b). It is the only species of the genus *Halimolobos* that occurs in Alberta. There are two other species of *Halimolobos* in Canada: soft mouse-ear-cress (*H. mollis* [Hook.] Rollins), which has been reported from Nunavut, Northwest Territories, Yukon and Alaska, and Whited's halimolobos (*H. whitedii* [Piper] Rollins), a species that occurs in British Columbia, where it is considered rare (Douglas et al. 1998a, 1998b).

The following critical diagnostic characteristics will distinguish slender mouse-ear-cress from the several similar species with which it most commonly may be confused in Alberta: 1) distinctive hairs on the basal and lower cauline leaves and lower stem that include a semi-open, velvety cover of very short, thrice-branching, dendritic (branched or splitting) hairs, over which is an open cover of taller, linear and often somewhat flattened hairs (*Sisymbrium altissimum* seedlings have simple hairs and *Arabis holboellii* var. *retrofracta* has only the stellate hairs); and 2) flowering and fruiting pedicels extend from the stem at a notable 45° angle (*Erysimum inconspicuum* has very similar fruits, but they are less angled, and it has yellow flowers, the several prairie *Arabis* species have either more acutely ascending fruits or distinctly reflexed, drooping fruits, and the several prairie species of *Descurania* have arching fruits, yellow flowers and deeply cleft pinnate leaves).

Several of the above physical characters are important features to the conservation biology of this species. The plants generally are biennial,

with a tap root and basal rosette of leaves produced the first year, and flower and seed production occurring in the second year following germination. However, the species has been reported to be able to produce flowers and seeds in the first season, and the plant may be able to survive more than two seasons. These foreshortened and prolonged life histories have been documented in the American populations, perhaps where the seasons are longer and have suitable precipitation regimes for such early flowering in the first case, and where the winter conditions allow sufficient protection for the root and stem to persist in the second (Dorn 1977, Welsh et al. 1987, Hickman 1993). This conceivably could allow multiple generations of seed production from single plants; however, no documentation for such a potentially productive situation for the populations could be found in the cited studies. The assumed situation for the species in Alberta is that, given the exposed habitats that afford little protection from the summer and winter environments, the species is at least a biennial, with seed production occurring in the second year.

The flowers are produced from May to June in Alberta, and possibly somewhat earlier (mid-April) and later (mid-July) in American populations (Dorn 1977, Welsh et al. 1987, Hitchcock et al. 1964, Kershaw et al. 2001). There is no information on available, suitable pollinating insects in the vicinity of the known slender mouse-ear-cress populations in Alberta. An examination of the 1996 specimens from the McNeill location at the University of Calgary Herbarium revealed that each productive plant had one to three, and occasionally up to eight, elongated inflorescences, each of which could produce 15 to 25 (12 to 30) individual flowers. If successfully pollinated, such inflorescences could produce at least 10 to 25 siliques (fruits), although the several Alberta specimens examined appeared to produce only 4 to 15 fruits. Each of the fruits can enclose approximately 20 (16 to 26) seeds. Additionally, an examination of the species' reproductive potential at the

McNeill location in 2004 indicated that about 40 seeds per silicle, 20 silicles per stem and 2–3 stems per plant was typical (C. Elchuk, pers. comm.). Hence, assuming the plants can survive early- and mid-summer desiccation, the average plant should be able to produce between 100 and 400 seeds before mid-July. The fruits mature and dehisce (split) before mid-July, and apparently shed their seeds readily. The seeds are held to the dry silique only by a thin stalk, and they readily pull away from the septum. The prairie winds undoubtedly shake the stalks and further aid in the shedding of the seeds, but since the seeds have only narrow wings, they are not adapted to being blown long distances by the winds.

There is no information on the rates of seed germination or of the survival of seedlings. Viable seeds probably can survive summer conditions until cooler and moister weather may allow them to germinate later in the summer and in the following spring; however, there is no information on actual seedling survivability over the winter or as summer dry periods advance. During the early summer surveys of 1999 and 2002, no recognizable seedlings were recorded in the vicinities of the known locations in the province—this may be attributed to the prolonged drought conditions of the previous year, when no fruits or seedlings were produced, or to the seedlings' desiccation as they germinated in the early spring (B.M. Smith, pers. comm.; Macdonald 2002).

Where the species has been located in Alberta and elsewhere, it is evident that some degree of light disturbance influences the habitat. Most of the locations in Alberta have had light grazing, and management of the range pasturage for cattle has maintained a normal light rotation of intensity and duration (F. Wittig, pers. comm.; B. Hale, pers. comm.). This species is not favoured by cattle, although incidental browsing and associated trampling may be expected to occur. Indeed, a modest level of physical disturbance to the ground that exposes sand and

creates depressions may assist in seedling establishment, and it is interesting to note that one habitat in Utah was a “sheep bedding ground” (New York Botanical Garden 2002).

Several observers (Smith 1999; B.M. Smith, pers. comm.; B. Heidel, pers. comm.) have reported that, whereas the plants are associated with grassland-dominated communities, they tend to be positioned in close proximity to the shrubs of silver sagebrush, or stout succulents, such as prickly pear. They suggest that these larger plants may provide a degree of cover and protection for the seedlings and mature plants. They also suggest that winter snow deposits in the lee of mounds and around depressions may afford some protection to seedlings and plants, and that these conditions may also provide needed ground moisture in the late autumn or early growing season.

DISTRIBUTION

1. Alberta – The known distribution in Alberta for slender mouse-ear-cress is restricted to the southeastern portion of the province, in an area roughly bounded by Medicine Hat, Empress (close to the Saskatchewan border) and Duchess (Figure 1). John Macoun first collected this species in Alberta in 1894 at Police Point Park in Medicine Hat (Table 1; location 7). A second collection record from the Cypress Hills by J. Macoun a year later, reported in Smith (1991, 1999), recently has been determined by J.H. Soper (former curator of the National Herbarium in Ottawa) to be likely from Saskatchewan instead of Alberta, on the southern side of the hills (M. Shchepanek, pers. comm.; J. Rintoul, pers. comm.; J. Keith, pers. comm.). A voucher collection by M.E. Moodie in 1914 from a location at Rosedale (near Drumheller; location 9) that was reported in Scoggan (1978), but omitted by Smith (1991, 1999), was sought at several promising herbaria (Canadian Museum of Nature, Ottawa; National Herbarium, Ottawa; McGill University, Montreal; Field Museum, Chicago), but was not found (M. Shchepanek,

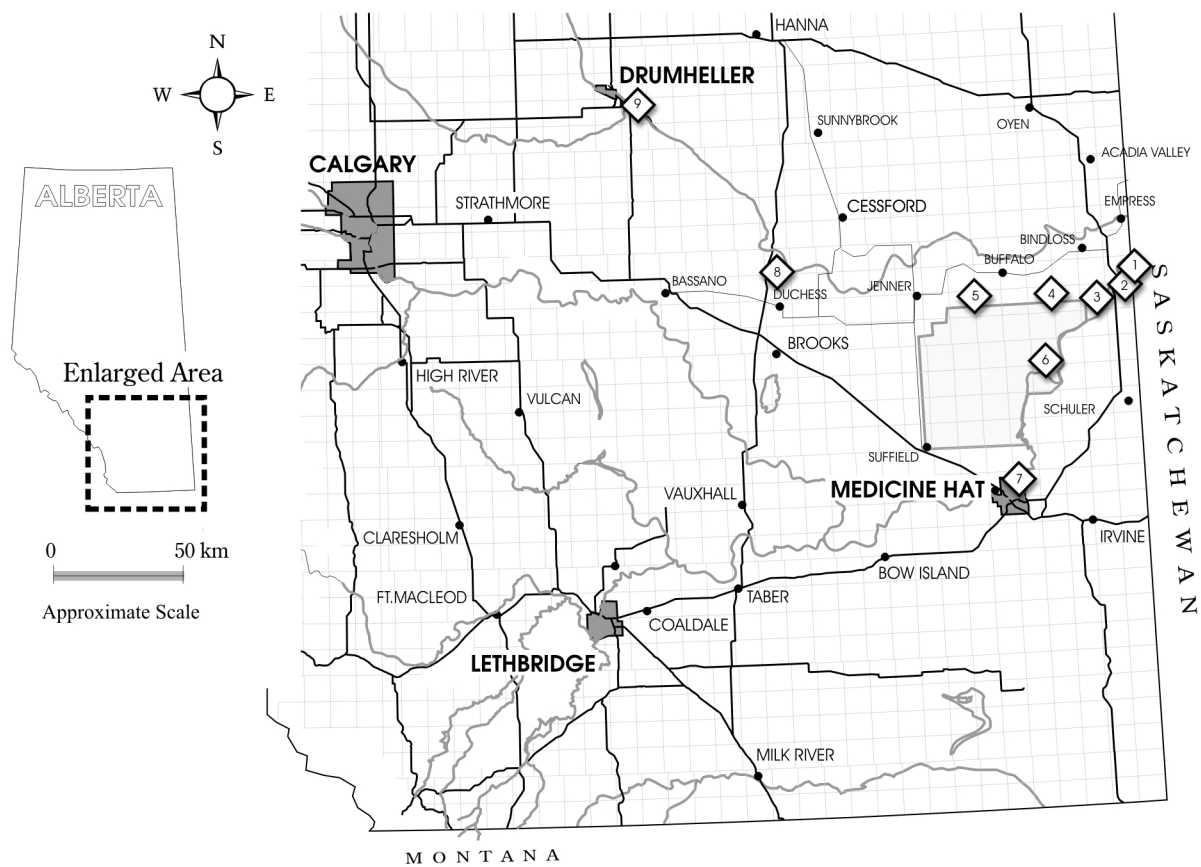


Figure 1. Known locations of slender mouse-ear-crec in Alberta (after Smith 1999). Numbers correspond to locations listed in Tables 1 and 2. Location 9 is unconfirmed.

Table 1. Descriptions of all known slender mouse-ear-cross locations in Alberta, and the size of known and potential habitats at each location. Potential habitat area estimates are taken from Smith (1999); potential habitat is defined as “habitat with similar qualities as that in known locations of slender mouse-ear-cross in Alberta.”

Location Name (EO#)	Known Habitat Area	Potential Habitat Area	Location Description
1a. North of McNeill (EO 04)	250 m ²	24 km ²	This location is approximately 5 to 10 km north of McNeill, as four sites in parts of Townships 20–1W4 and 21–1W4 (Smith 1999).
1b. South of McNeill (no EO#)	(no information)	(no information)	B. Smith (pers. comm.) indicated an additional site observed in 1996 and 1999 approximately 1 km south of the petrochemical facilities at McNeill.
2. Highway 41 crossing of South Saskatchewan River (EO 02)	(no information)	1 km ²	This location is at Sandy Point in the South Saskatchewan River valley in Township 20–1W4.
3. West side of the South Saskatchewan River (EO 05)	10 m ²	6 km ²	This location is on the west side of the middle terrace plain, above the edge of the incised valley of the South Saskatchewan River (parts of Township 20–2W4) (Smith 1999).
4. Northeastern portion of Canadian Forces Base (CFB) Suffield’s north boundary (EO 03 & EO 07—considered to be a single occurrence)	2400 m ²	150 km ²	Smith (1999) indicated five sites along the northern side of the multiple pipeline corridor complex, in parts of Township 20–3W4. This is also called the Remount Pasture.
5. Central portion of CFB Suffield’s north boundary (EO 06)	(no information)	100 km ²	Smith (1999) discovered two sites 12 to 15 km southwest and south-southwest of Buffalo, in parts of Township 20–6W4. This is also called the Buffalo-Atlee Pasture.

6. Linstead Flats in CFB Suffield's National Wildlife Area (EO 01)	375 m ²	10 km ²	This location occurs 5 km east of Linstead Flats on the National Wildlife Area portion of Canadian Forces Base Suffield (Macdonald 1997, Smith 1999).
7. Police Point Park at Medicine Hat (EO 08)	(no information)	(no information)	This historical record from an 1894 collection of John Macoun is in the Police Point Park in a bend in the South Saskatchewan River at Medicine Hat, in parts of Townships 12-5W4 and 13-5W4 (Smith 1999).
8. Duchess Community Pasture (EO 09)	25 m ²	6 km ²	This location, which is part of the Duchess Community Pasture, occurs on a portion of the Matzhiwin Sand Plain south of the Red Deer River, approximately 15 km north of Duchess (parts of Township 22-14W4) (Smith 1999).
9. Rosedale (no EO#)	(no information)	(no information)	This historical location near Drumheller was reported in Scoggan (1978), and his original research data cards indicated a specimen of Margaret E. Moodie #884 (M. Shepenek, pers. comm.). Moodie collected other specimens from the same area on 2 May 1914 (P.M. Catling, pers. comm.).
(Cypress Hills)	—	—	Note: This historical location of Macoun was reported by Smith (1999) as being in Alberta, but its location was determined by J.H. Soper in 1992 to be in southwestern Saskatchewan (M. Shepenek, pers. comm.).
TOTAL AREA:	> 3060 m ² (minimum)	> 297 km ² (minimum)	

* EO# is the Element Occurrence reference number assigned by the Alberta Natural Heritage Information Centre. EO numbers are used by ANHIC to track the provincial population of species that may be at risk and to assess their rank. EO numbers are provided here to assist in cross-referencing information provided in this report with information in ANHIC's database.

pers. comm.; P.M. Catling, pers. comm.; M. Waterway, pers. comm.; C. Niezgodna, pers. comm.). Although it does appear that H.J. Scoggan made note of its existence (M. Shchepanek, pers. comm.), formal acceptance of this record may have to await its future discovery and confirmation. The third collection record from Alberta was by John H. Hudson in 1978 on the South Saskatchewan River at the Highway 41 bridge (Smith 1991, 1999; location 2), and the fifth collection record was by Ian D. Macdonald in 1995, from Linstead Flats in the eastern portion of Canadian Forces Base Suffield National Wildlife Area (Macdonald 1997, Smith 1999; location 6).

A vegetation survey conducted in 1997 by Bonnie M. Smith between the Alberta/Saskatchewan border north of McNeill and westward to beyond Duchess, in conjunction with a pipeline development project, uncovered an additional six general locations for the species (Smith 1999; B.M. Smith, pers. comm., Golder Associates 1997): four subsites north of McNeill (location 1a), one along the western slope of the South Saskatchewan River 10 km west of McNeill (location 3), five along an 8-km long strip outside the northeastern corner of the Canadian Forces Base (CFB) Suffield's northern boundary (location 4), two further to the west along the central portion of this same boundary (location 5), and two along a 4-km strip in the Duchess Community Pasture, 13 km north of Duchess, west of Dinosaur Provincial Park (location 8). There are likely large numbers of undiscovered populations that could be found over a larger area over a longer period of time with the appropriate effort under good conditions, but this would require extensive fieldwork.

A survey along portions of the area north of CFB Suffield in 1996 did not discover any additional plants (Williams 1996), and a detailed resurvey of all of Smith's general locations in 2002 and of portions of the McNeill and Duchess general locations in 2003 did not discover any living

plants or plant remnants, probably because of the ongoing drought conditions. However, a survey in 2004 of the locations north of McNeill (Location 1a), the western slope of the South Saskatchewan River (Location 3), and along portions of the area north of CFB Suffield (Location 4) did rediscover populations (Macdonald 2004, C. Elchuk, pers. comm., Table 2).

Smith (1999) indicated that the known populations at all of the historical and recent locations occupied approximately 3060 m² in the accumulative area of approximately 20 km² that she examined at the time, and that this represented much less than 1% of their total potential habitat within this portion of the Dry Mixedgrass Natural Subregion (ANHIC 2002a). Given the extent of the known habitat in similar sand plains and river basins in this portion of the province, it is apparent that potential habitat may well cover up to 10 000 km². However, the data for determining the species' true extent of occurrence are lacking. Potential habitats may occur as small to relatively large blocks, but appear to be separated and fragmented across the Dry Mixedgrass Natural Subregion, and ongoing agricultural and industrial disturbances constantly compromise such habitats. It is unknown whether genetic exchange between the plant's known locations is possible; however, it is likely that at least the McNeill and Duchess Community Pasture locations have the potential for cross-pollination within their populations. Other populations may be relatively isolated from each other, but there is insufficient information available to evaluate whether there is exchange between them over a long time span.

Trends in the distribution of slender mouse-ear-cress cannot be accurately estimated, except to note that, as Smith (1999) observed, the consistent presence of previous years' stems indicates that there is some continuity in the population locations between years. There is little or no accurate tracking information on the occurrence or disappearance of populations.

Table 2. The number of slender mouse-ear-cress plants (stems) at known locations in Alberta, for each survey year. A zero indicates that surveys were conducted, but no plants were recorded (after Macdonald 1997, 2002; Smith 1999; B.M. Smith, pers. comm.).

Location name	1894	1914*	1978	1991	1994	1995	1996	1997	1999	2000	2001	2002	2003	2004
1a. North of McNeill							28	104	12	0		0	0	182
1b. South of McNeill								plants recorded (number unknown)	plants recorded (number unknown)					
2. Hwy 41 crossing of South Saskatchewan River			plants recorded (number unknown)	0				0				0		
3. West side of South Saskatchewan River							15	>100				0		0
4. NE portion of CFB Suffield's north boundary							8	216				0		1400
5. Central portion of CFB Suffield's north boundary							12	0				0		0

6. Linstead Flats in CFB Suffield's National Wildlife Area						20	0										?		
7. Police Point Park	>1?		0										0				0	0	
8. Duchess Community Pasture								6					58				0	0	
9. Rosedale																	?		
Year totals:	<5?	>10?	0	0	20	69	minimum of 478 to a maximum likely less than 1000	12	0	0	0	0	0	0	0	0	0	0	1582

*The identity of the 1914 location is unconfirmed.

2. Other Areas – Within Canada, Saskatchewan is the only province other than Alberta where slender mouse-ear-cress is known to occur. Prior to 1965, it had been reported from two locations along the Cypress Hills (including the reported Alberta location that is actually in Saskatchewan) and one from Wood Mountain Post Provincial Historic Park. Since 1965, it has been recorded from at least six locations north of the South Saskatchewan River between the Alberta border and the main body of Lake Diefenbaker, in southwestern Saskatchewan (Figure 2; Smith 1991, 1999; S. Lamont, pers. comm.; J. Keith, pers. comm.; Bedeki-Robson 1997; Elchuk 2002; Breitung 1954).

In the United States, slender mouse-ear-cress occurs in the following states: Montana (all but the extreme northeastern and northwestern corners), Wyoming (all but the eastern edge), Colorado (all but the eastern third and southern margin), Utah (all but the southern margin), Nevada (all but the southeastern and northwestern corners), Idaho (all but the northwestern half) and California (restricted to the east-central interior portion) (Figure 2; Smith 1991, 1999; Scoggan 1978; NatureServe 2004; Hitchcock et al. 1964; Booth and Wright 1959; B. Heidel, pers. comm.; Hartman and Nelson 1998; Montana Natural Heritage Program 2001, 2002; Welsh et al. 1987; Dorn 1977; California Department of Fish and Game, Natural Diversity Database 2003; Hickman 1993). The inclusion of the westernmost boundaries of North Dakota, South Dakota and Kansas, and the northernmost portion of New Mexico, as indicated in Smith 1991 and 1999, was not substantiated in the map database for the NatureServe Explorer website (NatureServe 2004) or other standard floras (Scoggan 1978). Additionally, the reports of the species from Washington and the Yukon in Hitchcock et al. (1964) and Scoggan (1978) were not substantiated in the NatureServe Explorer website-mapped distributions; these records may have been based on misidentifications of the related northern species, soft mouse-ear-cress (*Halimolobos mollis*).

No systematic documentation of the persistence of slender mouse-ear-cress populations in the various states or provinces has been conducted. In those states where the species is not abundant, it has not received much attention. In those states where it is considered rare, the management priorities have not afforded any continuous systematic monitoring of the species, or such data are unavailable. Efforts to locate the species in 2002 and 2003 in both Alberta and Saskatchewan were unsuccessful (Macdonald 2002, 2003; Elchuk 2002), and a study of rare plant species ecology in Saskatchewan by Bedeki-Robson (1997) discovered the species in only one location.

It should be noted that, in the adjacent state of Montana, slender mouse-ear-cress has been recorded from the north-facing lower flanks of the Sweetgrass Hills, within less than 10 km from the Alberta boundary. It also has been recorded from the front and central ranges of the Rocky Mountains, well over 150 km to the south of the Alberta border. Given the occurrences in Montana and Saskatchewan that are so near the Alberta border and in similar habitats, it is speculated that the species may also occur in Alberta in the vicinities of the north slopes of the Sweetgrass Hills south of the Milk River, the foothills at the extreme southwestern corner of the province, and the Cypress Hills area.

POPULATION SIZE AND TRENDS

1. Alberta – Information on the number of slender mouse-ear-cress plants in Alberta is very sparse. The two historical records from 1894 and 1914 (unconfirmed) (locations 7, 9) included no comment on the number of plants, and that from 1978 (location 2) indicated only “colonies good sized but spottily distributed” (Scoggan 1978; Table 2). No plants have been rediscovered at these locations (Smith 1991, 1999, Macdonald 2002, C. Elchuk, pers. comm.). The record from the Canadian Forces

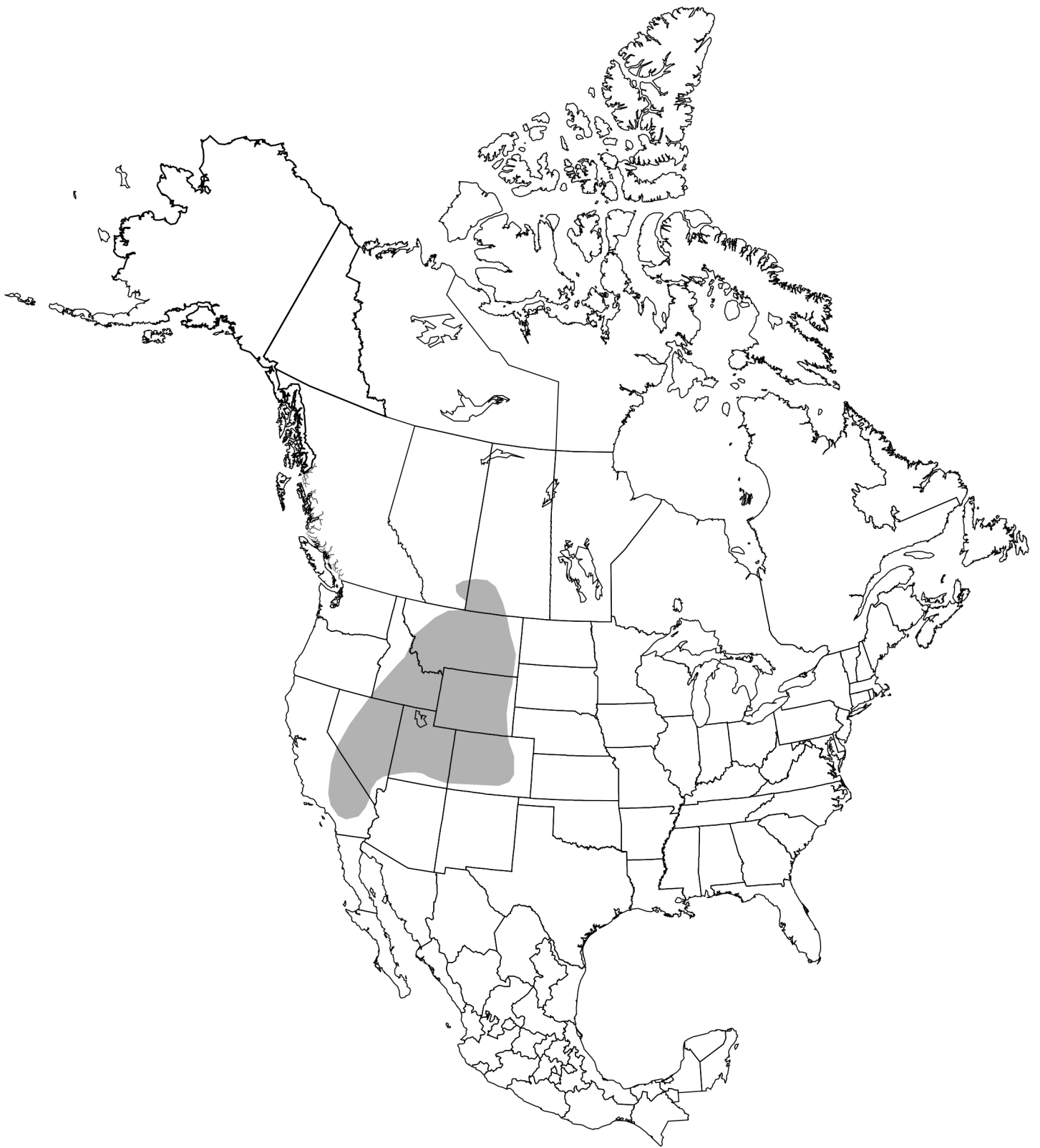


Figure 2. Distribution of slender mouse-ear-cress in North America (after Smith 1999).

Base Suffield National Wildlife Area in 1995 was the first record to present population data (20 fruiting plants) and area (375 m², 15 m x 25 m) (Macdonald 1997, Smith 1999) (Table 2), but a search of this location in 2004 did not record any plants (I.D. Macdonald, pers. obs.). Smith's discoveries along a pipeline corridor in the early summer of 1997 identified five general locations with 15 new sites, and she was able to provide partial counts and phenological conditions of plants of the 1997 growing season, as well as a count of the plant stems remaining from the 1996 growing season (Smith 1999; B.M. Smith, pers. comm.; Golder Associates, Ltd. 1997) (Table 2). A subsequent search of the most promising portion of the North McNeill site in 1999 discovered approximately 12 plants (Smith 1999), and a relatively thorough search of the previously reported locations at Medicine Hat and between the McNeill and Duchess areas in 2002 and 2003 did not record any live current year plants or remnants of the previous years' plants (Macdonald 2002, Macdonald unpubl. data.). However, searches for the species in 2004 uncovered 182 plants at the North McNeill location and 1400 plants at the northeast of CFB Suffield (C. Elchuk, pers. comm.) (Table 2).

Several factors limit the accuracy of assessing population size for slender mouse-ear-cress in the province. The earliest collection records of Macoun, Moodie and Hudson either provided no number of plants or provided only general information. The 1995 record of Macdonald provided plant numbers and area, but the area beyond the immediate vicinity of the vegetation survey grid was not searched for additional plants (Macdonald 1997, Adams et al. 1997). The survey conducted by Smith in 1997, which provided plant numbers and general locations, was restricted to a 30-m to 50-m wide corridor with only occasional extensions of up to 200 m, and no accurate locations could be provided (Golder Associates, Ltd. 1997; B.M. Smith, pers. comm.). Her subsequent searches for the species in 1999 and 2000 covered only restricted portions of the locations from 1997 (B.M. Smith, pers. comm.). The search in 2002 was hampered

by the extreme drought conditions of the previous two years, and there was no evidence of any slender mouse-ear-cress plants in that or the following year (Macdonald 2002). Indeed, such extremely dry conditions may have greatly reduced the appearance of seedlings and mature plants of the species, either by repressing seed germination, prematurely shrivelling and killing seedlings and maturing plants, or interrupting seed production directly through desiccation or interfering with pollination or other environmental factors.

Population trends for slender mouse-ear-cress in Alberta cannot be determined at this time because of several factors: the species' rarity in the province, the lack of monitoring effort, and the difficulty that surveyors may have had in identifying this technically complex species. Variation in the number of slender mouse-ear-cress plants observed from year to year is likely a result of both natural variation in numbers and the variability in survey effort for the species. The magnitude of variation in the number of plants is unknown.

2. Other Areas – In Saskatchewan, the size of the slender mouse-ear-cress populations at most of the locations has been indicated only by qualitative terms such as “rare, frequent, abundant” and in a single case “one only” (Hudson, specimen labels, in Smith 1991). In 1997, the species was discovered at two locations in the vicinity of Estuary, Saskatchewan, where eight live plants and 15 old stems from 1996 were found (Smith 1999). In 1999, all known locations were resurveyed, but no plants were recorded at any of the locations (Smith 1999). A separate reconnaissance of rare plant ecology in Saskatchewan in 1996 found some plants at only one of the then-known locations (Bedeki-Robson 1997), and a resurvey for these populations in 2002 found no plants at any of the locations (Elchuk 2002).

No information was available for the sizes of the populations in the states where the species

is rare: California, Utah and Colorado (California Natural Diversity Database 2003, Utah Division of Wildlife Resources 1998, Colorado Natural Heritage Program 2003). In Wyoming and Montana, where the species is not rare, it is listed as being sparse to frequent in the locations where it has been documented, and indeed, in range evaluations in Wyoming, it is treated as an “increaser” (a species that increases its cover with grazing pressure) (B. Heidel, pers. comm.). No information is available for the states where slender mouse-ear-cress merely has been reported: Idaho and Nevada (NatureServe 2004).

LIMITING FACTORS

1. Habitat Loss, Alteration and Fragmentation

– One of the most widely recognized requirements for the protection of species is the conservation of potential habitat (Schemske et al. 1994). More than two-thirds of the Dry Mixedgrass Natural Subregion has been destroyed by cultivation in Alberta (Wallis 1987; Samson and Knopf 1994), leaving only a small portion of original native prairie. Smith (1991) noted that increased grazing pressure on the remaining rangeland had changed the plant composition in a variety of habitats.

The known locations for slender mouse-ear-cress in the province occur within relatively large areas of potential habitat, from over 600 km² in the areas north of and along the eastern side of Canadian Forces Base Suffield, to less than 1 km² in the river valley locations. In most cases, the habitat is found in low intensity pasture, which apparently can be tolerated by the species. However, in a few cases the species is no longer found because the habitat has been converted to recreational uses, or the site has been stabilized, such as at the Highway 41 crossing and Police Point Park locations along the South Saskatchewan River.

The known habitat of slender mouse-ear-cress is associated with mid-grass prairies on sand

plains, but there is potential for the species to occur on other substrates and in mixed grassland communities in Alberta, such as those associated with the slopes of the Cypress Hills, and perhaps the Sweetgrass Hills and southern foothills. In many cases, these habitats have been compromised by agricultural and industrial uses, and corridors between remnants are being reduced or are discontinuous. Noss et al. (1997) have noted that to ensure the perpetuation of a species, habitat requirements must be considered in terms of a large landscape of potentially suitable and connected habitats, rather than as isolated, single, disconnected sites.

2. Drought – The effects of the recent drought conditions in southeastern Alberta have been to greatly reduce the amount of rainfall available throughout the growing season, and to delay the critical early and late stages when germination and initial growth of slender mouse-ear-cress may occur. This undoubtedly is part of a cycle that had origins well before the “dirty thirties”, and the effect in the province is that the southern portion of the “Palliser Triangle”, with its chronically dry climatic conditions, has shifted northward (H.D.J. McLean, pers. comm.). Although periodic drought appears to be part of the normal cycle for this species, an increase in the severity and duration of drought periods might be detrimental to the species if the longevity of seeds in the seed bank is not sufficient for them to survive the drought. If prolonged drought results in any decrease in the ability of the species to grow and set seed, there may be a further reduction in the number of plants in Alberta, although a return to normal rainfall conditions might allow a rebound in the number of plants.

3. Reduction/Absence of Grazing Disturbance

– The species appears to be able to withstand, if not actually require, some level of light disturbance. In Wyoming, range surveys classify it as an “increaser”, meaning that it is a species that not only is able to tolerate a modest level of grazing and disturbance, but may even prosper

under these conditions (B. Heidel, pers. comm.). Three of the areas where slender mouse-ear-cress has been recorded (McNeill, the Canadian Forces Base Suffield area and the Duchess Community Pasture) are currently under a light grazing regime that has been reduced even more as a result of the drought conditions. Detrimental impacts on the populations may be anticipated in situations where there is intense, long-term grazing pressure that exceeds the normal carrying capacity of the rangeland. The Duchess Community Pasture, which normally has 1 cow per 40 acres, had no cattle in 2001 and reduced its usual cattle load by 70% in 2002, to only 130 cattle, for a shortened, two-month period (B. Hale, pers. comm.). Similarly, the McNeill location had only 15% of its normal number of cattle in 2002, mostly because of the sensitivity of the sandy terrain and lack of forage growth (F. Wittig, pers. comm.). The areas along the northern boundary of Canadian Forces Base Suffield also appear to have had greatly reduced grazing pressure since the beginning of the drought in 2000. At this point, it is unlikely that the reduced grazing pressure at these locations has negatively affected the slender mouse-ear-cress population, but this should be monitored.

4. Competition from Introduced Species – In many of the lightly grazed native prairie situations, the introduction of non-native species, either as invasive weeds or as improvement species for grazing and stabilization, is not a serious problem. This is the situation for the slender mouse-ear-cress locations north of McNeill and north of Canadian Forces Base Suffield. The Duchess Community Pasture has not used crested wheat grass for improvement, although there is a notable presence of pasture sagewort (*Artemisia frigida*) and prickly pear. However, competition from introduced species is a problem at some locations. The Highway 41 crossing of the South Saskatchewan River has a vigorously overwhelming growth of crested wheat grass among the dense silver sagebrush thickets at the probable site reported by Hudson. The historical Police Point Park

location (an interpretive park), as indicated above, also has become overgrown with sagebrush and has lawn species and a variety of weeds in the undergrowth. Smith (1999) noted that awnless brome grass (*Bromus inermis*) and sweet yellow clover (*Melilotus officinalis*) were a problem in Saskatchewan, and Macdonald (2002) noted that tumbling mustard (*Sisymbrium altissimum*) was locally common along the north side of Canadian Forces Base Suffield.

5. Recreational Use – Recreational use by the general public is not a problem at the known locations for the species in the province, because they are under private ownership or have management regulations that restrict recreation use by all-terrain vehicles. The historical location at Police Point Park in Medicine Hat has a series of interpretive and parking facilities, but the overall river shore and floodplain features noted by Macoun in 1894 still persist. However, subsequent control of seasonal floodwater probably has changed the habitat somewhat.

STATUS DESIGNATIONS*

1. Alberta – Slender mouse-ear-cress has been on several provincial lists for candidate rare species since the late 1970s (Argus and White 1978, Packer and Bradley 1984). In 2000, the species was considered *May Be At Risk* in Alberta, according to the general status exercise conducted by Alberta Sustainable Resource Development (Alberta Sustainable Resource Development 2000). The species is currently designated by the Alberta Natural Heritage Information Centre (Vujnovic and Gould 2002) and NatureServe (2004) as being G4 N2 S1.

2. Other Areas – In May 2000, the Committee on the Status of Endangered Wildlife in Canada listed slender mouse-ear-cress as *Threatened* (COSEWIC 2003). This is a recent downgrade from its previous, more critical, status of

* See Appendix 1 for definitions of selected status designations.

Endangered, assigned in 1992 (COSEWIC 2002). Argus and Pryer (1990) classified the species as being one of 67 species in Alberta that had a Canadian Priority 4 (out of 5) rating. The new federal *Species at Risk Act* recognizes the species on Schedule 1, in the *Threatened* category (Government of Canada 2003). The only other province in Canada that includes this species in its flora is Saskatchewan, where it also is regarded as currently having a status of S1, with only six locations supporting populations since 1990, and three additional historical locations at which populations have not been rediscovered (Smith 1991, 1999; Saskatchewan Conservation Data Centre 2001; S. Lamont, pers. comm.).

In the United States, the species has a ranking of N2N3 (NatureServe 2004). The adjacent state of Montana currently places this species' rank as S3 (Montana Natural Heritage Program 2002; B. Heidel, pers. comm.). Similarly, Wyoming currently ranks this species as S3 (Wyoming Natural Diversity Database 2002), and in both states, the species is on the watch list (B. Heidel, pers. comm.). In Utah, the species has a rank of S1, and is listed with locations in only four counties (Welsh et al. 1987, Utah Division of Wildlife Resources 1998, Utah Conservation Data Center 2003, NatureServe 2004). The Colorado Natural Heritage Program includes it in its list of "Tracked Vascular Plant Species", as having a rarity rank of S1?, indicating that it is undoubtedly rare, although there is some question about its exact rank (Colorado Natural Heritage Program 2003, NatureServe 2004). In California, although it is not listed in the California Natural Diversity Database of endangered and threatened plants, it is included in its list of "special" plants with a rank of S1.3? (California Natural Diversity Database 2003). In Nevada and Idaho the species has only SNR status (NatureServe 2004), and it has not been listed as having significant status in the Nevada Rare Plant Atlas (Nevada Natural Heritage Program 2001).

It is possible that the species has been overlooked in past inventories because of its very infrequent occurrence and its resemblance to more common species, and it is likely that, particularly in its vegetative stage, it has been overlooked in range surveys. Hence, its detailed distribution within the prairies of Canada, and quite possibly those of the United States as well, may well be underestimated.

RECENT MANAGEMENT IN ALBERTA

No management plans specifically for the conservation and protection of slender mouse-ear-cress have been initiated in Alberta (J. Rintoul, pers. comm.). All but two of the known locations for the species are under private ownership, and up to this point no concern has been expressed to the owners about the populations within their control. One of the publicly owned locations is at Police Point Park in Medicine Hat, where the species has not been reported since the late 1800s; however, the park is not a provincially designated protected area (K. Vujnovic, pers. comm.). The one location that is under current protection is the Linstead Flats location in the Canadian Forces Base Suffield National Wildlife Area. This area is protected from general disturbance by its use designation, which precludes most human activities, including the armoured tank training activities of the base operations (G.C. Trottier, pers. comm.). Currently, there are no active petrochemical activities in the vicinity of this population, and the immediate vicinity of this location would be excluded from disturbance. Otherwise, the only potential for disturbance may be from the little-used vehicle trail that passes adjacent to several of the plants. The extreme isolation of the location and the considerable access restrictions within the base further protect the population.

In Saskatchewan and Wyoming, conservation management of the species appears to be limited

to continued inventories, monitoring, and landowner cooperation and stewardship encouragement activities (S. Lamont, pers. comm.; B. Heidel, pers. comm.).

SYNTHESIS

The infrequency of records of slender mouse-ear-cress makes it difficult to determine the species' true significance in Alberta. It is known mostly from several widespread sand plain grassland locations in Alberta's Grassland Natural Region, and also from river valley sites. There is good potential for it also to be found in the slope meadows of the Cypress Hills, Sweetgrass Hills and southern foothills of the province. Currently, it is considered to be *May Be At Risk* in Alberta (Alberta Sustainable Resource Development 2000), *Threatened* in Canada (COSEWIC 2003) and is on Schedule 1 of the federal *Species at Risk Act* (Government of Canada 2003).

Several research pursuits and management activities would be valuable in confirming the status of slender mouse-ear-cress in Alberta. Systematic early-season monitoring of the known locations should be undertaken on a regular basis. Pursuit of additional new populations in the known potential habitat would be productive, especially in other suitable sand plains grasslands and slope grasslands in the

Cypress Hills, Sweetgrass Hills and southern foothills. Research into the ecological requirements of the species, particularly with respect to its success in developing and setting seed, would help to clarify the plant's chances of long-term survival in Alberta. Information regarding which species of insects are active in pollinating slender mouse-ear-cress, and whether the species may also be self-pollinated, would be helpful not only in broadening our understanding of the seed production process, but also perhaps in identifying potential habitat conditions. Additionally, while wind probably plays a major role in spreading the seeds once the siliques dehisce, their germination success is unknown. Research on gene exchange within or between locations for the species is also needed. Given the probable confusion of this species with more common species, range surveyors, researchers, managers and concerned landowners should be advised of the potential for this species' occurrence, and should be assisted in its identification.

Ultimately, the preservation of this species in Alberta will require the cooperation of private landowners, public managers and management advisors, through the use of conservancy agreements, facilitated management options, and a shared understanding and appreciation of the Grassland Natural Region.

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Appendix 1. Definitions of selected legal and protective designations.

A. The General Status of Alberta Wild Species 2000 (after Alberta Sustainable Resource Development 2001)

2000 Rank	1996 Rank	Definitions
At Risk	Red	Any species known to be <i>At Risk</i> after formal detailed status assessment and designation as <i>Endangered</i> or <i>Threatened</i> in Alberta.
May Be At Risk	Blue	Any species that may be at risk of extinction or extirpation, and is therefore a candidate for detailed risk assessment.
Sensitive	Yellow	Any species that is not at risk of extinction or extirpation but may require special attention or protection to prevent it from becoming at risk.
Secure	Green	Any species that is not <i>At Risk</i> , <i>May Be At Risk</i> or <i>Sensitive</i> .
Undetermined	Status Undetermined	Any species for which insufficient information, knowledge or data is available to reliably evaluate its general status.
Not Assessed	n/a	Any species known or believed to be present but which has not yet been evaluated.
Exotic/Alien	n/a	Any species that has been introduced as a result of human activities.
Extirpated/Extinct	n/a	Any species no longer thought to be present in Alberta (<i>Extirpated</i>) or no longer believed to be present anywhere in the world (<i>Extinct</i>).
Accidental/Vagrant	n/a	Any species occurring infrequently and unpredictably in Alberta, i.e., outside its usual range.

B. Alberta Wildlife Act/Regulation

Species designated as *Endangered* under Alberta's *Wildlife Act* include those listed as *Endangered* or *Threatened* in the *Wildlife Regulation*.

Endangered	A species facing imminent extirpation or extinction.
Threatened	A species that is likely to become endangered if limiting factors are not reversed.

C. Committee on the Status of Endangered Wildlife in Canada (after COSEWIC 2002)

Extinct	A species that no longer exists.
Extirpated	A species that no longer exists in the wild in Canada, but occurs elsewhere.
Endangered	A species facing imminent extirpation or extinction.
Threatened	A species that is likely to become endangered if limiting factors are not reversed.
Special Concern	A species of special concern because of characteristics that make it particularly sensitive to human activities or natural events.
Not at Risk	A species that has been evaluated and found to be not at risk.
Data Deficient	A species for which there is insufficient scientific information to support status designation.

Appendix 1 continued.

D. Heritage Status Ranks: Global (G), National (N), Sub-National (S) (after Alberta Natural Heritage Information Centre 2002b, NatureServe 2004)

G1/N1/S1	5 or fewer occurrences or only a few remaining individuals. May be especially vulnerable to extirpation because of some factor of its biology.
G2/N2/S2	6 to 20 or fewer occurrences or with many individuals in fewer locations. May be especially vulnerable to extirpation because of some factor of its biology.
G3/N3/S3	21 to 100 occurrences, may be rare and local throughout its range, or in a restricted range (may be abundant in some locations). May be susceptible to extirpation because of large-scale disturbances.
G4/N4/S4	Typically > 100 occurrences. Apparently secure.
G5/N5/S5	Typically > 100 occurrences. Demonstrably secure.
GX/NX/SX	Believed to be extinct or extirpated, historical records only.
GH/NH/SH	Historically known, may be relocated in the future.
GNR/NNR/SNR	Unranked—conservation status not yet assessed.

E. United States Endangered Species Act (after National Research Council 1995)

Endangered	Any species which is in danger of extinction throughout all or a significant portion of its range.
Threatened	Any species which is likely to become an endangered species within the foreseeable future throughout all or a significant portion of its range.

Appendix 2. Plant species found growing in association with slender mouse-ear-cress habitat in 1995, 2002 and 2003, including those listed in the Habitat section of the report (after Macdonald 1997, 2002; Smith 1999).

variegated horsetail (*Equisetum variegatum*)
prairie selaginella (*Selaginella densa*)
crested wheat grass (*Agropyron pectiniforme*)
western wheat grass (*Agropyron* [= *Pascopyrum*] *smithii*)
slender wheat grass (*Agropyron* [= *Elymus*] *trachycaulum*)
blue grama (*Bouteloua gracilis*)
sand grass (*Calamovilfa longifolia*)
Rocky Mountain fescue (*Festuca saximontana*)
June grass (*Koeleria macrantha*)
Sandberg bluegrass (*Poa sandbergii*)
needle-and-thread (*Stipa comata*)
western porcupine grass (*Stipa curtiseta*)
silvery-flowered sedge (*Carex aenea*)
thread-leaved sedge (*Carex filifolia*)
blunt sedge (*Carex obtusata*)
sun-loving sedge (*Carex pensylvanica* var. *digyna*)
low sedge (*Carex stenophylla*)
prairie onion (*Allium textile*)
star-flowered false Solomon's-seal (*Smilacina stellata*)
goosefoot (*Chenopodium pratericola*)
mouse-ear chickweed (*Cerastium arvense*)
bee plant (*Cleome serrulata*)
purple rock cress (*Arabis divaricarpa*)
reflexed rock cress (*Arabis holboellii* var. *retrofracta*)
annual whitlow-grass (*Draba nemorosa*)
green tansy mustard (*Descurania pinnata*)
whitlow-grass (*Draba reptans*)
prairie rocket (*Erysimum asperum*)
small-flowered rocket (*Erysimum inconspicuum*)
common pepper-grass (*Lepidium densiflorum*)
tumbling mustard (*Sisymbrium altissimum*)
common wild rose (*Rosa woodsii*)
annual lupine (*Lupinus pusillus*)
scurf pea (*Psoralea lanceolata*)
golden bean (*Thermopsis rhombifolia*)
yellow prairie violet (*Viola nuttallii*)
cushion cactus (*Coryphantha vivipara*)
prickly pear (*Opuntia polyacantha*)
silverberry (*Elaeagnus commutata*)
white evening-primrose (*Oenothera nuttallii*)
scarlet mallow (*Sphaeralcea coccinea*)
northern fairy candelabra (*Androsace occidentalis*)

Appendix 2 continued.

moss phlox (*Phlox hoodii*)
Fendler's cryptanthe (*Cryptantha fendlerii*)
western bluebur (*Lappula occidentalis*)
buckbrush (*Symphoricarpos occidentalis*)
silver sagebrush (*Artemisia cana*)
pasture sagewort (*Artemisia frigida*)
prairie sagewort (*Artemisia ludoviciana*)
Flodman's thistle (*Cirsium flodmanii*)
tufted fleabane (*Erigeron caespitosus*)
gumweed (*Grindelia squarrosa*)
golden aster (*Heterotheca villosa*)
skeletonweed (*Lygodesmia juncea*)
low goldenrod (*Solidago missouriensis*)
common goat's-beard (*Tragopogon dubius*)

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