

# Management Plan for the Western Harvest Mouse *megalotis* subspecies (*Reithrodontomys megalotis megalotis*) in Canada

## Western Harvest Mouse, *megalotis* subspecies



2015



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For copies of the management plan or for additional information on species at risk, including the Committee on the Status of Endangered Wildlife in Canada (COSEWIC) Status Reports, residence descriptions, action plans, and other related recovery documents, please visit the [Species at Risk Public Registry](#)<sup>1</sup>.

**Cover photo:** Andy Teucher

Également disponible en français sous le titre:  
« Plan de gestion de la souris des moissons de la sous-espèce *megalotis* (*Reithrodontomys megalotis megalotis*) au Canada [Proposition] »

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<sup>1</sup> <http://registrelep-sararegistry.gc.ca/default.asp?lang=En&n=24F7211B-1>

MANAGEMENT PLAN FOR THE WESTERN HARVEST  
MOUSE *MEGALOTIS* SUBSPECIES (*Reithrodontomys  
megalotis megalotis*) IN CANADA

2015

Under the Accord for the Protection of Species at Risk (1996), the federal, provincial, and territorial governments agreed to work together on legislation, programs, and policies to protect wildlife species at risk throughout Canada.

In the spirit of cooperation of the Accord, the Government of British Columbia has given permission to the Government of Canada to adopt the *Management Plan for the Western Harvest Mouse (Reithrodontomys megalotis) in British Columbia* (Part 2 of this document) under section 69 of the *Species at Risk Act*. Environment Canada has included an addition which completes the SARA requirements for this management plan.

The federal Management Plan for the Western Harvest Mouse *megalotis* subspecies in Canada consists of two parts:

Part 1 - Federal Addition to the *Management Plan for the Western Harvest Mouse (Reithrodontomys megalotis) in British Columbia*, prepared by Environment Canada.

Part 2 - *Management Plan for the Western Harvest Mouse (Reithrodontomys megalotis) in British Columbia*, prepared by B.C. Ministry of Environment.

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Part 2 - *Management Plan for the Western Harvest Mouse (Reithrodontomys megalotis) in British Columbia*, prepared by B.C. Ministry of Environment.

**PART 1 - Federal Addition to the *Management Plan for the Western Harvest Mouse (Reithrodontomys megalotis) in British Columbia*, prepared by Environment Canada.**

## PREFACE

The federal, provincial, and territorial government signatories under the [Accord for the Protection of Species at Risk \(1996\)](#)<sup>2</sup> agreed to establish complementary legislation and programs that provide for effective protection of species at risk throughout Canada. Under the *Species at Risk Act* (S.C. 2002, c. 29) (SARA) the federal competent ministers are responsible for the preparation of management plans for listed Special Concern species and are required to report on progress within five years after the publication of the final document on the SAR public registry.

SARA section 65 requires the competent Minister, which is the federal Minister of the Environment in this case, to prepare a management plan for all listed Special Concern species. SARA section 69 allows the Minister to adopt all or part of an existing plan for the species if the Minister is of the opinion that an existing plan relating to a wildlife species includes adequate measures for the conservation of the species.

The attached provincial management plan (Part 2 of this document) for the species was provided as science advice to the jurisdictions responsible for managing the species in British Columbia. Environment Canada has prepared this federal addition to meet the requirements of SARA.

Success in the conservation of this species depends on the commitment and cooperation of many different constituencies that will be involved in implementing the directions set out in this management plan and will not be achieved by Environment Canada or any other jurisdiction alone. All Canadians are invited to join in supporting and implementing this plan for the benefit of the Western Harvest Mouse *megalotis* subspecies and Canadian society as a whole.

Implementation of this management plan is subject to appropriations, priorities, and budgetary constraints of the participating jurisdictions and organizations.

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<sup>2</sup> <http://registrelep-sararegistry.gc.ca/default.asp?lang=en&n=6B319869-1#2>

## Additions and Modifications to the Adopted Document

The following sections have been included to address specific requirements of SARA that are not addressed in the *Management Plan for the Western Harvest Mouse (Reithrodontomys megalotis) in British Columbia (Part 2)* and/or to provide updated or additional information for the *megalotis* subspecies.

### 1. Species Status Information

This section modifies the “Species Status Information” (section 2) provided in the provincial management plan to reflect the *megalotis* subspecies’ conservation status and ranks as reported by NatureServe.<sup>3</sup>

Legal Designation: SARA Schedule 1 (Special Concern) (2007)

Global (G) Rank*	National (N) Rank(s)*	Sub-national (S) Rank(s)*	COSEWIC Status
G5T5	Canada (N2N3)** United States (N5)	Canada: BC (SNR) United States: Colorado (SH)	Special Concern

\* Ranks: 1 = critically imperiled; 2 = imperiled; 3 = vulnerable to extirpation or extinction; 4 = apparently secure; 5 = secure; SNR = unranked; H = possibly extirpated

\*\* Range rank: range of uncertainty about the status of the species or community

Approximately 0.3% of the global range of this subspecies is in Canada (COSEWIC 2007).

### 2. Effects on the Environment and Other Species

A strategic environmental assessment (SEA) is conducted on all SARA recovery planning documents, in accordance with the [Cabinet Directive on the Environmental Assessment of Policy, Plan and Program Proposals](#)<sup>4</sup>. The purpose of a SEA is to incorporate environmental considerations into the development of public policies, plans, and program proposals to support environmentally sound decision-making and to evaluate whether the outcomes of a recovery planning document could affect any component of the environment or achievement of any of the [Federal Sustainable Development Strategy’s](#) (FSDS)<sup>5</sup> goals and targets.

Recovery planning is intended to benefit species at risk and biodiversity in general. However, it is recognized that plans may also inadvertently lead to

<sup>3</sup> NatureServe Explorer: An online encyclopedia of life [http://explorer.natureserve.org; accessed September 9, 2014]

<sup>4</sup> <http://www.ceaa.gc.ca/default.asp?lang=En&n=B3186435-1>

<sup>5</sup> [www.ec.gc.ca/dd-sd/default.asp?lang=En&n=F93CD795-1](http://www.ec.gc.ca/dd-sd/default.asp?lang=En&n=F93CD795-1)

environmental effects beyond the intended benefits. The planning process based on national guidelines directly incorporates consideration of all environmental effects, with a particular focus on possible impacts upon non-target species or habitats. The results of the SEA are incorporated directly into the plan itself, but are also summarized below in this statement.

The provincial management plan notes in section 8 that efforts to maintain Western Harvest Mouse habitat are not expected to have negative effects on other species and that those recovery actions would benefit co-occurring species.

Recovery actions for the *megalotis* subspecies (e.g., inventory and monitoring, threat mitigation, and education) will be implemented with consideration of all co-occurring species at risk, such that there are no negative impacts to these species or their habitats. These recovery actions will likely benefit other species that overlap with the *megalotis* subspecies' distribution.

Some SARA-listed species in the Okanagan and Similkameen River Valleys of British Columbia that may co-occur with the Western Harvest Mouse *megalotis* subspecies are: American Badger *jeffersonii* subspecies (*Taxidea taxus jeffersonii*) and Tiger Salamander (*Ambystoma tigrinum*; southern mountain population), both listed as Endangered under SARA; Lewis's Woodpecker (*Melanerpes lewis*; southern mountain population), Western Rattlesnake (*Crotalus oreganus*), and Great Basin Spadefoot (*Spea intermontana*), which are listed as Threatened under SARA.

### 3. References

COSEWIC 2007. COSEWIC Assessment and Update Status Report on the Western Harvest Mouse *Reithrodontomys megalotis megalotis* and *Reithrodontomys megalotis dychei* in Canada. Committee on the Status of Endangered Wildlife in Canada, Ottawa. vii + 27 pages.

**Part 2 - *Management Plan for the Western Harvest  
Mouse (Reithrodontomys megalotis) in British  
Columbia*, prepared by B.C. Ministry of Environment.**

# Management Plan for the Western Harvest Mouse (*Reithrodontomys megalotis*) in British Columbia



Prepared by B.C. Ministry of Environment



July 2014

## **About the British Columbia Management Plan Series**

This series presents the management plans that are prepared as advice to the Province of British Columbia. Management plans are prepared in accordance with the priorities and management actions assigned under the British Columbia Conservation Framework. The Province prepares management plans for species that may be at risk of becoming endangered or threatened due to sensitivity to human activities or natural events, or species where management is required to meet population targets for ecosystem management, human uses, or ecological services.

### **What is a management plan?**

A management plan identifies a set of coordinated conservation activities and land use measures needed to ensure, at a minimum, that the target species does not become threatened or endangered or is being managed for use, ecosystem goals, or ecological services. A management plan summarizes the best available science-based information on biology and threats to inform the development of a management framework. Management plans set goals and objectives, and recommend approaches appropriate for species or ecosystem conservation.

### **What's next?**

Direction set in the management plan provides valuable information on threats and direction on conservation measures that may be used by individuals, communities, land users, conservationists, academics, and governments interested in species and ecosystem conservation.

### **For more information**

To learn more about species at risk recovery planning in British Columbia, please visit the B.C. Ministry of Environment Recovery Planning webpage at:

<<http://www.env.gov.bc.ca/wld/recoveryplans/rcvry1.htm>>

**Management Plan for the Western Harvest Mouse  
(*Reithrodontomys megalotis*) in British Columbia**

**Prepared by the B.C. Ministry of Environment**

**July 2014**

## **Recommended citation**

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## **Cover illustration/photograph**

Western Harvest Mouse in southern Okanagan. Photograph by Andy Teucher.

## **Additional copies**

Additional copies can be downloaded from the B.C. Ministry of Environment Recovery Planning webpage at:

<<http://www.env.gov.bc.ca/wld/recoveryplans/rcvry1.htm>>

## **Publication information**

**ISBN:** 978-0-7726-6815-8

## **Disclaimer**

This management plan has been prepared by the B.C. Ministry of Environment, as advice to the responsible jurisdictions and organizations that may be involved in managing the species.

This document identifies the management actions that are deemed necessary, based on the best available scientific and traditional information, to prevent Western Harvest Mouse populations in British Columbia from becoming endangered or threatened. Management actions to achieve the goals and objectives identified herein are subject to the priorities and budgetary constraints of participatory agencies and organizations. These goals, objectives, and management approaches may be modified in the future to accommodate new objectives and findings.

The responsible jurisdictions have had an opportunity to review this document. However, this document does not necessarily represent the official positions of the agencies or the personal views of all individuals.

Success in the conservation of this species depends on the commitment and cooperation of many different constituencies that may be involved in implementing the directions set out in this management plan. The B.C. Ministry of Environment encourages all British Columbians to participate in the conservation of the Western Harvest Mouse.

## **ACKNOWLEDGEMENTS**

The completion of this document was a result of the work of many people. A preliminary draft was prepared by Gabrielle Pang (Environment Canada – Canadian Wildlife Service) with input and revisions from Megan Harrison (Environment Canada – Canadian Wildlife Service). Orville Dyer (B.C. Ministry of Forests, Lands and Natural Resource Operations) revised this document for publication following an external review by Dave Nagorsen and Mike Sarell (consultants). This review was funded by the Land Based Investment Fund. Orville Dyer, Purnima Govindarajulu (B.C. Ministry of Environment [B.C. MOE]), Megan Harrison, Dave Nagorsen, Mike Sarell, and Leah Westereng (B.C. MOE) completed the threats assessment for Western Harvest Mouse. Leah Westereng provided technical input and guidance.

## EXECUTIVE SUMMARY

The Western Harvest Mouse (*Reithrodontomys megalotis*) was designated by the Committee on the Status of Endangered Wildlife in Canada (COSEWIC) as a species of Special Concern because it has a limited range, and small extent of occurrence and area of occupancy. It is listed as Special Concern under Schedule 1 of the *Species at Risk Act* (SARA). In British Columbia (B.C.), the Western Harvest Mouse is ranked S2S3 (imperiled to vulnerable) by the Conservation Data Centre and is on the provincial Blue list. The B.C. Conservation Framework ranks the Western Harvest Mouse as a priority 2 under goal 3 (to maintain the full diversity of native species and ecosystems).

The Western Harvest Mouse is a small, omnivorous grassland rodent. In B.C., it is found in the intermontane grasslands of the Okanagan and Similkameen valleys, occupying areas with tall, herbaceous cover. It is predominantly located in the Bunchgrass biogeoclimatic zone but is also found in the Ponderosa Pine and Interior Douglas-fir biogeoclimatic zones. The species nests on the ground under heavy vegetation or in shrubbery.

Threats to the Western Harvest Mouse include loss of habitat due to conversion of land for residential and agricultural development as well as livestock grazing, predation by cats, and the application of rodenticides. A lack of comprehensive studies has resulted in knowledge gaps that limit understanding of other threats to the Western Harvest Mouse.

The management goal is to maintain stable or increasing populations of the Western Harvest Mouse distributed throughout the species' known range in B.C.

Management objectives for the Western Harvest Mouse include:

1. Quantify population, habitat, and distribution targets required to maintain viable populations.
2. Secure protection<sup>1</sup> for priority populations and habitats.
3. Assess and mitigate current threats at priority populations in B.C.
4. Address knowledge gaps related to key elements of Western Harvest Mouse ecology (e.g., home range size, dispersal, relative importance of different habitat types) and threats (e.g., impacts of livestock grazing, rodenticides).

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<sup>1</sup> Protection can be achieved through various mechanisms including: voluntary stewardship agreements, conservation covenants, sale by willing vendors on private lands, land use designations, and protected areas.

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# 1 COSEWIC\* SPECIES ASSESSMENT INFORMATION

**Assessment Summary - April 2007**

**Common name (population):**\*\* Western Harvest Mouse (*megalotis* subspecies)

**Scientific name:**\*\* *Reithrodontomys megalotis megalotis*

**Status:** Special Concern

**Reason for designation:** This subspecies has a limited range, and a small extent of occurrence and area of occupancy. However, the extent of occurrence and area of occupancy appear to be constant. Its principal native habitat in the Okanagan as well as old fields is declining. Furthermore, old apple orchards where the mouse has been caught are being converted to vineyards. Dispersal distance is limited and the likelihood of rescue effect is small. Extensive sampling has revealed the occurrence of the mouse at more localities. 61,000 hectares of suitable habitat is protected.

**Canadian occurrence:** British Columbia

**Status History:** Designated Special Concern in April 1994 and in April 2007. Last assessment based on an update status report.

\* Committee on the Status of Endangered Wildlife in Canada.

\*\* Common and scientific names reported in this management plan follow the naming conventions of the B.C. Conservation Data Centre, which may be different from names reported by COSEWIC.

# 2 SPECIES STATUS INFORMATION

<b>Western Harvest Mouse<sup>a</sup></b>		
<b>Legal Designation:</b>		
FRPA: <sup>b</sup> No	B.C. <i>Wildlife Act</i> : <sup>c</sup> Schedule A	<a href="#">SARA Schedule:</a> 1 - Special Concern (2009)
OGAA: <sup>b</sup> No		
<b>Conservation Status<sup>d</sup></b>		
B.C. List: Blue	B.C. Rank: S2S3 (2006)	<a href="#">National Rank:</a> N2N3 (2012)      Global Rank: G5 (2003)
Other <a href="#">Subnational Ranks</a> : <sup>e</sup> Arizona: S5; Colorado: SH		
<b>B.C. Conservation Framework (CF)<sup>f</sup></b>		
Goal 1: Contribute to global efforts for species and ecosystem conservation.		Priority: <sup>g</sup> 6 (2009)
Goal 2: Prevent species and ecosystems from becoming at risk.		Priority: 6 (2009)
Goal 3: Maintain the diversity of native species and ecosystems.		Priority: 2 (2009)
<a href="#">CF Action Groups:</a>	Monitor Trends; Compile Status Report; Planning; Send to COSEWIC; Private Land Stewardship; Habitat Protection; Habitat Restoration	

<sup>a</sup> Data source: B.C. Conservation Data Centre (2013) unless otherwise noted.

<sup>b</sup> No = Not listed in one of the categories of wildlife that require special management attention to address the impacts of forest and range activities on Crown land under the *Forest and Range Practices Act* (FRPA; Province of British Columbia 2002) and/or the *Oil and Gas Activities Act* (OGAA; Province of British Columbia 2008).

<sup>c</sup> Schedule A = designated as wildlife under the B.C. *Wildlife Act*, which offers it protection from direct persecution and mortality (Province of British Columbia 1982).

<sup>d</sup> S = subnational; N = national; G = global; T = refers to the subspecies level; B = breeding; X = presumed extirpated; H = possibly extirpated; 1 = critically imperiled; 2 = imperiled; 3 = special concern, vulnerable to extirpation or extinction; 4 = apparently secure; 5 = demonstrably widespread, abundant, and secure; NA = not applicable; NR = unranked; U = unrankable.

<sup>e</sup> Data source: NatureServe (2013).

<sup>f</sup> Data source: B.C. Ministry of Environment (2010).

<sup>g</sup> Six-level scale: Priority 1 (highest priority) through to Priority 6 (lowest priority).

### 3 SPECIES INFORMATION

#### 3.1 Species Description

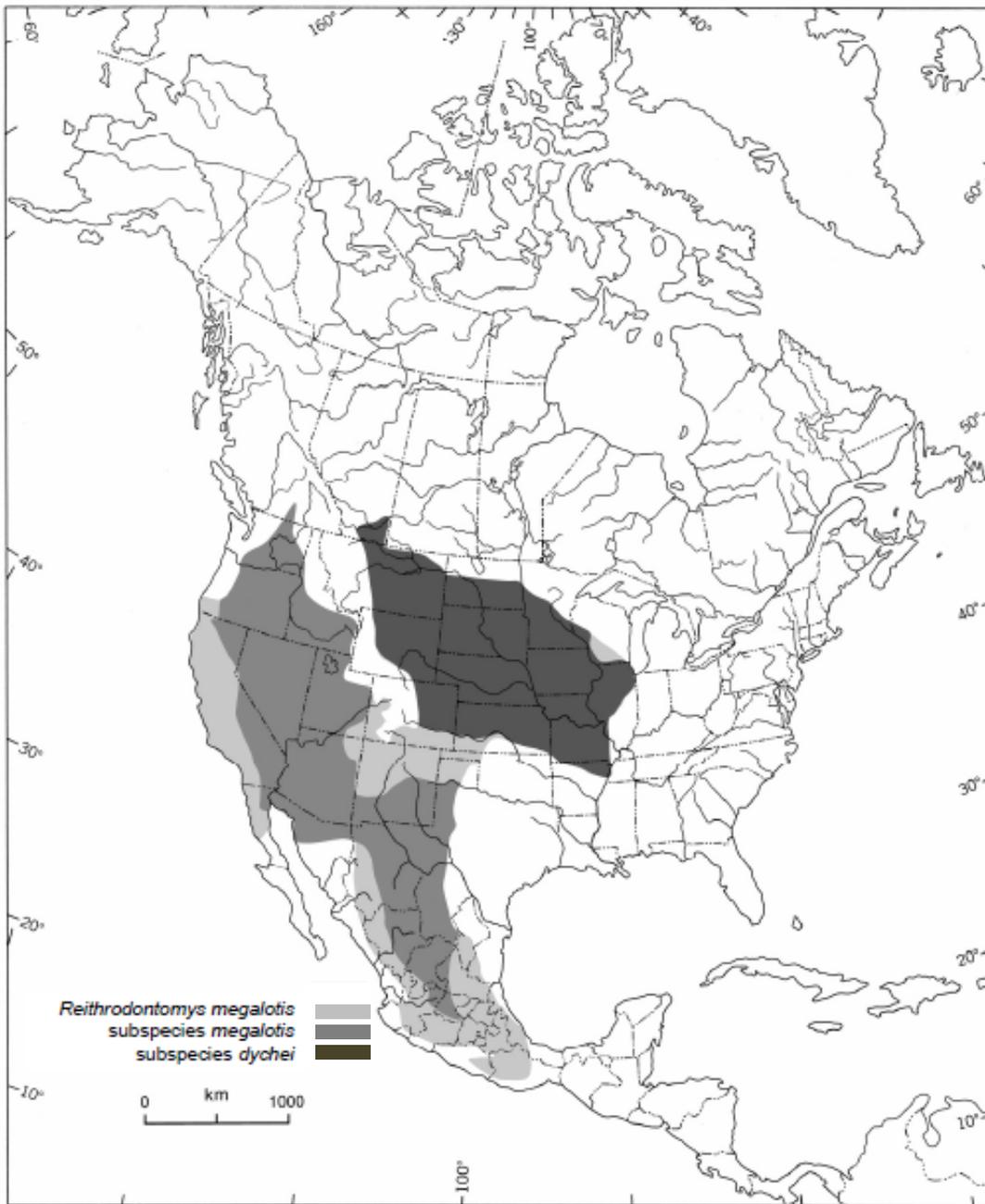
The Western Harvest Mouse is a small (8.0–15.0 g), omnivorous grassland rodent (Nagorsen 2005). The smallest rodent in B.C., its total length ranges from 116 to 151 mm, approximately half of which is a thin, sparsely furred bicoloured tail (Nagorsen 2005). It has a tawny pelage, buff-coloured sides, white to grey undersides, and a dark mid-dorsal stripe that runs from the forehead to tail. Other features unique to the Western Harvest Mouse are naked ears and white hind feet. It is similar in appearance to the more common juvenile North American Deer Mouse (*Peromyscus maniculatus*) and House Mouse (*Mus musculus*); the juvenile North American Deer Mouse is distinguished by its dull grey pelage and the House Mouse is distinguished by its naked tail (Nagorsen 2005).

#### 3.2 Populations and Distribution

The Western Harvest Mouse is widespread and abundant throughout North America, present extensively in much of western and central United States and Mexico. South-central B.C. and southeastern Alberta demark the northernmost boundary of the species' range in North America (COSEWIC 2007; Figure 1). Limited information is available on the abundance of U.S. populations of the Western Harvest Mouse, although densities as high as 60 animals per hectare have been recorded in some parts of the United States (Whitford 1976).

The Canadian range of Western Harvest Mouse represents less than 1% of the total range in North America. Two subspecies are known in Canada: the *dychiei* subspecies found in southeastern Alberta and southwestern Saskatchewan (Proulx and Proulx 2012) and the *megalotis* subspecies found in southern B.C. (COSEWIC 2007).

In B.C., the Western Harvest Mouse *megalotis* subspecies is found throughout the Okanagan Valley, as far north as Vernon, as well as in the Similkameen River Valley north to Keremeos (Figure 2; Table 1). Estimates of population density have varied by habitat type, season, and year (Sullivan and Sullivan 2006, 2008). A maximum density of 80 animals per hectare was recorded in B.C. by Sullivan and Sullivan (2004). Populations fluctuate from season to season but causes are not clearly understood (Nagorsen 2005; Sullivan and Sullivan 2008). Sullivan and Sullivan (2008) and Skupski (1995) speculated that local variation in population numbers could be driven by broader-scale source-sink dynamics or by local competition with other small mammal species. Home range size in B.C. is not known, but estimates in the southwestern United States ranged from 0.95 to 1.12 ha (Nagorsen 2005). There are no provincial or national estimates of overall abundance or population trends as Western Harvest Mice observations are largely from periodic small mammal trapping that targeted multiple species rather than surveys focused on the Western Harvest Mouse.



**Figure 1.** Western Harvest Mouse distribution in North America (COSEWIC 2007). *Megalotis* subspecies occurs west of the Rocky Mountains.

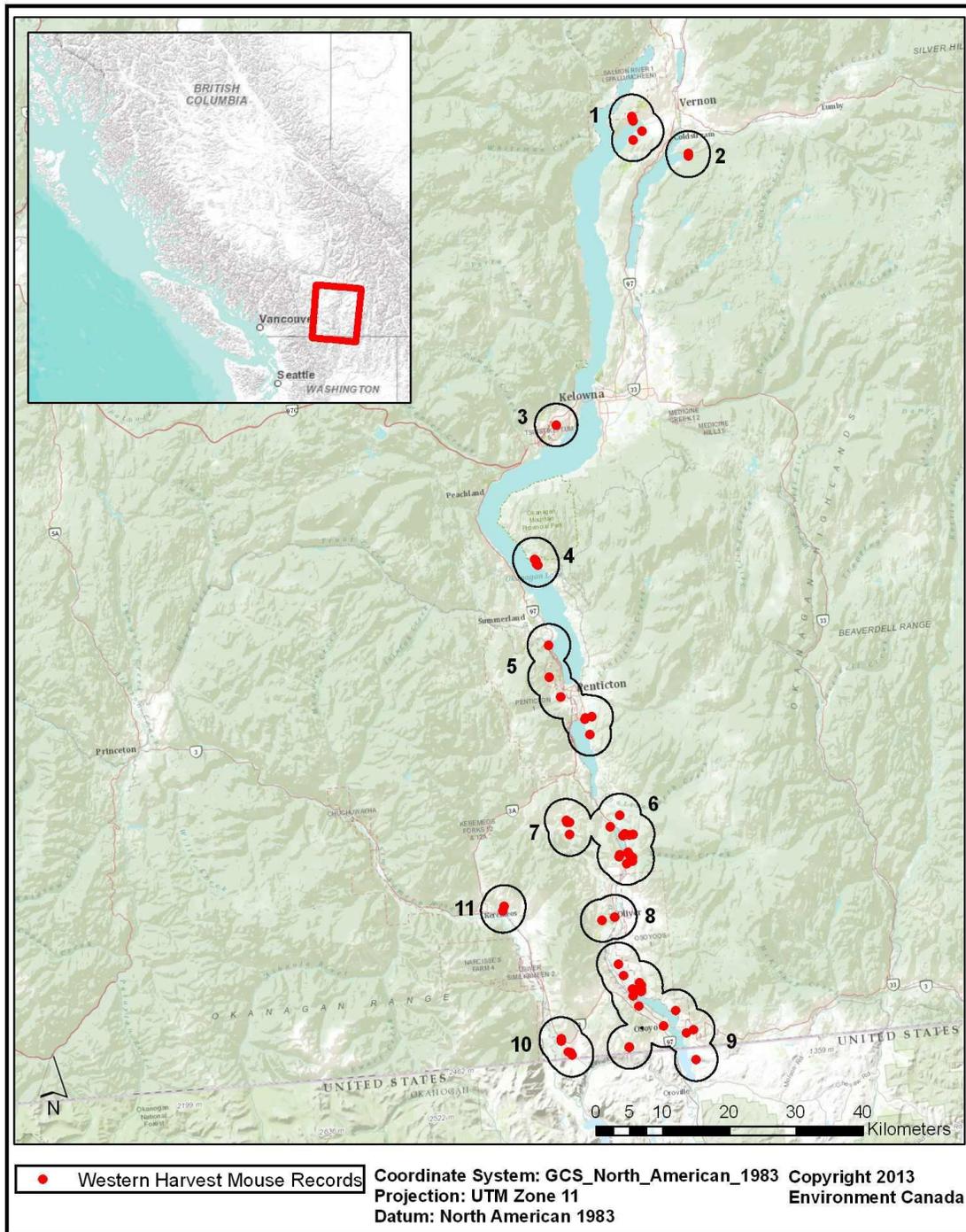


Figure 2. Populations of Western Harvest Mouse in B.C. based on capture records from 1941 to 2011.

**Table 1.** Populations of Western Harvest Mouse in B.C. (B.C. Conservation Data Centre 2013).

<b>Population<sup>a</sup></b>	<b>Status and description<sup>b</sup></b>	<b>Land tenure</b>
1. West of Vernon	Presumed extant. Last capture in 1991, habitat intact as of 2012	• Private
2. East of Vernon	Presumed extant. Last capture in 2001, habitat intact as of 2012	• Provincial (Kalamalka Lake Provincial Park)
3. Kelowna	Presumed extant. Last capture in 2002, habitat intact as of 2012	• Private
4. Okanagan Mountain Park	Presumed extant. Last capture in 1993, habitat intact as of 2012	• Provincial (Okanagan Mountain Provincial Park) • Private (on a ranch near park)
5. Penticton	Presumed extant. Last capture in 2001, habitat intact as of 2012	• Private • First Nations Reserve (within dispersal range)
6. Vaseux Lake	Presumed extant. Last capture in 2007, habitat intact as of 2012	• Federal (Vaseux National Wildlife Area) • Private
7. White Lake	Presumed extant. Last capture in 1997, habitat intact as of 2012	• Federal (National Research Council) • Provincial (White Lake Grasslands Protected Areal)
8. Oliver	Presumed extant. Last capture in 2001, habitat loss at 2001 capture location as of 2012 but intact to the west (at site of 1990 capture)	• Private • First Nations Reserve (within dispersal range)
9. Osoyoos	Extant. Last capture in 2013. As of 2012, habitat loss at the points of several captures but intact habitat within dispersal range	• Private • First Nations Reserve (within dispersal range) • Provincial (South Okanagan Grasslands Protected Area; Nature Conservancy of Canada Sage and Sparrow Grasslands; Hayne's Lease Ecological Reserve)
10. Chopaka (Nighthawk Border Crossing)	Presumed extant. Last capture in 1995, habitat intact as of 2012	• Private • First Nations Reserve (within dispersal range) • Provincial (South Okanagan Grasslands Protected Area)
11. Keremeos	Presumed extant. Last capture in 2001, habitat intact as of 2012	• Private

<sup>a</sup>Populations listed here are presumed extant as they have been reconfirmed in the last 20 years or so and the habitat is still extant. Populations are defined here as one or more capture location(s) separated from other capture locations by a distance > 3.2 km (based on a maximum recorded dispersal distance in tall grass prairie habitat) (Clark *et al.* 1988). Although this approach was used to determine populations, it is likely the outcome would have been very similar following NatureServe standards (i.e., a separation distance of 2 km if intervening habitat is unsuitable; 5 km if intervening habitat suitable) (Hammerson and Cannings 2005).

<sup>b</sup>Habitat status was assessed using 2012 orthophotos. Populations found in areas that were shown to be still vegetated (vs. urbanized) were presumed extant.

### 3.3 Habitat and Biological Needs of the Western Harvest Mouse

In B.C., the Western Harvest Mouse has been found from elevations ranging from 300 to 900 m, although most records are found below 600 m (Nagorsen 2005, 2013). The species has been recorded in the Bunchgrass (BG), Interior Douglas-fir (IDF), and Ponderosa Pine (PP) biogeoclimatic zones (B.C. Conservation Data Centre 2013). The Western Harvest Mouse is generally restricted to valley bottoms, or south-facing slopes of the Southern Okanagan Basin, Southern Okanagan Highland, Okanagan Range, and Northern Okanagan Basin ecosections (COSEWIC 2007).

The species occurs in habitats with abundant shrub and high grass cover including (in decreasing order of observed densities) old fields, sagebrush shrub-steppe, orchards, riparian, pine forests, and hedgerows (Sullivan and Sullivan 2004, 2006, 2008; COSEWIC 2007). Highest densities (80 per hectare) in B.C. were in an irrigated old field with residual alfalfa (Sullivan and Sullivan 2004). However, densities are typically lower. Sullivan and Sullivan (2008) recorded densities up to 10 per hectare in old fields and an organic orchard and up to 5 per hectare in sagebrush habitats. Walt Klenner (unpublished data, 1994) reported densities up to 41 per hectare in antelope brush-steppe habitats in the south Okanagan. Western Harvest Mice require tall grasses and dense vegetative cover for nesting, foraging, and shelter from predators (Kaufman and Fleharty 1974). They are most closely associated with antelope-brush (*Purshia tridentata*), big sagebrush (*Artemisia tridentata*), common rabbitbrush (*Ericameria nauseosa*), and grasses such as bluebunch wheatgrass (*Pseudoroegneria spicata*) and needlegrass (*Stipa* spp.). Other associated shrub species include wild rose (*Rosa* spp.), mock-orange (*Philadelphus lewisii*), saskatoon (*Amelanchier alnifolia*), and black hawthorn (*Crataegus douglasii*) (Nagorsen 2005; Sullivan and Sullivan 2008).

There are no estimates of home-range size or dispersal distances in B.C. (Nagorsen 2005); however, a number of studies have estimated home range and dispersal distances within U.S. Western Harvest Mouse populations. Pearson (1959) showed that the home range of Western Harvest Mice is likely to be small, as indicated by movement between runways that were more than 45 ft (18 m) apart. Various other U.S. studies estimated mean home ranges between 0.44 and 1.12 ha (O'Farrell 1974; Meserve 1977). The diameter of hypothetical home ranges assembled by Brant (1962) was estimated to average about 250 ft (100 m). A study conducted in Kansas documented that Western Harvest Mice have a dispersal ability ranging from 375 to 3200 m (Clark *et al.* 1988).

Western Harvest Mice construct nests made up of a coarse outer layer of fibrous grasses surrounding a layer of softer plant material. They are usually placed in heavy vegetation and shrubs up to 1 m off the ground, but can also be found in burrows or on the ground (COSEWIC 2007). In southern B.C., the breeding season ranges from March to November (Sullivan and Sullivan 2008). While captive females can produce as many as 14 litters in a year, wild females in Canada likely produce 2 to 3 litters per year (Hayssen *et al.* 1993; Nowak 1999; COSEWIC 2007).

Sullivan and Sullivan (2008) found that early juvenile survival varied by habitat type, ranging from 3.27 young per pregnant female in old fields to 5 in organic orchards, and 1 in linear habitats.

The Western Harvest Mouse spends much of its time on the ground and in shrubs searching for seeds, flowers, fungi, and other herbaceous material (Cahalane 1961). It will also eat invertebrates, with arthropods (particularly Lepidoptera larvae) making up to 30% of its diet in coastal California (Meserve 1977). Most foraging occurs at night and there is no evidence that the Western Harvest Mouse caches its food in or near its burrows and dens.

While there does not appear to be any evidence of hibernation, Western Harvest Mice can go into torpor in cold weather (Thompson 1985). This could be critical for survival in Canadian winter conditions.

### 3.4 Ecological Role

The Western Harvest Mouse is a nocturnal, non-migratory, omnivorous nest-dweller that has ecological relationships with many other species during its breeding, and wintering periods.

The Western Harvest Mouse preys on invertebrates, particularly arthropods such as Lepidoptera larvae (Cahalane 1961; Whitaker and Mumford 1972; Meserve 1977; Johnson and Gaines 1988; Jekanoski and Kaufman 1995; Nagorsen 2005).

Possible predators for the Western Harvest Mouse include owls, hawks, jays, shrikes, snakes, raccoons, foxes, weasels, skunks, badgers and coyotes (Brant 1962; Marti 1974; Cannings 1987; Brillhart and Kaufman 1994). Based on analysis of owl pellets, it is thought that as much as 5% of the Northern Saw-whet Owl (*Aegolius acadicus*) diet in southern B.C. consists of the Western Harvest Mouse (Cannings 1987).

## 4 THREATS

Threats are defined as the proximate activities or processes that have caused, are causing, or may cause in the future the destruction, degradation, and/or impairment of the entity being assessed (population, species, community, or ecosystem) in the area of interest (global, national, or subnational) (Salafsky *et al.* 2008). For purposes of threat assessment, only present and future threats are considered.<sup>2</sup> Threats presented here do not include biological features of the species or population such as inbreeding depression, small population size, and genetic isolation; or likelihood of regeneration or recolonization for ecosystems, which are considered limiting factors (Table 2).<sup>3</sup>

For the most part, threats are related to human activities, but they can be natural. The impact of human activity may be direct (e.g., destruction of habitat) or indirect (e.g., invasive species introduction). Effects of natural phenomena (e.g., fire, hurricane, flooding) may be especially important when the species or ecosystem is concentrated in one location or has few occurrences, which may be a result of human activity (Master *et al.* 2009). As such, natural phenomena are included in the definition of a threat, though should be applied cautiously. These stochastic events should only be considered a threat if a species or habitat is damaged by other threats, has lost its resilience, and is thus vulnerable to the disturbance (Salafsky *et al.* 2008). In such cases,

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<sup>2</sup> Past threats may be recorded but are not used in the calculation of Threat Impact. Effects of past threats (if not continuing) are taken into consideration when determining long-term and/or short-term trend factors (Master *et al.* 2009).

<sup>3</sup> It is important to distinguish between limiting factors and threats. Limiting factors are generally not human induced and include characteristics that make the species or ecosystem less likely to respond to recovery/conservation efforts.

these types of events would have a disproportionately large effect on the population/ecosystem compared to the effect they would have had historically.

#### **4.1 Threat Assessment**

The threat classification below is based on the IUCN-CMP (World Conservation Union–Conservation Measures Partnership) unified threats classification system and is consistent with methods used by the B.C. Conservation Data Centre and the B.C. Conservation Framework. For a detailed description of the threat classification system, see the [CMP website](#) (CMP 2010). Threats may be observed, inferred, or projected to occur in the near term. Threats are characterized here in terms of scope, severity, and timing. Threat “impact” is calculated from scope and severity. For information on how the values are assigned, see [Master \*et al.\*](#) (2009) and table footnotes for details. Threats for the Western Harvest Mouse were assessed for the entire province (Table 2).

**Table 2.** Threat classification table for Western Harvest Mouse.

Threat #	Threat description	Impact <sup>a</sup>	Scope <sup>b</sup>	Severity <sup>c</sup>	Timing <sup>d</sup>	Population(s)
1	Residential & commercial development	Low	Small	Extreme	High	
1.1	Housing & urban areas	Low	Small	Extreme	High	Vernon (West), Kelowna, Penticton, Oliver, Osoyoos, Keremeos
1.2	Commercial & industrial areas	Negligible	Negligible	Extreme	High	
1.3	Tourism & recreation areas	Negligible	Negligible	Serious	High	
2	Agriculture & aquaculture	Low	Pervasive	Slight	High	
2.1	Annual & perennial non-timber crops	Low	Small	Extreme	High	Vernon (West), Kelowna, Penticton, Oliver, Osoyoos, Keremeos
2.3	Livestock farming & ranching	Unknown	Pervasive	Unknown	High	Penticton, Vaseux Lake, White Lake, Oliver, Osoyoos, Chopaka, Keremeos
3	Energy production & mining	Negligible	Negligible	Not Scored	High	
3.2	Mining & quarrying	Negligible	Negligible	Not Scored	High	
4	Transportation & service corridors	Unknown	Pervasive	Unknown	High	
4.1	Roads & railroads	Unknown	Pervasive	Unknown	High	All
4.2	Utility & service lines	Negligible	Pervasive	Negligible	High	
6	Human intrusions & disturbance	Negligible	Negligible	Not Scored	High	
6.1	Recreational activities	Negligible	Negligible	Not Scored	High	Extent unknown
7	Natural system modifications	Negligible	Small	Negligible	High	
7.1	Fire & fire suppression	Negligible	Small	Negligible	High	All
7.3	Other ecosystem modifications	Negligible	Negligible	Slight	High	
8	Invasive & other problematic species, genes & diseases	Low	Restricted	Moderate	High	
8.1	Invasive non-native/alien species/diseases	Low	Restricted	Moderate	High	All
9	Pollution	Low	Small	Serious	High	
9.3	Agricultural & forestry effluents	Low	Small	Serious	High	Vernon (West), Kelowna, Penticton, Oliver, Osoyoos, White Lake, Keremeos

<sup>a</sup> **Impact** – The degree to which a species is observed, inferred, or suspected to be directly or indirectly threatened in the area of interest. The impact of each threat is based on severity and scope rating and considers only present and future threats. Threat impact reflects a reduction of a species population or decline/degradation of the area of an ecosystem. The median rate of population reduction or area decline for each combination of scope and severity corresponds to the following classes of threat impact: Very High (75% declines), High (40%), Medium (15%), and Low (3%). Unknown: used when impact cannot be determined (e.g., if values for either scope or severity are unknown); Not Calculated: impact not calculated as threat is outside the assessment (e.g., timing is insignificant/negligible [past threat] or low [possible threat in long term]) Negligible: when scope or severity is negligible; Not a Threat: when severity is scored as neutral or potential benefit.

<sup>b</sup> **Scope** – Proportion of the species that can reasonably be expected to be affected by the threat within 10 years. Usually measured as a proportion of the species' population in the area of interest. (Pervasive = 71–100%; Large = 31–70%; Restricted = 11–30%; Small = 1–10%; Negligible < 1%).

<sup>c</sup> **Severity** – Within the scope, the level of damage to the species from the threat that can reasonably be expected to be affected by the threat within a 10-year or 3-generation timeframe. Usually measured as the degree of reduction of the species' population. (Extreme = 71–100%; Serious = 31–70%; Moderate = 11–30%; Slight = 1–10%; Negligible < 1%; Neutral or Potential Benefit  $\geq$  0%).

<sup>d</sup> **Timing** – High = continuing; Moderate = only in the future (could happen in the short term [ $<$  10 years or 3 generations]) or now suspended (could come back in the short term); Low = only in the future (could happen in the long term) or now suspended (could come back in the long term); Insignificant/Negligible = only in the past and unlikely to return, or no direct effect but limiting.

## 4.2 Description of Threats

The overall province-wide threat impact for this species is Medium.<sup>4</sup> Threats include housing and urban areas, annual and perennial non-timber crops, and livestock farming and ranching (Table 2). Details are discussed below under the Threat Level 1 headings.

### IUCN-CMP Threat 1. Residential & commercial development

#### 1.1 Housing & urban areas

The human population in the Okanagan region is growing, especially in the low-elevation areas where the grassland habitats occupied by Western Harvest Mice occur. From 1976 to 2006, the human population in the Okanagan-Similkameen region increased 47% to 305,011 (Statistics Canada 2011). By 2022, urban development is predicted to increase 5% in the Okanagan-Similkameen Regional District (Province of British Columbia 2011). The Vernon (West), Kelowna, Penticton, Oliver, Osoyoos, and Keremeos populations are at particular risk as they occur primarily on private land and are near developed residential areas. Where development occurs habitat loss is usually extreme; however, this is a fairly localized threat and so the overall impact is thought to be low over the next 10 years.

#### 1.2 Commercial & industrial areas

Although some industrial parks and the Kelowna airport can be expected to expand, the impact of these threats is negligible.

#### 1.3 Tourism & recreation areas

There will continue to be tourism and recreational development (e.g., possibly a new golf course in Peachland, Formula 1 track in Osoyoos area); however, the scope of this threat is negligible.

### IUCN-CMP Threat 2. Agriculture & aquaculture

#### 2.1 Annual & perennial non-timber crops

Orchards and vineyards are abundant around the southern Okanagan Valley. Further conversion of grasslands to crop production has eliminated large areas of shrub-steppe habitats important to the Western Harvest Mouse (B.C. Ministry of Environment, Lands and Parks 1998; Wood 2003). Wood (2003) calculated a rate of loss of 220 ha/yr during 2001–2003 for antelope-brush shrub-steppe habitat primarily due to agricultural development. The Western Harvest Mouse also uses sagebrush habitats, which are impacted but under less threat since they occupy a greater area and are less sought after for grape growing than antelope-brush shrub-steppe habitat. Within the Okanagan-Similkameen region, 5965 ha of land are dedicated to fruit, berry, and nut orchards (B.C. Ministry of Agriculture and Lands 2006). Future conversion of land to agriculture in the Okanagan Valley is expected mainly from vineyard expansion. Bremmer and Bremmer (2008, 2011) quantified vineyard expansion between 2008 and 2011. Based on their data, about 582 ha

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<sup>4</sup> The overall threat impact was calculated following Master *et al.* (2009) using the number of Level 1 Threats assigned to this species where Timing = High or Moderate. This includes 4 Low, and 1 Unknown (Table 2). The overall threat considers the cumulative impacts of multiple threats.

and 50 ha of new vineyard are predicted in the south Okanagan-Similkameen and Vernon areas, respectively, over the next 10 years. Most new vineyards will be developed on existing orchards, but some are expected on pasture and natural habitats. Because only a small portion of the species' habitat is expected to be affected, and thus only a small proportion of the species, the overall impact for this threat was calculated to be low. Direct impacts from mowing alfalfa fields may also be an issue but impacts of mowing are unknown.

### **2.3 Livestock farming & ranching**

Cattle grazing may change abundance and composition of populations and communities of small mammals by altering the physical structure of vegetative cover (Grant *et al.* 1982). Relative densities of Western Harvest Mice are positively correlated with the depth of plant litter (Kaufman *et al.* 1988; Masters *et al.* 1998) and depth of litter can be negatively impacted by cattle grazing. Of the 37,000 ha of Crown grassland in the Okanagan region, 83.3% are under grazing tenure (Grasslands Conservation Council of B.C. 2004), including protected areas. With decreased food and cover availability, Western Harvest Mouse populations are likely to decline. In eastern Colorado, Moulton *et al.* (1981) found that Western Harvest Mice were absent from grazed sagebrush habitats. Walt Klenner (pers. comm., 2013) found Western Harvest Mouse populations of varying densities in a range of livestock grazing conditions in south Okanagan Valley antelope-brush habitat. However, his data analysis is not complete and grazing condition impacts to the Western Harvest Mouse are not clear. Other factors, including shrub density, season of grazing, and invasive plant species, may influence the impact of grazing on annual or seasonal abundance of the Western Harvest Mouse. The impact of livestock farming and ranching is unknown and requires further investigation.

## **IUCN-CMP Threat 3. Energy production & mining**

### **3.2 Mining & quarrying**

A negligible amount of Western Harvest Mouse habitat may be lost as a result of quarrying (e.g., gravel pits).

## **IUCN-CMP Threat 4. Transportation & service corridors**

### **4.1 Roads & railroads**

The loss of grasslands in the Okanagan and Similkameen valleys due to roads and railways has not been quantified but could be significant (Grasslands Conservation Council of B.C. 2004). Roads fragment Western Harvest Mouse habitats and may act as a barrier to dispersal and movement (Kozel and Fleharty 1979). However, more than 90% of all known Western Harvest Mouse observations are close to a road or to densely populated areas, suggesting that this species exploits linear and edge habitats (Munro 1958; Nagorsen 2005). All populations are within the dispersal distance of roads, so the impact of roads, whether positive or negative, would apply to all populations. The overall impact of roads and railroads threat is unknown.

### **4.2 Utility & service lines**

Trenching for installation of utility pipes may trap Western Harvest Mice causing direct mortality, if it is not mitigated. However, the impact at a population level is expected to be negligible.

## **IUCN-CMP Threat 6. Human intrusions & disturbance**

### **6.1 Recreational activities**

The use of off-road vehicles (ORVs) can cause long-term habitat damage in grasslands. However, the scope of ORV use within Western Harvest Mouse habitat is likely negligible. The impact of hikers, bikers, birdwatchers, and campers would only affect a very small portion of the habitat and the impact is negligible.

## **IUCN-CMP Threat 7. Natural systems modifications**

### **7.1 Fire & fire suppression**

Western Harvest Mice are likely susceptible to the effects of fire, both direct and indirect (Kaufman *et al.* 1988). Forest fires commonly occur during the dry summer months in the southern Okanagan and Thompson valley regions, preventing forest encroachment and rejuvenating vegetation. Anthropogenic fire suppression increases the likelihood of a catastrophic fire, which could drastically reduce populations and at least temporarily severely alter foraging habitat (Noss *et al.* 2006).

The population density of Western Harvest Mice decreases immediately following fire because of emigration and mortality (Kaufman *et al.* 1988; McMillan 1995). As Western Harvest Mice nest above ground, mortality of both juveniles and adults may be high. Population recovery from the effects of fire appears to be rapid (between 2 and 4 years) because of immigration and increased reproduction following seed production and increased plant litter (Kaufman *et al.* 1988; COSEWIC 2007). Relative densities of Western Harvest Mice are positively correlated with the depth of plant litter (Kaufman *et al.* 1988; Masters *et al.* 1998). Overall, the impact of fire is negligible.

The Western Harvest Mouse may be impacted by fire suppression over longer timeframes, if trees replace grassland and shrubs. The impacts of fire suppression are expected to be negligible.

### **7.3 Other ecosystem modifications**

Whitaker and Mumford (1972) suggested that mowing for regular roadside maintenance is a significant threat to Western Harvest Mice occupying edge habitats. However, mowing is only done along paved roads and only along the shoulders of the roads, which represent a negligible portion of the species' habitat. The Western Harvest Mouse uses the edge habitat found in ditches or along the road edge that generally is not mowed. The impact is negligible.

## **IUCN-CMP Threat 8. Invasive & other problematic species & genes**

### **8.1 Invasive non-native/alien species**

Feral and pet house cats are suspected to be found within an estimated 10–25% of Western Harvest Mouse habitat and are known to kill rodents (M. Sarell, pers. comm., 2014). Within those areas, the severity of house cat predation is estimated to be moderate. Hawkins *et al.* (2004) found more than 85% of Western Harvest Mice and deer mice (*Peromyscus* sp.) trapped in their California study were in a “no cat” zone as opposed to a zone where cats had been

attracted by supplemental feeding. Capture rates did not differ for voles, suggesting harvest and deer mice are more susceptible to cat predation than voles. Given that the scope of this threat is currently restricted, the impact from invasive mammalian species is currently estimated to be low; however, rural and agricultural expansion is expected to exacerbate the threat of House Cats in the future.

Although invasive, non-native plants are found extensively in Western Harvest Mouse habitat, it is unknown what impact they have on the Western Harvest Mouse.<sup>5</sup>

## **IUCN-CMP Threat 9. Pollution**

### **9.3 Agricultural & forestry effluents**

Rodenticides are used extensively to control vole (*Microtus* spp.) and Northern Pocket Gopher (*Thomomys talpoides*) populations in Okanagan orchards and vineyards. The Western Harvest Mouse does not harm crops in the same manner as some other rodents and, because its populations are low in comparison to other rodents, it is not specifically targeted (M. Sarell, pers. comm., 2014). However, if the assumption that the Western Harvest Mouse relies on edge habitats is correct, then rodenticides could have a greater impact on the Western Harvest Mouse. Rodenticides may impact local populations of the Western Harvest Mouse (COSEWIC 2007); however, given that rodenticides are only used within a small portion of the species range (scope), the impact from rodenticide poisoning is currently thought to be low.

## **5 MANAGEMENT GOAL AND OBJECTIVES**

### **5.1 Management Goal**

The management goal is to maintain stable or increasing populations of the Western Harvest Mouse distributed throughout the species' known range in B.C.

### **5.2 Rationale for the Management Goal**

The Western Harvest Mouse is likely to remain as a species of special concern (and thus unlikely to be removed from Schedule 1) because of its limited range in southern B.C. and the permanent loss of significant lowland grassland habitat to urban and agricultural development. However, it should be possible to prevent the species from being up-listed (i.e., to Threatened) by maintaining the current distribution by minimizing threats to preserve stable populations. Quantifying targets for population size and habitat area are not feasible at this time due to lack of baseline information. Population and habitat targets can be quantified as knowledge gaps are addressed.

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<sup>5</sup> As the impact of non-native plants is unknown, this potential impact was not included in the scoring of Threat 8.1 in Table 2.

### 5.3 Management Objectives

1. Quantify population, habitat, and distribution targets required to maintain viable populations.
2. Secure protection<sup>6</sup> for priority populations and habitats.
3. Assess and mitigate current threats at priority populations in B.C.
4. Address knowledge gaps related to key elements of Western Harvest Mouse ecology (e.g., home range size, dispersal, relative importance of different habitat types) and threats (e.g., impacts of livestock grazing, rodenticides).

## 6 APPROACHES TO MEET OBJECTIVES

### 6.1 Actions Already Completed or Underway

The following actions have been categorized by the action groups of the B.C. Conservation Framework (B.C. Ministry of Environment 2010). Status of the action group for this species is given in parentheses.

#### Compile Status Report (complete)

- COSEWIC report completed (COSEWIC 2007). Update due 2017.

#### Send to COSEWIC (complete)

- Western Harvest Mouse *megalotis* subspecies assessed Special Concern (COSEWIC 2007). Re-assessment due 2017.

#### Planning (complete)

- B.C. Management Plan completed (this document, 2014).

#### Monitor Trends (in progress)

- One systematic inventory was done in 1990–1992 (Nagorsen 1995).

#### Habitat Protection and Private Land Stewardship (in progress)

- Several Crown and private protected areas support Western Harvest Mouse. Kalamalka Lake Provincial Park, South Okanagan Grasslands Protected Area, White Lake Grassland Protected Area, Vaseux-Bighorn National Wildlife Area, Hayne's Lease Ecological Reserve, Sage and Sparrow Grasslands (Nature Conservancy of Canada).
- In addition, over 2500 ha of grassland with potential habitat for Western Harvest Mice have been acquired and are being managed for conservation by The Nature Trust (TNT) of B.C.

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<sup>6</sup> Protection can be achieved through various mechanisms including: voluntary stewardship agreements, conservation covenants, sale by willing vendors on private lands, land use designations, and protected areas.

## 6.2 Recommended Management Actions

**Table 3.** Recommended management actions and suggested implementation schedule for Western Harvest Mouse.

Objective No.	Actions to meet objectives	Threat <sup>a</sup> or concern addressed	Priority
1, 2	Develop and test a habitat model to facilitate habitat mapping for use in deriving population estimates (using existing density estimates) and identifying appropriate population and habitat targets.	Knowledge gaps	Essential
2	Use the habitat model to identify priority locations (i.e., high quality, large, well-connected habitat areas) for habitat protection.	All	Necessary
2	Protect/manage identified priority habitat and populations of Western Harvest Mouse.	All	Necessary
3	Develop and implement Best Management Practices for this species.	All	Necessary
4	Work with researchers to: <ul style="list-style-type: none"> <li>• Evaluate home range size and movement patterns in B.C. populations.</li> <li>• Complete studies of marked animals in various linear edge habitats to determine the importance of these habitats for supporting resident populations and dispersal movements among habitat patches and to determine source-sink dynamics of B.C. populations.</li> <li>• Conduct a well-designed study of grazing impacts that incorporates data collected from previous research such as Walt Klenner's 1994–1995 study.</li> <li>• Conduct study on effects of rodenticides on Western Harvest Mouse.</li> </ul>	Knowledge gaps	Necessary Necessary Necessary Beneficial

<sup>a</sup> Threats found in Table 2.

## 6.3 Narrative to Support Management Actions Table

Habitat protection and management are necessary for maintaining existing Western Harvest Mouse populations. Low elevation grassland habitats occupied by the Western Harvest Mouse have been impacted by development (Lea 2008) and will need protection to ensure that unsustainable losses do not continue. Using an ecosystem conservation approach to protect a suitable amount of well-connected habitat is likely to benefit this and other shrub-steppe species.

The many knowledge gaps for the Western Harvest Mouse must be prioritized and addressed to ensure threat abatement measures are effective and targeted at the threats with the greatest impact on the species.

## **7 MEASURING PROGRESS**

The performance indicators presented below provide a way to define and measure progress toward achieving the management objectives over the next 5 years.

### **Measures for Objective 1**

- Habitat suitability model is developed by 2017.

### **Measure for Objective 2**

- Priority populations for protection have been identified and protection efforts have been initiated by 2018.

### **Measures for Objective 3**

- Best Management Practices have been developed by 2019.

### **Measure for Objective 4**

- Studies to fill key knowledge gaps have been initiated by 2017.

## **8 EFFECTS ON OTHER SPECIES**

Grasslands make up a very small proportion of B.C. but provide important habitat for more than 30% of B.C.'s threatened and endangered species (Grasslands Conservation Council of B.C. 2004). Efforts to maintain the shrub-steppe grassland habitats would therefore benefit many species of plants and animals other than the Western Harvest Mouse that depend on the open grasslands for habitat and foraging. Negative effects are not foreseen.

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### **Personal Communications**

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