Committee on the Status of Endangered Wildlife in Canada

Comité sur le statut des espèces menacées de disparition au Canada

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STATUS REPORT ON THE WESTERN HARVEST MOUSE

REITHRODONTOMYS MEGALOTIS

IN CANADA

BY

DAVID W. NAGORSEN

STATUS ASSIGNED IN 1994

PRAIRIE POPULATION: INSUFFICIENT SCIENTIFIC INFORMATION AVAILABLE ON WHICH TO BASE A DESIGNATION.

BRITISH COLUMBIA POPULATION: VULNERABLE

REASON: PRAIRIE POPULATION: INSUFFICIENT SCIENTIFIC INFORMATION AVAILABLE ON WHICH TO BASE A DESIGNATION.

BRITISH COLUMBIA POPULATION: OCCURS IN LOW NUMBERS, HAS A RESTRICTED RANGE CONFINED TO LOW ELEVATION GRASSLANDS, EVIDENCE FOR HABITAT FRAGMENTATION.

OCCURRENCE: BRITISH COLUMBIA AND ALBERTA

COSEWIC — A committee of representatives from federal, provincial and private agencies which assigns national status to species at risk in Canada.

CSEMDC — Un comité de représentants d'organismes fédéraux, provinciaux et privés qui attribue un statut national aux espèces menacées de disparition au Canada.

STATUS REPORT ON THE WESTERN HARVEST MOUSE

REITHRODONTOMYS MEGALOTIS

IN CANADA

BY

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STATUS ASSIGNED IN 1994
PRAIRIE POPULATION - INSUFFICIENT SCIENTIFIC INFORMATION AVAILABLE ON WHICH TO BASE A DESIGNATION
BRITISH COLUMBIA POPULATION - VULNERABLE

A. ABSTRACT

The Western Harvest Mouse (*Reithrodontomys megalotis*) is a small murid rodent associated with the grasslands of western North America. In Canada, it is restricted to the Okanagan and southern Similkameen valleys of British Columbia and southern Alberta. These two populations represent distinct subspecies: *R. m. megalotis* and *R. m. dychei.*

Distribution and habitat requirements in British Columbia were determined from a three year field study. *R. megalotis* was a naturally rare species in grassland rodent communities, typically representing less than 10% of small mammal captures. Estimates of absolute density ranged from 1 to 7 animals per ha. Ideal habitat consists of dry gulleys with dense shrub cover that border grassland and shrub-steppe rangeland. Limiting factors are habitat disturbances from livestock grazing, hay mowing, fire, and cultivation; and especially habitat loss and fragmentation from urban development.

The Alberta population is known from only three historical museum specimens taken from Milk River, Medicine Hat, and the Pinhorn Grazing Reserve near Manyberries. No *R. megalotis* were captured in a survey of Writing-On-Stone Provincial Park done in 1992. Populations and habitat requirements in Alberta are unknown.

The British Columbia population should be designated as VULNERABLE. There is insufficient scientific information to recommend a designation for the Alberta population.

B. DISTRIBUTION

The Western Harvest Mouse (*Reithrodontomys megalotis*) is widely distributed across the western United States and Mexico (Figure 1). In western Canada, where it reaches its

northern limits, *R. megalotis* is restricted to the grasslands of south-central British Columbia (Cowan and Guiguet 1965) and southern Alberta (Soper 1964). The Albertan and British Columbian populations represent two subspecies: *R. megalotis dychei* and *R. megalotis megalotis* (Hall 1981).

British Columbia

Cowan and Guiguet (1965:176) described the range of the British Columbian population as "confined to the floor of the Okanagan Valley north as far as Penticton". Evidently they were unaware of Munro's (1958) records from Okanagan Landing near Vernon at the northern end of Okanagan Lake. From a three year field study and a review of all known museum records, I have determined that the distribution is more extensive (Fig. 2) than originally described by Cowan and Guiguet (1965). The range extends throughout most of the Okanagan Valley as far north as Vernon and the Similkameen Valley north to Keremeos. However, intensive sampling revealed that *R. megalotis* is absent from adjacent arid valleys such as the Thompson River and Kettle River valleys.

An intriquing aspect of the distribution is the question of whether *R. megalotis* is a relatively recent invader to the province (Munro 1958). Although various naturalist-collectors did sporadic small mammal collecting in the south Okanagan during the 1920's and 1930's, *R. megalotis* was only first captured in 1942 when Holland (1942) trapped individuals at the north end of Osoyoos Lake and at Dog Lake [=Skaha Lake] near Penticton. If this species only recently expanded its range into British Columbia from Washington, then its northern dispersal throughout the Okanagan and Similkameen valleys has been extremely rapid for a mammal with low dispersal abilities. Munro (1958) trapped

six individuals at Okanagan Landing near Vernon in 1956, a distance of 200 km north of Holland's 1942 sites. Alternatively, because this is rare species in British Columbia and these early small mammal surveys in the Okanagan were not comprehensive, a more likely explanation is that *R. megalotis* was undetected by early collectors.

Alberta

R. megalotis is known from only three localities (Fig. 3) in Alberta: Milk River, Medicine Hat, and Pinhorn Grazing Reserve near Manyberries (Moore 1952, Smith 1993). Each of these occurrences is based on a single museum specimen. The distances that separate these localities suggest that they represent distinct local populations. No captures of this species were taken during a survey of dry coulee habitats in Writing-On-Stone Provincial Park by the Alberta Provincial Museum in August 1992. Because the first records from Alberta (Milk River and Medicine Hat) were only taken in 1951, Soper (1964) suggested that *R. megalotis* may have recently immigrated to Alberta from Montana. However, given this species' rarity and the sporadic nature of early small mammal work in the province, the lack of early records could reflect sampling effort.

C. PROTECTION

In British Columbia *R. megalotis* is listed under the provincial Wildlife Act; collecting or live-trapping requires permits. Although this species has no official designation as threatened or endangered, it is on the provincial "Blue List" (candidate species for vulnerable status) prepared by the British Columbia Ministry of Environment. In Alberta *R. megalotis* is protected under the provincial Wildlife Act as a non-game species; however, this species was not included in the provincial status lists prepared by the Alberta

government (The Status of Alberta Wildlife, Alberta Forestry, Lands, and Wildlife, 1991, 49 pp.)

D. POPULATION SIZE AND TREND

R. megalotis may be a dominant small mammal in grassland communities of the United States with densities as high as 60 per ha (Whitford 1976). Highest densities are generally associated with the grasslands of coastal California and tallgrass prairie communities in the Great Plains. In the grasslands of Canada, this is a rare species.

British Columbia

The only estimates of absolute density are from Sullivan's (unpublished data) research at the Federal Agriculture Research Station near Summerland. He found *R. megalotis* somewhat sporadic in his live trapping grids with estimates ranging from 1 to 7 per ha. My surveys of relative abundance using standard transect lines of live-traps and Museum Special snap traps also demonstrated that this is a rare species in British Columbia grassland communities. In 21 transect lines (4200 trap nights) that were set within the known range in British Columbia during three summers' field work, only 16 individuals were captured. In all communities, *R. megalotis* represented less than 10% of the total small mammal captures (Fig. 4). Cannings (1987) reported similar results from a study of Northern Saw-whet Owl (*Aegolius acadicus*) prey in the Okanagan Valley.

No data are available on long term population trends for this species in British Columbia.

Alberta

The population size and trend in Alberta are unknown. The few museum specimens taken and the lack of captures in recent surveys by the Provincial Museum of Alberta suggest that this mammal is rare in the grassland communities of southern Alberta. Hugh Smith (personal communication) noted that no *R. megalotis* remains were found in a sample owl pellets that he collected from various sites in the grasslands of southern Alberta.

E. HABITAT

In the western United States and Mexico, *R. megalotis* inhabits grasslands, edge habitats bordering agricultural areas, coastal salt marshes, and riparian habitats (Webster and Jones 1982). This species prefers habitats characterized by tall lush herbaceous cover (Kaufman and Fleharty 1974; Moulton et al. 1981). *R. megalotis* has been found at elevations as high as 4000 m in Mexico but in the northern portion of its range it is confined to low elevations.

British Columbia

In British Columbia, *R. megalotis* is associated with the intermontane grasslands where it inhabits shrub-steppe rangeland, old fields, and grassy areas bordering cultivated fields. The elevational range extends from 300 to 780 m with most occurrences below 600 m. Populations found at higher elevations (>600 m) were associated with south facing slopes. Most occurrences (Table 1) are in the Very Hot Dry subzone of the Bunchgrass biogeoclimatic zone (Meidinger and Pojar 1991) which is equivalent to the lower grassland zone described by Tisdale (1947). This zone, which is confined to the hot valley bottoms, is dominated by bunchgrass (*Agropyron spicatum*) and big sage (*Artemisia tridentata*).

Greasewood (*Purshia tridentata*) replaces big sage in the sandy soils of the south Okanagan. A few occurrences in the south Okanagan were in the Ponderosa Pine zone and in the north Okanagan, *R. megalotis* is associated with the Interior Douglas-fir zone. Although I trapped this species in shrub-steppe rangeland and Sullivan (unpublished data) captured it in abandoned fields and pastures, *R. megalotis* is most common in edge habitats (Fig. 4) Highest captures were taken in dry gulleys with abundant shrub cover that bordered grasslands. The most important habitat features are high grass cover and a shrub understory. Typical shrub species in *R. megalotis* habitats include: wild rose (*Rosa* sp), mock orange (*Philadelphia lewisii*), Saskatoon berry (*Amelanchier alnifolius*), chokecherry (*Prunus virginiana*), squaw currant (*Ribes cereum*), Douglas maple (*Acer galbrum*), snowberry (*Symphoricarpus albus*), and black hawthorn (*Crataegus douglasii*). Giant wildrye (*Elymus cinereus*) was present at many *R. megalotis* capture sites.

Undisturbed grassy edge habitats are also exploited. Munro's (1958) captures at Okanagan Landing were from roadside habitats with high grass and weeds such as thistle (*Cirsium* sp), *Aster* sp, and *Chaemapodium* sp. In the Similkameen Valley, a population was found in undisturbed edge habitat of smooth brome (*Bromus inermis*), thistle (*Cirsium arense*), giant wildrye, and goldenrod (*Solidago canadense*) that bordered hay and alfalfa fields.

Grassland habitats in southern British Columbia have been impacted by cattle grazing, agriculture, and urbanization. The most intensive grazing in the Okanagan Valley occurred in late 1880's (Cannings et al. 1987). Over-grazing by cattle has altered the plant species composition and cover in British Columbian grasslands (Tisdale 1947) and

presumably this has affected habitat quality and small mammal population densities. Nonetheless, habitat loss through agriculture and urbanization has had more impact on *R. megalotis*. Originally, grasslands were distributed continuously throughout low elevations of the Okanagan and Similkameen valleys. The conversion of grasslands to irrigated orchards, vineyards, and cultivated fields, and recent urban development has eliminated much of the original grassland-steppe in these valleys (Cannings et al. 1987) and contributed to habitat fragmentation (Fig. 2). Because most orchards and cultivated fields are mowed, these habitats provide little high grass cover. However, urbanization in the past decade has had the most impact on grassland habitat. The rapid growth of urban centres such as Penticton, Kelowna, and Vernon in the past decade, has been particulary destructive.

The amount of protected (i.e., parks and ecological reserves) habitat in this region is small and fragmented (Table 2). The size of these protected areas (even the large area at Vaseux Lake) may be insufficient to maintain minimum viable populations of *R. megalotis* if these areas were to become isolated and surrounded by unsuitable habitat. A fire in July 1993 that burned the entire Hayne's Lease Ecological Reserve at Osoyoos Lake, demonstrates the vulnerablity of small reserves. It is also noteworthy that these protected areas are widely separated, possibly beyond the dispersal distance of *R. megalotis*. Two large "non-protected" areas with significant habitat are the Inkaneep Indian Reserve on Osoyoos Lake and the Okanagan Reserve at the north end of Okanagan Lake. Both reserves support large tracts of low elevation grassland that is relatively undisturbed.

Alberta

The three known locality records are from the Upper Sonoran and Transition life

zones described by Soper (1964). No data are available on habitats used in Alberta. Although Soper (1964) reported that *R. megalotis* typically exploited shortgrass plains, edge habitats, and benchlands, presumably he extrapolated these habitat requirements from studies in the western United States.

The prairie grassland has been impacted by cultivation and grazing (Coupland 1987) and there has been a loss of potential habitat for grassland small mammals such as *R. megalotis*. However, with virtually nothing known about the habitat requirements of this species in Alberta, it is impossible to evaluate habitat distribution and loss in the province.

F. GENERAL BIOLOGY

Reproductive capability

The potential reproductive rate is high. Female *R. megalotis* are polyeostrous, breeding throughout the year in southern parts of the range. In northern regions, the breeding season extends from April to October (Webster and Jones 1982). Pregnant or lactating females were captured between June and September in British Columbia. Although females may produce as many as 14 litters per year in captivity (Bancroft 1967), wild females in Canada probably produce two or three litters. The gestation period is 23 to 24 days with embryo counts ranging from 1-7 ($x=4.1 \pm 3$) and litter size at birth ranging from 1-7 ($x=2.6 \pm 2$) (Asdell 1964). Females are capable of breeding at about four months age; reproductive senility begins about 45 weeks of age (Bancroft 1967).

Food habits

Dietary data are based on studies done in California and the Great Plains of the

United States. Seeds and invertebrates (especially lepidoptera larvae) are the major food items (Whitaker and Mumford 1972; Meserve 1977). Flowers, herbaceous material, and Endogone fungi are also consumed. The arboreal activity in shrubs of *R. megalotis* is probably related to foraging for seeds, flowers, and invertebrates (Meserve 1977).

Species movement

As would be expected for a small mammal with a mean body weight of only 10 g, *R. megalotis* demonstrates low vagility. Based on few captures, O'Farell (1978) calculated a home range estimate of 0.95 ha. Maximum distances between capture sites for individuals are usually less than 300 m (Brant 1962; Fisler 1966; Clark et al. 1988). Nonetheless, Clark et al. (1988) reported long-distance movements (375-3200 m) for a few individuals. Such long-distance movements may be related to high population densities. In a series of experiments testing homing, Fisler (1966) found that individuals displaced as far as 300 m were able to return to their home areas. Estimates of two-dimensional home range may be inappropriate because of this species arboreal activity. Tracking studies (Meserve 1977) have revealed that *R. megalotis* climbs as high as 1 m in shrubs and nests have been found 1 m above the ground in shrubs (Webster and Jones 1982).

Behaviour and adaptability

There have been no comprehensive behavioural studies on this species and the available data consist of descriptive observations from field studies or captive individuals. Wild and captive *R. megalotis* appear to be strictly nocturnal with activity greatest on moonless or rainy nights (Pearson 1960; Fisler 1965). Several researchers have noted this species' tendency to utilize vole (*Microtus*) runways. *R. megalotis* constructs spherical or cup-

shaped nests that are located on the ground or in branches of shrubs above ground. According to Fisler (1965), this species does not construct burrows, although it will use other small mammal burrows for shelter.

Captive *R. megalotis* can be induced to enter shallow torpor by exposure to temperatures below 10 °C (Fisler 1965; Thompson 1985). The ability to enter shallow torpor presumably is an adaptation for conserving energy during periods of stress from food deprivation, water shortage, or cool ambient temperatures. Torpor may be critical for the survival of Canadian populations because they are at the extreme northern limits of the range where they may be exposed to cool temperatures. It is unknown if this species is capable of hibernation. O'Farrell (1974) did not capture *R. megalotis* on his study grids during autumn and winter in Nevada and he assumed that this species hibernated. In other regions of the United States *R. megalotis* has been captured throughout winter (Whitaker and Mumford 1972). Similarly, Sullivan (unpublished data) captured *R. megalotis* throughout the year on his trapping grids at Summerland in the Okanagan Valley of British Columbia.

G. LIMITING FACTORS

Because of its rarity in Canada, this species is of little economic concern in agricultural areas. Rodenticides are routinely used by orchardists in British Columbia to control vole and pocket gopher populations but *R. megalotis* is uncommon in the mowed grass habitats of orchards (Sullivan, personal comment) and mortality from poisoning is probably low. Potential limiting factors are: competition with other small mammals; habitat disturbance from grazing, hay mowing, cultivation, and fire; and habitat fragmentation.

In grassland communities of the western United States, where *R. megalotis* and voles (*Microtus* sp.) coexist, harvest mice may be excluded from an area and become locally extinct during years of extreme vole abundance (Heske et al. 1984). Voles associated with *R. megalotis* habitats in British Columbia occur in low densities (Fig. 4) and competitive exclusion of *R. megalotis* is unlikely. The dominant small mammal in these habitats is *Peromyscus maniculatus*. In the mixed-grass prairie of Kansas, *Peromyscus* and *Reithrodontomys* appear to avoid competion by exploiting different microhabitats (Stroh and Fleharty 1988).

Given this species' affinity for high grass and shrubs, habitats disturbed by fire, livestock grazing, hay mowing, and cultivation would be expected to be unproductive. Moulton et al. (1981) found low densities of *R. megalotis* in grazed sagebrush and riparian habitats and Kaufman et al. (1988) demonstrated population declines after fire. This species may suffer direct mortality from fire because it occupies above ground nests rather than underground burrows. The effects of cultivation have not been documented but Sullivan (personal comment) noted that *R. megalotis* rarely occurs in the grasslands associated with orchards in the Okanagan Valley. Although my transect at Keremeos Creek bordered hay and alfalfa fields, *R. megalotis* inhabited the undisturbed high grass habitats that bordered these fields. Its noteworthy that most of the plants in these borders were native species. This species will use roadside edge habitats that are dominated by alien plant species but it requires high herbaceous cover that is not disturbed by mowing.

In British Columbia, ongoing habitat loss through urbanization has had the greatest impact on this species. The growth of urban centres such as Vernon, Kelowna, and Penticton

has resulted in significant habitat loss and contributed to fragmentation of the range (Redpath 1990).

H. SPECIAL SIGNIFICANCE OF SPECIES

Throughout most of its range, *R. megalotis* is common and not at risk. An exception is *R. m. limnicola*, a subspecies associated with coastal saltmarshes in California, that is listed as vulnerable by the IUCN. *R. megalotis* is of national interest because it is one of several mammalian species, associated with the grasslands of western North America, that reach their northern limits in western Canada. The two subspecies of *R. megalotis* found in Canada inhabit two distinct grassland biomes: the Prairie grasslands of the the Great Plains and the intermontane grasslands of the Great Basin. These two taxa presumably reflect the different biogeographic histories and ecology of these distinct biomes.

I. RECOMMENDATIONS/MANAGEMENT OPTIONS

Any management of this species has to be related to conserving and maintaining natural grassland ecosystems. Only a small portion of this species distribution is in protected areas (Table 1) and clearly acquisition of more habitat is desirable. With the provincial Protected Areas Strategy and the South Okanagan Conservation Strategy (Hlady 1990) in British Columbia, more grassland habitat may be acquired for protection. Nevertheless, much of this species range will ultimately remain on private land, Crown land leased for grazing, or Indian Reserve land. Habitat protection on these lands is essential to maintain dispersal corridors and refuge areas linking protected areas. Farmers and ranchers should

be encouraged to maintain undisturbed edge habitats with high grass and dense shrub cover. Protecting such habitats from grazing cattle and hay mowing is critical. Municipalities also could be encouraged to maintain natural grassland habitat in municipal parks. Unfortunately, these parks are usually modified by irrigation into "greenbelt areas" effectively destroying native grassland habitat.

J. EVALUATION AND PROPOSED STATUS

Although a rare species in grassland communities, there is no evidence for population declines of *R. m. megalotis* in British Columbia, and there is probably sufficient habitat to maintain most of the existing populations. Nonetheless, *R. megalotis* is at long-term risk because of habitat changes and fragmentation of its range (Redpath 1990). The Okanagan Valley has become a major retirement centre and is undergoing rapid human population growth. *R. megalotis* populations in the north Okanagan around Vernon are now essentially relict populations isolated from populations in southern areas of the valley by the recent urban development of Kelowna (Fig. 2). Little suitable habitat remains in the central Okanagan. With the exception of the Okanagan Indian Reserve, grasslands in the north Okanagan are also threatened. My study area on the north arm of Okanagan Lake near Vernon, for example, was being developed for housing subdivisions in 1991.

Because *R. m. megalotis* occurs in low population numbers, has a restricted range and low dispersal abilities, and there is evidence for habitat fragmentation I recommend that *R. m. megalotis* be designated by COSEWIC as VULNERABLE.

There is insufficient scientific information to recommend a status designation for the

Alberta population (*R. m. dychei*). The last substantiated record was a museum specimen taken in 1966 at the Pinhorn Grazing Reserve. At present, it is not clear if there is even an extant population in Alberta. An intensive small mammal inventory of the grassland communities of southern Alberta and western Saskatchewan is required to determine the status of this species in the Canadian Prairies.

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Hugh Smith summarized the known records from Alberta. The 1992 field research in Alberta was funded by the World Wildlife Fund and was carried out with the cooperation of the Provincial Museum of Alberta.

Table 1. Locality records, elevations, and biogeoclimatic zone occurrences for the Western Harvest Mouse (*Reithrodontomys megalotis*) in British Columbia. Based on all known historical museum specimens, published records, and surveys (1990-1992).

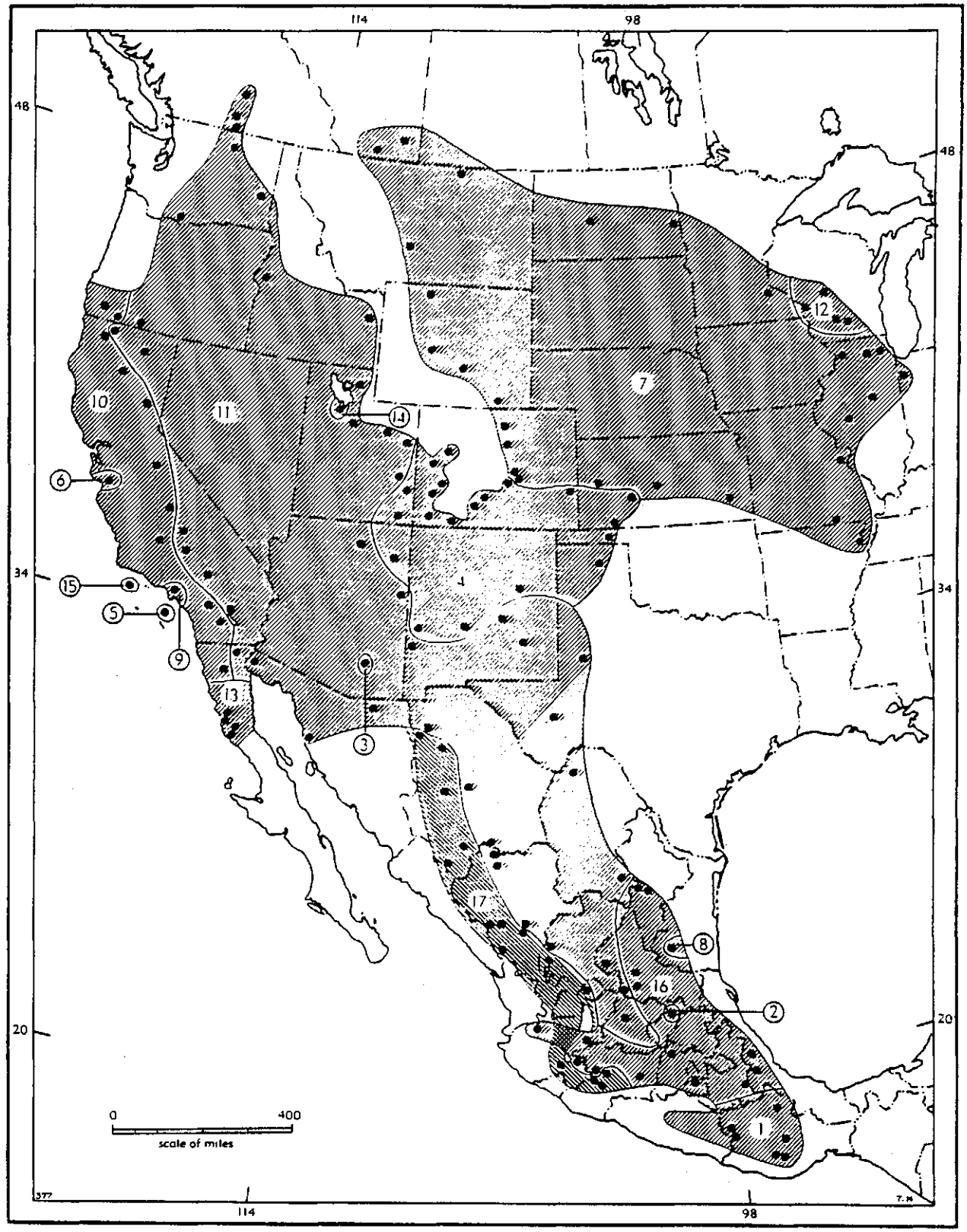
LOCALITY	ELEVATION	ZONE*
Chopaka	500	BG xh
Fairview; 1.5 km NE	500	BG xh
Frederick Creek; Hidden Paradise Ranch	360	BG xh
Kalamalka Lake Prov Park; Red Hawthorne Creek	400	IDF xh
Keremeos Creek; Rocking Chair Ranch	400	BG xh
Cawston; 1 km NW	400	BG xh
Lone Pine Creek; S of Kilpoola Lake	780	BG xh
Madeline Lake; 0.25 km N	520	PP xh
Okanagan Lake; Beachcomber Bay	500-540	IDF xh
Okanagan Landing	350	IDF xh
Okanagan Landing-Vernon Road	350	IDF xh
Okanagan Mountain Prov Park; S end	400-560	BG xh
Oliver; S of	-	BG xh
Osoyoos	336	BG xh
Osoyoos; 5 mi N N side of Highway	-	BG xh
Osoyoos Lake; 4 km NE	300	BG xh
Osoyoos Lake; E side	366	BG xh
Osoyoos Lake; N end	-	BG xh
OsoyoosLake; Haynes Lease Ecological Reserve	320	BG xh
Osoyoos Lake NE side	320	BG xh
Penticton	400	BG xh
Skaha Lake; NE end	320	BG xh
Summerland; Agriculture Research Station	420	PP xh
Vaseux Lake	-	BG xh
Vaseux Lake; Small Lagoon; S end	320	BG xh

* BG xh= Bunchgrass zone (Very Hot Dry subzone), IDF xh= Interior Douglas-fir zone (Very Hot dry subzone), PP xh= Ponderosa Pine zone (Very Hot Dry subzone)

Table 2. Major protected areas in the Okanagan and Similkameen valleys of British Columbia with suitable *Reithrodontomys megalotis* habitat. Distance is straight line distance (km) to nearest protected area.

Park/Reserve	Area (ha) Total	Suitable	Distance
Kalamalka Lake Provincial Park	978	150	7.0
Campbell-Brown Ecological Reserve	107	100	7.0
Okanagan Mountain Provincial Park	10649	200	49.0
Vaseux Lake[1]	1121	410	18.5
Haynes Lease Ecological Reserve	101	100	18.5

[1] includes Nature Trust land, Bighorn National Wildlife Area, Migratory Bird Sanctuary, and Provincial Park



Map 377. *Reithrodontomys megalotis.*

Guide to subspecies

1. *R. m. alticolus*
2. *R. m. amoles*
3. *R. m. arizonensis*
4. *R. m. aztecus*
5. *R. m. catalinae*
6. *R. m. distichlis*
7. *R. m. dychei*
8. *R. m. hooperi*
9. *R. m. limicola*
10. *R. m. longicaudus*
11. *R. m. megalotis*
12. *R. m. pectoralis*
13. *R. m. peninsulae*
14. *R. m. ravus*
15. *R. m. santacruzae*
16. *R. m. saturatus*
17. *R. m. zacatecae*

Figure 1. Distribution of *Reithrodontomys megalotis* (Hall 1981).

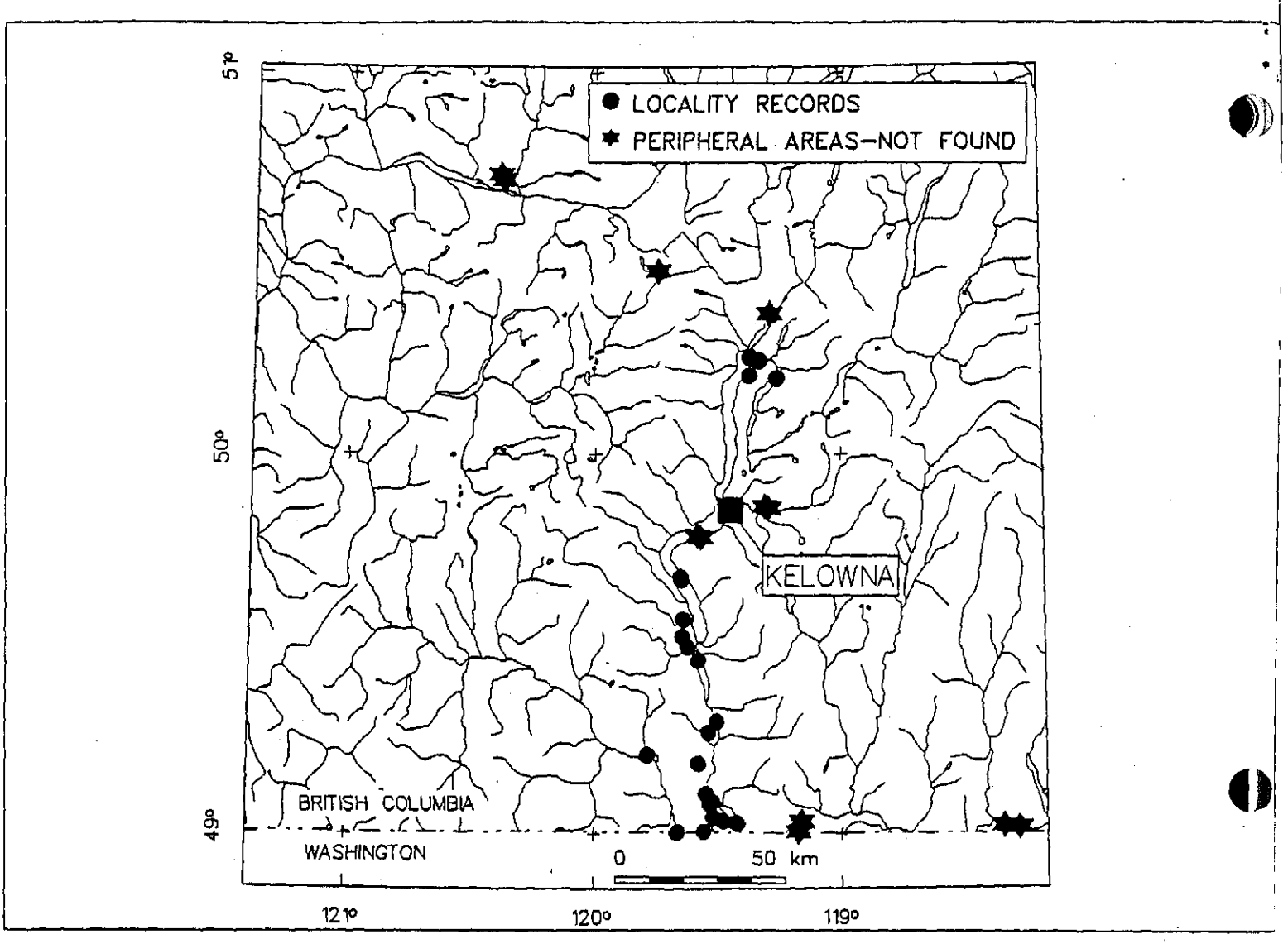


Figure 2. Distribution of *Reithrodontomys megalotis megalotis* in British Columbia. Derived from all known museum records and field surveys from 1990-1992.

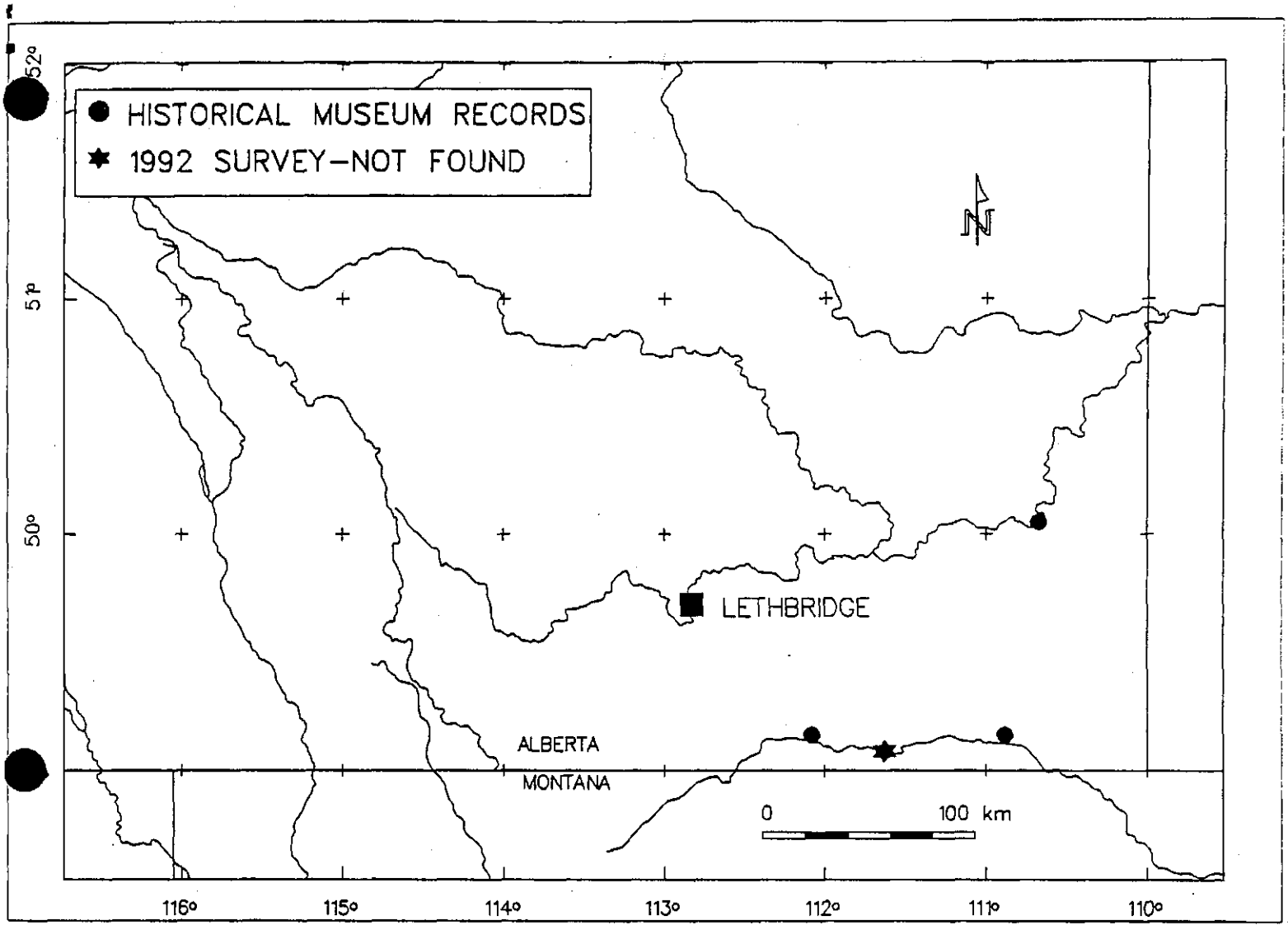


Figure 3. Distribution of *Reithrodontomys megalotis dychei* in Alberta. Derived from all known museum records and field surveys in 1992.

Figure 4. Species composition (per cent total captures) of eight rodent species in grassland habitats of the Okanagan and Similkameen valleys. PEMA= *Peromyscus maniculatus*, REME= *Reithrodontomys megalotis*, PEPA= *Perognathus parvus*, MIPE= *Microtus pennsylvanicus*, MILO= *Microtus longicaudus*, MIMO= *Microtus montanus*, TAAM= *Tamias amoenus*, MUMU= *Mus musculus*.