COSEWIC
Assessment and Update Status Report

on the

Spotted Bat
Euderma maculatum

in Canada

SPECIAL CONCERN
2004

COSEWIC
COMMITTEE ON THE STATUS OF
ENDANGERED WILDLIFE
IN CANADA

COSEPAC
COMITÉ SUR LA SITUATION
DES ESPÈCES EN PÉRIL
AU CANADA

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COSEWIC
Assessment Summary

Assessment Summary – May 2004

Common name
Spotted bat

Scientific name
Euderma maculatum

Status
Special Concern

Reason for designation
In Canada, this species occurs in the intermontane grasslands of southern British Columbia. It is a distinctively coloured bat that is unmistakable to identify. Unlike any other Canadian species of bat, its echolocation call is within the range of human hearing. It roosts in crevices in large cliff faces. It is considered the easiest and best censused species of bat in Canada. Population estimates, based on relatively good census effort, suggests that there are fewer than 1000 adults. At this time, numbers appear to be stable, and there are relatively few threats to populations or habitats. Perhaps the biggest threat to this species is its small population size. Use of pesticides on its prey, loss of foraging habitat, and disturbance at roosting sites by rock climbers are potential threats. Rescue may be possible from neighbouring populations in the United States, however, movements of individuals between Canadian and US populations are not documented.

Occurrence
British Columbia

Status history
Designated Special Concern in April 1988 and in May 2004. Last assessment based on an update status report.

COSEWIC
Executive Summary

Spotted Bat
Euderma maculatum

Species information

The Spotted Bat, *Euderma maculatum,* belongs to the Order Chiroptera, Family Vespertilionidae, tribe Plecotini. The genus is monotypic; no subspecies are recognized for the species. A combination of jet black fur contrasting with prominent white spots on the rump and shoulders and enormous ears make this is the most spectacular bat in Canada.

Distribution

Globally, the Spotted Bat ranges from Mexico, across the western United States to southern British Columbia in Canada. Because the Spotted Bat can be detected and identified by its echolocation calls that are readily audible to most human observers, it distribution can be determined from acoustic surveys. Surveys done over the past two decades have revealed that this bat inhabits valleys of the Okanagan, Similkameen, Thompson, Fraser and Chilcotin River in British Columbia. The 80 distributional records (roosting and foraging records) for Spotted Bats in Canada represent about 40 element occurrences. The area of occupancy is unknown; the extent of occurrence in Canada is about 10,590 km^2 representing less than 5% of the species' global range.

Habitat

Known summer day roosts including maternity colonies of the Spotted Bat are in the crevices or cracks (2.0 to 5.5 cm wide) of high, vertical cliff faces. This species is not known to use night roosts in Canada. It may hibernate in cliffs within its Canadian range or migrate to the United States to overwinter. The Spotted Bat forages over marshes, riparian habitats, open fields, golf courses, and clearings in forest. Habitat suitability maps developed for the southern Okanagan Valley reveal that foraging habitat is widespread but roosting habitat is fragmented and patchily distributed. The impacts of agricultural development and urbanization on Spotted Bat roosting habitat are minimal.

Biology

Females produce a single young in the breeding season. The limited data suggest that the young are born in Canada in late June or early July. The age at sexual maturity is unknown.

Spotted Bats move 6 to 10 km from their day roost to foraging sites. From May to July, this bat shows a strong fidelity to its day roost, returning to the same roost site night after night. By early August, the daily movements become less predictable. Nothing is known about seasonal or long distance migratory movements.

This species may feed mostly on moths (5-12 mm in length). Flying Spotted Bats capture flying prey after detecting and tracking it by echolocation. The low frequency echolocation calls are dominated by the 9-12 kHz range (within the range of human hearing), rendering them inaudible or only detectable at close range by most moths with bat detecting ears.

The social structure is unknown—it is unclear if this bat roosts alone or in groups.

Population sizes and trends

Spotted Bats can be inventoried by acoustic surveys at potential roost sites or foraging areas. Although there has been no systematic inventory done throughout the entire Canadian range applying a standard methodology, the available census data suggest the Canadian population may be less than 1,000 total Spotted Bats. Seven population counts done in the southern Okanagan Valley over the past 20 years suggest the population trend is stable.

Limiting factors and threats

Specialized roosting requirements and a patchy distribution make the Spotted Bat a species of conservation concern throughout its range. The availability of suitable roosting sites may be a limiting factor for the Spotted Bat in Canada. There are no known threats to habitat used for foraging or roosting. There is no evidence that foraging habitat or moth prey are limiting. Known threats are generic threats such as disturbance to cliff roosts sites and pesticides.

Special significance of the species

The Spotted Bat is one of three western North American bat species that are confined to the intermontane grasslands of British Columbia in Canada. Its audible, low frequency echolocation calls that can be detected without the aid of electronic bat detectors make this bat an ideal species for research, detailed inventories, and educational programs that promote bat conservation.

Existing protection or other status designations

The Spotted Bat was designated Special Concern by COSEWIC in 1988; the global heritage status rank is G4 (apparently secure); national ranks are N3N4 (vulnerable to apparently secure) for the United States and N3 (vulnerable) for Canada. Three states (Montana, Oregon, and Wyoming) rank the Spotted Bat as S1 (critically imperilled); four states rank this species as S1S2 or S2 (critically imperilled or

imperilled). British Columbia has designated the Spotted Bat as S3S4 (vulnerable to apparently secure). This species is protected from killing under the provincial Wildlife Act, and it is listed as an Identified Wildlife Species under the revised British Columbia Provincial Forest and Range Practices Code. Nonetheless, the Forest and Range Practices Code only applies to provincial crown land; in the southern portion of the Canadian range more than 50% of this species' habitat is exempt from the code.

COSEWIC HISTORY

The Committee on the Status of Endangered Wildlife in Canada (COSEWIC) was created in 1977 as a result of a recommendation at the Federal-Provincial Wildlife Conference held in 1976. It arose from the need for a single, official, scientifically sound, national listing of wildlife species at risk. In 1978, COSEWIC designated its first species and produced its first list of Canadian species at risk. On June 5, 2003, the *Species at Risk Act* (SARA) was proclaimed. SARA establishes COSEWIC as an advisory body ensuring that species will continue to be assessed under a rigorous and independent scientific process.

COSEWIC MANDATE

The Committee on the Status of Endangered Wildlife in Canada (COSEWIC) assesses the national status of wild species, subspecies, varieties, or other designatable units that are considered to be at risk in Canada. Designations are made on native species and include the following taxonomic groups: mammals, birds, reptiles, amphibians, fishes, arthropods, molluscs, vascular plants, mosses, and lichens.

COSEWIC MEMBERSHIP

COSEWIC comprises members from each provincial and territorial government wildlife agency, four federal organizations (Canadian Wildlife Service, Parks Canada Agency, Department of Fisheries and Oceans, and the Federal Biosystematic Partnership, chaired by the Canadian Museum of Nature), three nonjurisdictional members and the co-chairs of the species specialist and the Aboriginal Traditional Knowledge subcommittees. The committee meets to consider status reports on candidate species.

DEFINITIONS (AFTER MAY 2004)

Species	Any indigenous species, subspecies, variety, or geographically or genetically distinct population of wild fauna and flora.
Extinct (X)	A species that no longer exists.
Extirpated (XT)	A species no longer existing in the wild in Canada, but occurring elsewhere.
Endangered (E)	A species facing imminent extirpation or extinction.
Threatened (T)	A species likely to become endangered if limiting factors are not reversed.
Special Concern (SC)*	A species that may become a threatened or an endangered species because of a combination of biological characteristics and identified threats.
Not at Risk (NAR)**	A species that has been evaluated and found to be not at risk.
Data Deficient (DD)***	A species for which there is insufficient scientific information to support status designation.

* Formerly described as “Vulnerable” from 1990 to 1999, or “Rare” prior to 1990.

** Formerly described as “Not In Any Category”, or “No Designation Required.”

*** Formerly described as “Indeterminate” from 1994 to 1999 or “ISIBD” (insufficient scientific information on which to base a designation) prior to 1994.

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The Canadian Wildlife Service, Environment Canada, provides full administrative and financial support to the COSEWIC Secretariat.

Update
COSEWIC Status Report

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2004

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SPECIES INFORMATION

Name and classification

The Spotted Bat, *Euderma maculatum*, (J.A. Allen 1891) belongs to the Order Chiroptera, Family Vespertilionidae, tribe Plecotini. First described and named as *Histiotus maculatus* by Allen (1891), this taxon was subsequently classified as *Euderma maculatum* by Allen (1892). *E. maculatum* is most closely related to Allen's big-eared bat (*Idioncyteris phylottis*). Taxonomists have generally considered these two taxa to be genetically distinct. However, a cladistic analysis of morphological and karyotypic characters led Frost and Timm (1992) to conclude that the genus *Idionycteris* should be synonymized with the genus *Euderma.* Another cladistic study (Tumlinson and Douglas 1992) using morphological traits concluded that the two taxa are highly derived and warrant treatment as separate genera. An analysis of mitochondrial DNA by Hoofer and van den Bussche (2001) demonstrated a sequence divergence between *Idionycteris* and *Euderma* of 16.9%, a difference consistent with genetic distinction. No subspecies are recognized in *E. maculatum*.

Another English common name for *E. maculatum* is the pinto bat. The French common name is Oreillard maculé.

Description

The most distinctive bat in Canada, the Spotted Bat has jet black fur that contrasts with prominent white spots on the rump and shoulders (Figure 1). Smaller white patches occur at the base of the ears; the undersides are whitish with black underfur. The enormous pinkish-grey ears are connected at their base across the forehead. A bare

Figure 1. Dorsal view of Spotted bat (*Euderma maculatum*). Photo M.B. Fenton.

area about 7 to 10 mm in diameter is present on the throat. The wing and tail membranes are pinkish-red. Distinctive features of the skull include an elongated braincase and elliptical shaped auditory bullae (van Zyll de Jong 1985). The dental formula is: incisors 2/3, canines 1/1, premolars 2/2, molars 3/3.

There has been considerable speculation on the adaptive significance of the striking markings on this bat that resemble the 'death-mask' markings found on some invertebrates. Easterla (1965) suggested that the pelage colour and markings were cryptic providing camouflage for roosting Spotted Bats against black rocks with white crystalline patches. Given the wide range and colour of rock types used as roosts, selection for camouflage seems unlikely. Other explanations include aposematic markings or a visual signal for communicating with conspecifics (van Zyll de Jong 1985).

Body measurements (range in parentheses) for the few captures and single museum specimen from the Canadian population are: ear length 39 mm, n=1, tragus 14 mm n=1, forearm length 51.2 mm (47.9-53.1) n=6, and body mass 17.9 g (16.2-21.4) n=5 (Nagorsen 2002). Of 16 cranial and external measurements analyzed by Best (1988), only forearm length showed significant sexual dimorphism with females larger than males. A mutivariate analysis of the 16 measurements revealed significant geographic variation across the range with Spotted Bats from the northern United States and Canada smaller than specimens from the southern United States and Mexico (Best 1988).

DISTRIBUTION

Global range

The Spotted Bat ranges from central Mexico and the western United States (Arizona, New Mexico, Nevada, Texas, California, Oregon, Utah, Colorado, Wyoming, Montana, Idaho, Washington) to southern British Columbia (Figure 2). Throughout its range, this bat has a patchy distribution (Fenton et al. 1987; Pierson and Rainey 1998).

Canadian range

In Canada, this bat is restricted to southern British Columbia where it is generally found below 900 m in valleys of the dry interior grasslands (Nagorsen and Brigham 1993). Because the Spotted Bat can be detected and identified by its audible echolocation calls, it is one of the few Canadian bat species that can be inventoried without relying on captures (Fenton et al. 1987). Although the Spotted Bat has probably inhabited Canada since the early Holocene, its echolocation calls were only first detected in 1979; identification was verified from a museum specimen (RBCM 10799) collected in 1980 (Woodward et al. 1981). Subsequent surveys (Collard et al. 1990; Roberts and Roberts 1992, 1993; Holroyd et al. 1994; Sarell and Haney 2000) and incidental observations from naturalists demonstrate that Spotted Bats inhabit the

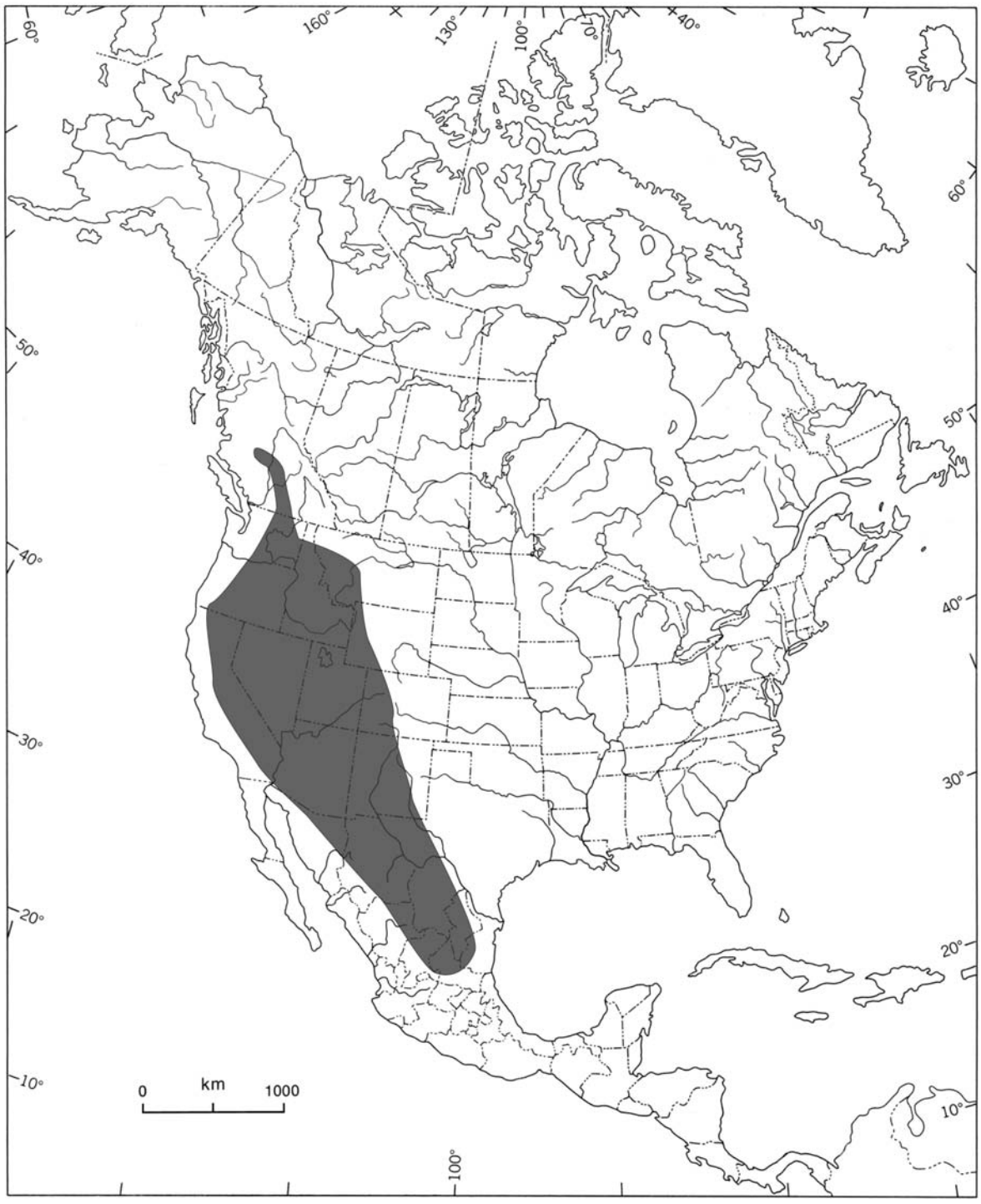

Figure 2. Global range of the Spotted Bat (*Euderma maculatum*).

Okanagan, Similkameen, Thompson, Fraser and Chilcotin River valleys (Figure 3). Northernmost occurrences are at Macalister north of Williams Lake in the Fraser River and Bull Canyon in the Chilcotin River.

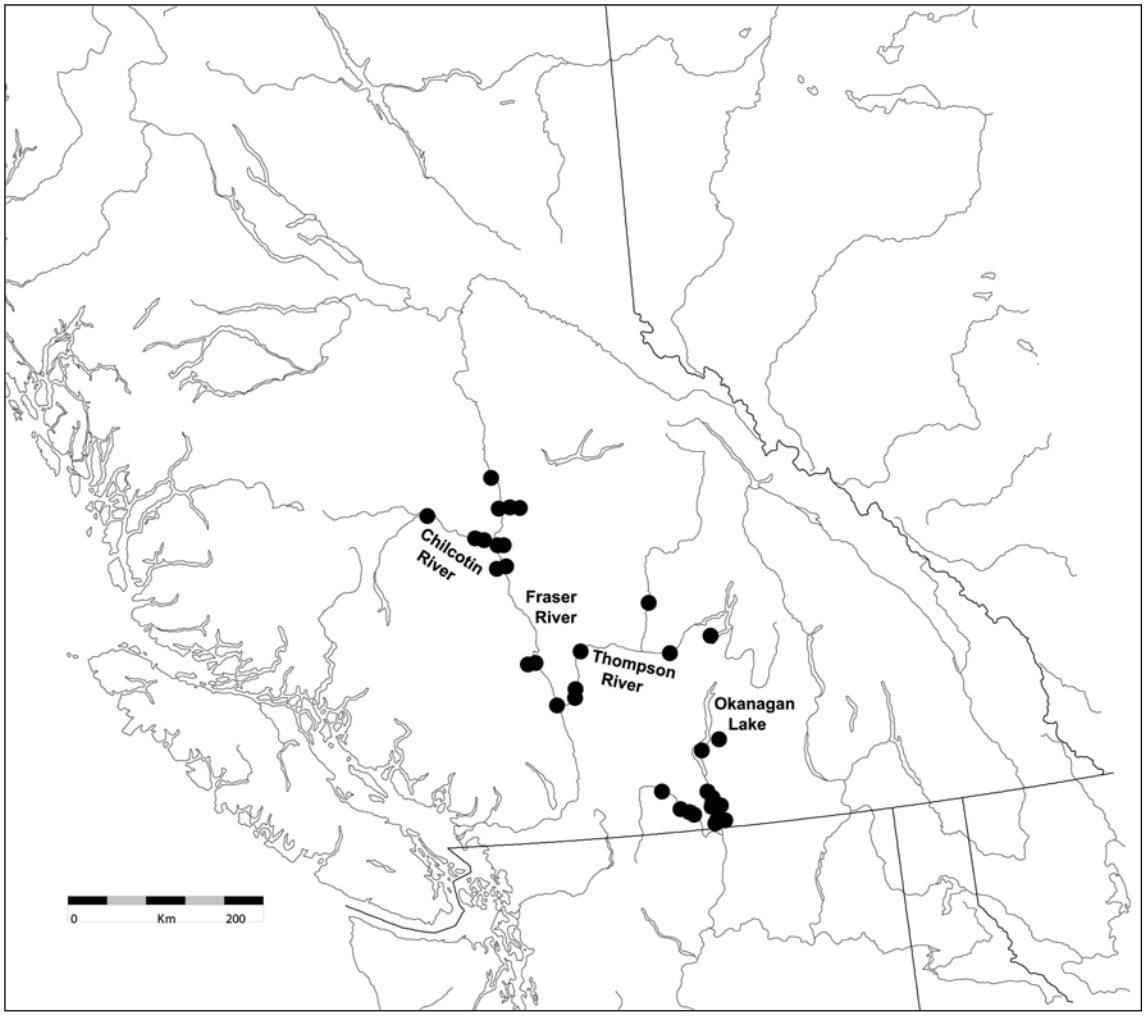

Figure 3. Canadian range of the Spotted Bat (*Euderma maculatum*).

The 80 distributional records (roosting and foraging records) of the Spotted Bat in Canada represent about 40 element occurrences[1]. Although the distributional records (Figure 3) are clustered into three regions (Cariboo-Fraser, Thompson, southern Okanagan-Similkameen) suggesting the existence of three subpopulations, this disjunct pattern is probably an artifact of sampling. Little inventory work has been done in the north Okanagan valley or the Fraser River valley between Lillooet and Churn Creek.

[1]An element occurrence for small bats is defined by the Heritage Ranking System as sites occupied historically or at present that are separated by 10 km or more.

The various inventories done in Canada have not systematically recorded the presence-absence of this bat at sites. For example, in the comprehensive survey done by Sarell and Haney (2000) in the southern Okanagan and Similkameen, only sites with high habitat potential were surveyed (Sarell pers. comm.) and no attempt was made to document sites where the Spotted Bat was not detected. Nevertheless, given the irregular distribution of suitable cliffs and rock outcrops, locally the Spotted Bat appears to be discontinuous in its distribution.

Historical distributional changes cannot be assessed because the Spotted Bat's Canadian range has only been delimited over the past few decades. The area of occupancy is unknown; the extent of occurrence in Canada is about 10,590 km^2. This represents less than 5% of the species' global range.

HABITAT

Habitat requirements

General

In the United States, the Spotted Bat ranges to 3,230 m above sea level (Watkins 1977; Reynolds 1981) and it occupies habitats from desert to coniferous forest. In Canada, this species is restricted to grassland, shrub-steppe and open ponderosa pine (*Pinus ponderosa*) or Douglas-fir (*Pseudotsuga menziesii*) forest where most occurrences are from 300 to 900 m elevation in the Bunchgrass, Ponderosa Pine, or Interior Douglas-fir biogeoclimatic zones (Meidinger and Pojar 1991).

Roosting habitat

Known day roosts are in crevices suggesting that the Spotted Bat has specialized roosting requirements. Day roosts, including the maternity roosts where females give birth to their young, are located in the crevices or cracks (2.0 to 5.5 cm wide) of high cliff faces (Poché 1981, Leonard and Fenton 1983; Sarell and Haney 2000). In British Columbia, the Spotted Bat generally selects vertical faces up to 400 m high in cliffs (Figures 4, 5) or rocky outcrops of granitic gneiss, limestone or basalt (Roberts and Roberts 1993; Sarell and Haney 2000). These sites typically have warm aspects, but the specific physical features of roost sites selected by this bat are not known. Wai-Ping and Fenton (1987) found considerable variation in the height, length, and aspect of six cliffs used as day roosts in the southern Okanagan valley. Because they are inaccessible, no research has been done on the microclimate in these crevice roosts.

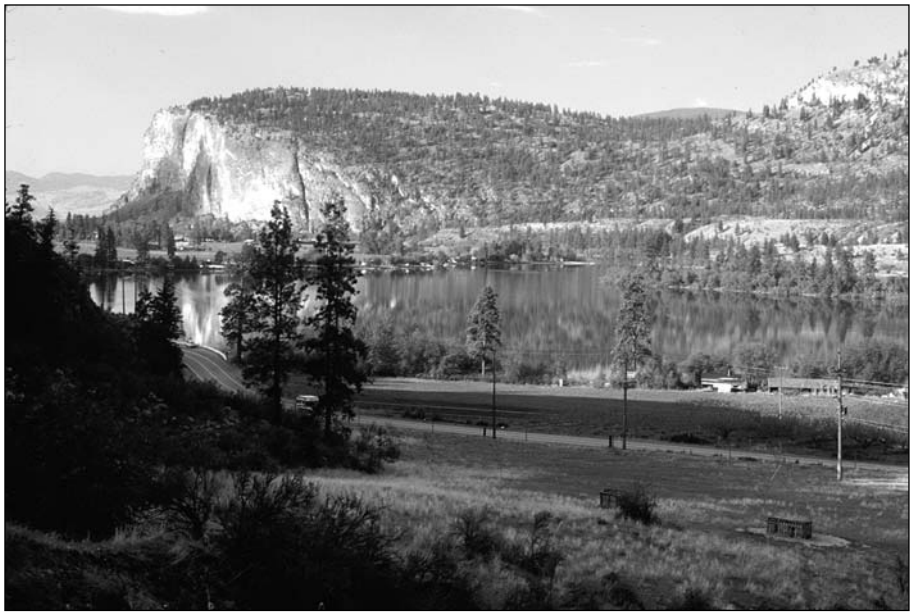

Figure 4. Vaseux Lake and McIntyre Bluff in the southern Okanagan Valley. The cliffs at McIntyre Bluff support as many as 30 roosting Spotted Bats (*Euderma maculatum*); marshy areas by the lake are important foraging habitat. Photo D. Nagorsen.

Following radio-tagged bats, Wai-Ping and Fenton (1989) found no evidence that this species uses night roosts (temporary roosting sites used after nocturnal feeding bouts) in the southern Okanagan Valley. However, in Grand Canyon National Park in northern Arizona three female Spotted Bats were found night roosting in aspen trees (Rabe et al. 1998). This is the only report of the Spotted Bat roosting in trees and using night roosts.

The winter roosting habitat is essentially unknown. Hardy (1941) reported four Spotted Bats hibernating in a cave in Utah, but his anecdotal observation is inconsistent with several comprehensive surveys of mines and caves in various parts of the range (e.g. Poché 1981; Kuenzi et al. 1999) that have shown no evidence for roosting in caves or mines.

A habitat model developed for the southern Okanagan and Similkameen valleys (Ministry of Environment, Lands and Parks 1998; Sarell and Haney 2000) was based on the presence of steep cliffs with horizontal or vertical crevices for roosting habitat. The habitat suitability map (Figure 6) demonstrates that roosting habitat in this region is fragmented and patchily distributed, a pattern consistent with the distribution of known roost sites described by Sarell and Haney (2000). Roosting habitat in the Thompson, Fraser and Chilcotin river valleys would be expected to show a similar pattern.

Figure 5. Chilcotin Oxbow, Chilcotin River. Spotted Bats (*Euderma maculatum*) roost in the hoodoo formations and forage over adjacent riparian thickets. Photo T. Chatwin.

Foraging habitat

Monitoring echolocation calls and observations of radio-tagged individuals In Canada indicate that Spotted Bats forage over marshes, riparian habitats, open fields, and clearings in forest (Leonard and Fenton 1983; Wai-Ping and Fenton 1989, Holroyd et al. 1994). Open meadows appear to be important forging habitat for this species in parts of the United States (Storz 1995). This species also forages opportunistically as it commutes between its day roost and nocturnal foraging areas. Foraging sites are usually located within 6 km of cliff roosts and in close proximity to water (Collard et al. 1990). Of six habitats studied by Leonard and Fenton (1983) in the southern Okanagan Valley, foraging was observed in old fields and hay fields bordering ponderosa pine forest. Feeding buzzes (echolocation calls associated with prey capture) were detected in these habitats confirming that Spotted Bats were capturing prey. Foraging activity was low in burned and mature ponderosa pine forest and river side habitats. Because no feeding buzzes were detected, it appears that Spotted Bats were commuting through these habitats. No Spotted Bat activity was detected by Leonard and Fenton (1983) in a cherry orchard. Furthermore, these bats showed no evidence of foraging among groups of insects that concentrate at street or yard lights (Fenton pers. comm.). Another foraging study in the southern Okanagan by Wai-Ping and Fenton (1989) demonstrated similar results, although high foraging activity was also observed over marshy areas and open ponderosa pine forest woodland. In the Chilcotin River valley at the northern edge of the range, Spotted Bats forage in riparian habitats and open upland habitats with Douglas-fir.

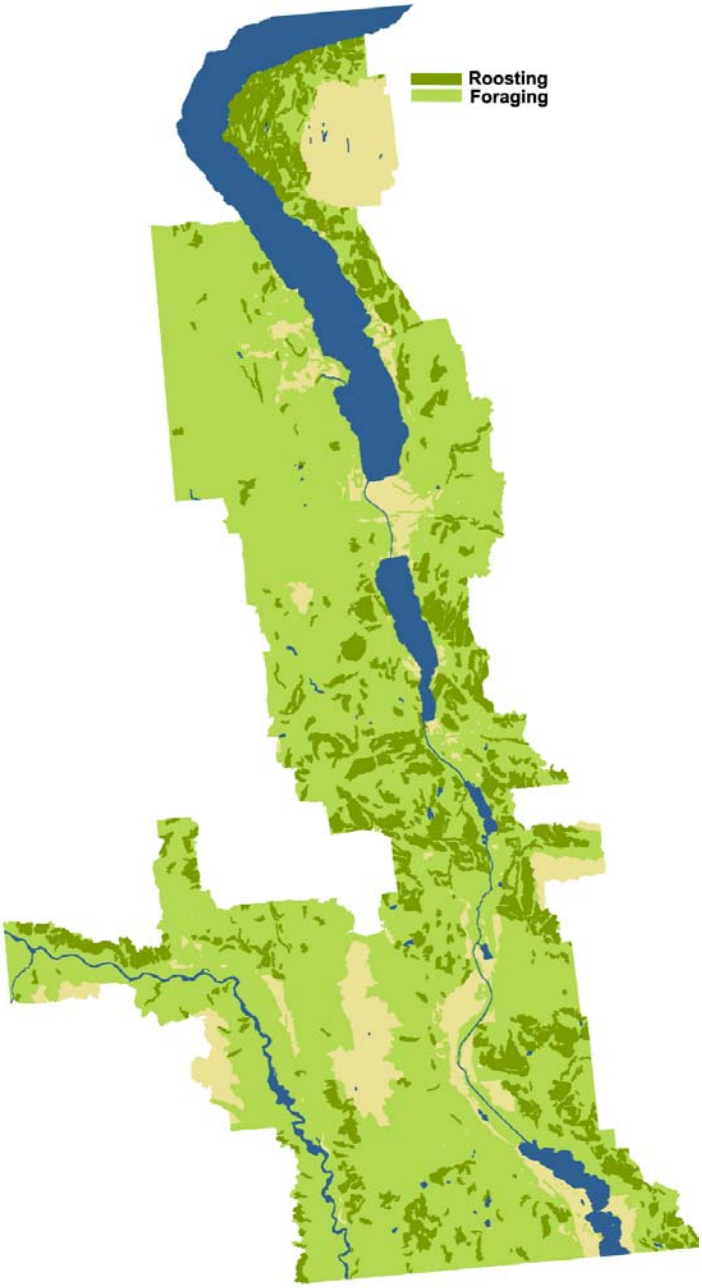

Figure 6. Habitat suitability map showing day roosting and foraging habitat of the Spotted Bat (*Euderma maculatum*) in the southern Okanagan and Similkameen valleys of British Columbia. From Habitat atlas for wildlife at risk: south Okanagan and lower Similkameen, Ministry of Environment, Lands and Parks, 1998.

A habitat suitability map developed for the southern Okanagan and Similkameen valleys (Ministry of Environment, Lands and Parks 1998; Sarell and Haney 2000) demonstrated that foraging habitat in this region is widespread and continuously distributed (Figure 6).

Trends

The valleys of the interior grasslands of British Columbia have been modified by livestock grazing, irrigation, and local urban growth. Detailed analyses of habitat trends exist only for the southern Okanagan-Similkameen valleys. Natural communities in this region were first impacted by livestock grazing in the late 1880s, but agricultural development (Table 1) associated with orchards, irrigated hay fields, and vineyards that began in the early 1900s and more recent urban growth have resulted in a significant decline in grassland, wetland, and riparian habitats (Cannings et al. 1987; Lea unpublished data; Ministry of Environment, Lands and Parks 1998). According to Redpath (1990) more than 90% of the land in the southern Okanagan-Similkameen has been altered from its 'normal' state.

Table 1. Historical changes in area (hectares) of natural and anthropogenic habitats in the southern Okanagan-Similkameen valleys of British Columbia. Based on unpublished data from Ted Lea, British Columbia Ministry of Water, Air, and Land Protection.

Habitat Type	Year			
	1800s	1939	1995	2001
Antelope-Bush	9607	7046	4279	4093
Riparian[1]	8679	4996	2957	2957
Big Sagebrush	7243	5567	4369	4369
Urban Area	0	368	3567	3567
Cultivated Area	0	11482	18871	19057

[1]water birch, cottonwood communities

The impacts of agricultural development and urbanization on Spotted Bat roosting habitat are minimal. Because rock faces and cliffs used by this bat are inaccessible and have little resource potential, they have been buffered from historical habitat changes. Garcia et al. (1995) concluded that there has been a "severe" reduction in foraging habitat citing "urbanization, destruction of wetlands, extensive irrigation, and the development of orchards, crop lands, and pasture". Nevertheless it is difficult to quantify the loss of Spotted Bat foraging habitat. Natural foraging habitats such as riparian or marshy areas have undoubtedly declined. For example, according to the *Habitat atlas for wildlife at risk-south Okanagan and lower Similkameen* (British Columbia Ministry of Environment, Lands and Parks 1998) about 85% of the valley bottom riparian habitat has disappeared. Nevertheless, anthropogenic habitats such as old fields, hay fields and golf courses provide significant feeding areas for the Spotted Bat (Leonard and Fenton 1983; Gitzen et al. 2001).

Protection/ownership

Quantitative data on land tenure for Spotted Bat habitat exists only for the southern Okanagan and Similkameen valleys (Ministry of Environment, Lands and Parks 1998).

The 1998 analysis estimated that only 5% of potential Spotted Bat habitat was protected in conservation land (Table 2); a significant portion of habitat was either in Indian Reserve land particularly the Inkaneep and Penticton Reserves or private land holdings. Data in Table 2 were calculated before the establishment of new protected areas (South Okanagan Grasslands, White Lake Grasslands) as part of the Provincial Protected Areas Strategy. These new protected areas support additional Spotted Bat habitat and probably increase the proportion of habitat in conservation land to about 10%.

Table 2. Land tenure for Spotted Bat (*Euderma maculatum*) habitat in the southern Similkameen-Okanagan valleys of British Columbia. Taken from *Habitat atlas for wildlife at risk: south Okanagan and lower Similkameen*, Ministry of Environment, Lands and Parks 1998.

Tenure	Area (ha)	% Total Habitat[1]
Conservation Land	8,340	5
Provincial Land	67,384	43
Indian Reserve	36,455	24
Private Land	43,553	28

[1]includes roosting and foraging habitat

BIOLOGY

General

The general biology of the Spotted Bat is poorly documented. Nonetheless its general life history strategy presumably is similar to that of other temperate region verspertilionid bats—the ability to enter torpor, a long life span, and a low reproductive rate. Roosting sites are critical for protection from predators, providing shelter and suitable physiological conditions. Echolocation is used for orientation in flight and prey detection.

Reproduction

Reproductive data for the Spotted Bat are scanty. Most Canadian bats mate in autumn, but the timing of copulation in the Spotted Bat is unknown. The only data on male reproduction is Poché's (1975, 1981) observations of males captured in March and April with mature sperm in their cauda epididymis and males with scrotal testes taken in May and June. Females produce a single young in the breeding season (Watkins 1977). The young are generally born in May or June and nursing animals have been found from June to August in the United States (Watkins 1977). There are no specific dates for parturition in Canada, but the limited data suggest that the young are born in late June or early July (Nagorsen and Brigham 1993). In Washington, the young are volant by mid-August (Sarell and McGuiness 1993). The age at sexual maturity is unknown.

Survival

There are no longevity records but the Spotted Bat is presumably long-lived similar to other temperate region vespertilionid bats. Nothing is known about survival rates or

the population age structure in this species. Information on mortality is limited to a few anecdotal observations. Black (1976) described predation by an American Kestrel (*Falco sparverius*) on a Spotted Bat that was flying during the day; owls presumably occasionally take this species when it is foraging at night. Rabies has been reported in two Spotted Bats (Constantine et al. 1979) in the United States. A rabid Spotted Bat found near Bastion Mountain in British Columbia in 1994 is the only known case of rabies for this bat in Canada.

Physiology

Spotted Bats forage at temperatures from 4.4 to 18.3^{o}C (Leonard and Fenton 1989). This species uses torpor to reduce its energy demands at low temperatures. Poché (1981) observed that captive Spotted Bat's were capable of only awkward flight when their body temperature dropped to 23^{o}C. A male captured in January with a body temperature of 0.8 ^{o} C increased its body temperature to 32.5^{o}C within 10 minutes after being exposed to an ambient temperature of 20^{o}C. To what extent this species can prolong bouts of torpor into extended hibernation is unknown. In Utah it has been captured in mist nets in mid-winter (Poché 1981; Ruffner et al. 1979). Spotted Bats have only been detected in Canada from April to October (Nagorsen and Brigham 1993).

The Spotted Bat is also exposed to high ambient temperatures in summer. According to Poché (1981) roosting Spotted Bats exposed to 35^{o}C extend their wings and tail membrane and move their ears forward to expose more surface area for cooling. At 38^{o}C, panting occurs indicating heat stress. Captive Spotted Bats exposed to 25 to 30^{o}C, drank about 1.2 cm^{3} of water daily.

Movements/dispersal

No data exist on dispersal movements. In the southern Okanagan Valley, radio tracking studies by Wai-Ping and Fenton (1989) demonstrated that Spotted Bats move 6 to 10 km from their day roost to foraging sites. Round-trip movements up to 77 km from the day roosts to foraging areas were reported for the Grand Canyon National Park in northern Arizona (Rabe et al. 1998). From May to July, this bat shows a strong fidelity to its roost, returning to the same roost site night after night (Wai-Ping and Fenton 1987, 1989). By early August, the daily movements become less predictable. This change in roost fidelity may reflect behavioural changes associated with nursing and volant young or possibly migratory movements. Nothing is known about seasonal or long distance migratory movements.

Nutrition and interspecific interactions

Analyses of stomach contents and faecal pellets have shown that in the wild this species feeds mostly on moths (5- 2 mm in length) (Easterla 1965; Ross 1967; Poché 1981; Wai-Ping and Fenton 1989). Despite one observation that was interpreted as evidence of gleaning (taking prey from surfaces), Spotted Bats appear to capture their prey while in fight using echolocation calls to detect and track flying moths (Woodsworth

et al. 1981; Wai-Ping and Fenton 1989). Spotted Bats forage in open areas 5 to 30 m above ground flying in elliptical paths of 200 to 300 m.

Because its echolocation calls (Figure 7) demonstrate several adaptations for hunting moths, Fullard and Dawson (1997) suggested that the Spotted Bat is a 'moth-specialist'. Its low frequency echolocation calls have a dominant frequency of 9-12 kHz (within the range of human hearing) and several harmonics of higher frequency. Many moths have 'ears' sensitive to bat echolocation calls and will take evasive action to avoid capture when they detect a bat's echolocation calls. Fullard et al. (1983) found that moths from the Canadian range of Spotted Bat are most sensitive to ultrasonic frequencies of 30 to 75 kHz suggesting that they be unable to detect the search calls of the Spotted Bat. Experimental studies by Fullard and Dawson (1997) revealed that the low frequency, soft, short calls of the Spotted Bat are either inaudible to moths or detectable at close range (distances of less than 1 m) making them vulnerable to capture. The long wave length of Spotted Bat calls (a characteristic of low frequency sounds) makes the calls most effective for detecting objects about 10 mm in diameter; this is consistent with the size of moths recovered in prey remains (Leonard and Fenton 1984). Nevertheless, because no extensive dietary studies have been done on this bat, the extent that its diet is restricted to moths is unknown.

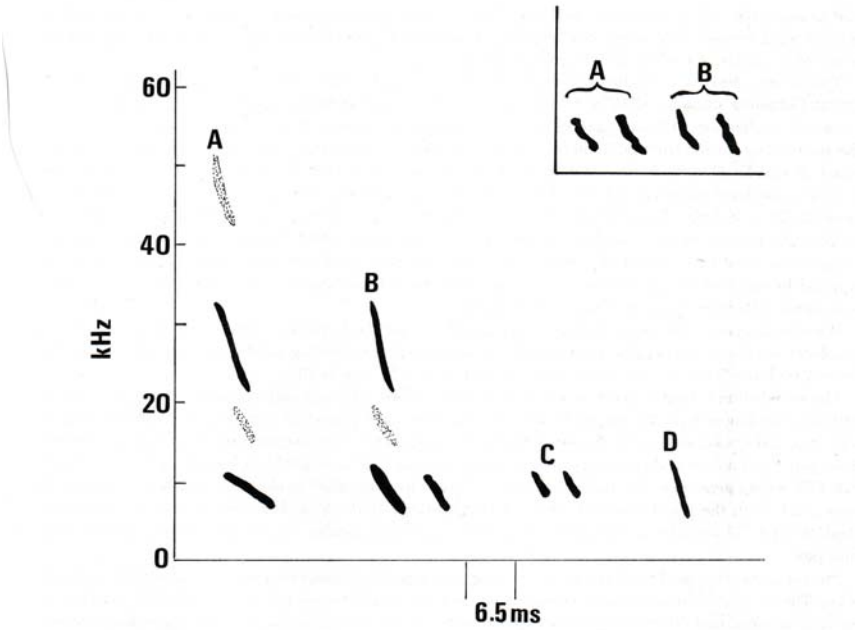

Figure 7. Sonogram of representative calls of the Spotted Bat (*Euderma maculatum*). A, B: search phase, C: approach phase, D: terminal feeding buzz. Inset shows variation in the fundamental note of calls A and B. Taken from Leonard and Fenton (1984).

Even if it is a moth-specialist, the Spotted Bat would have a diverse and abundant prey base. According to Don Lafontaine (pers. obser.) the Cordilleran ecozone of British Columbia supports about 700 species of noctuid moths; more than half of these species

would occur in the low elevation steppe and grasslands of areas such as the Okanagan Valley. Species such as cutworms are especially abundant and diverse in grassland communities. A light trap (attractancy range of 6 m) set in these habitats would be expected to capture several thousand moths on a warm night.

With 12 to 14 species, the southern interior grasslands of British Columbia support the most diverse bat community in Canada with some species occurring in high densities (Fenton et al. 1980). Most bats in this region forage in the valleys over lakes, marshes, and open grassland or forest. Some overlap with foraging Spotted Bats would be expected. However, competition for food resources with the Spotted Bat is probably limited as these bats tend to be opportunistic feeders taking a variety of invertebrate species in addition to moths.

Behaviour/adaptability

Although most researchers have concluded that this bat roosts solitarily, its social structure is unknown and the Spotted Bat may roost alone or in small groups. The limited data suggest that it is not found in large aggregations. Evidently echolocation calls of the Spotted Bats are also used in communication. It reacts strongly to playback calls of other individuals (Obrist 1995). When foraging, agonistic vocalizations are produced in response to intruders entering a bat's foraging area (Leonard and Fenton 1983; Storz 1995) and some researchers (Easterla 1973) have observed chases in flight. Although there is a tendency for neighbouring Spotted Bats to space out their feeding areas, the extent to which this bat is territorial, however, is not clear. Leonard and Fenton (1983) concluded that individuals maintained exclusive feeding territories separated by at least 50 m; however, Wai-Ping and Fenton (1989) observed extensive overlap in the foraging areas of neighbouring individuals.

Adept at crawling into small crevices and openings in rock outcrops, and able to climb vertical rock faces (Poché 1975) the Spotted Bat is well adapted for crevice roosting. Garcia et al. (1995) and Sarell and Haney (2000) noted that this species is intolerant of noise and disturbance at its roosting sites. However, most of this evidence appears to be anecdotal. The Spotted Bat is adaptable in its use of foraging habitat feeding over disturbed habitats such as agricultural fields and golf courses (Leonard and Fenton 1983; Gitzen et al. 2001).

POPULATION SIZES AND TRENDS

Because it is a solitary bat with distinctive search-phase echolocation calls that are audible to the unaided human ear up to 250 m, Spotted Bats can be censused by acoustic surveys at potential roost sites or foraging areas (Fenton et al. 1987; Wai-Ping and Fenton 1987). The most reliable population estimates are based on emergence counts made at dusk as Spotted Bats emerge from their day roosts to forage. Emergence counts are more reliable than counts of foraging bats because they avoid multiple counts of the same individual. Since its discovery in Canada in 1979, there

have been at least nine acoustic inventories and estimates of the minimum population size for various parts of the Canadian range (Table 3). However, there has been no systematic inventory done throughout the Canadian range applying a standard methodology. Census data are also geographically biased for the southern Okanagan Valley. Inventories for the Cariboo-Chilcotin region are limited to two surveys done in 1992 and 1993 (Roberts and Roberts 1992, 1993). Although Sarell and Woodgate (1991) reported the first observations of Spotted Bats in the Thompson River valley in 1991, there has been no systematic inventory of potential roost sites throughout the North and South Thompson River valleys.

Table 3. Estimates of minimum population size for Spotted Bats (*Euderma maculatum*) from various regions of British Columbia. Estimates based on acoustic monitoring of emergence counts at roosts. Modified from Sarell and Haney (2000).

Year	South Okanagan	Similkameen	Thompson	Chilcotin-Cariboo	Source
1981	50	-	-	-	Leonard & Fenton (1983)
1986	29	-	-	-	Fenton et al. (1986)
1987	34	-	-	-	Wai-Ping & Fenton (1987)
1989	38	24	-	-	Collard et al. (1990)
1991	55	0	-	-	Chapman et al. (1994)
1992	29	-	24[1]	19[2]	Holroyd et al. (1994)[1]; Roberts & Roberts (1992)[2]
1993	-	-	-	62	Roberts & Roberts (1993)
2000	60	2	-	-	Sarell and Haney (2000)

[1]includes observations for both the Thompson and Cariboo-Chilcotin

[2]a partial census of the Chilcotin-Cariboo region

The Spotted Bat is possibly the only Canadian bat species with population estimates. Nevertheless, these population counts should be regarded with caution. There are inconsistencies in sampling periods among different studies, unequal sampling effort across the Canadian range, the possibility of multiple counts of foraging individuals in some studies, and a bias for only surveying high quality roosting habitat. Garcia et al. (1995) estimated the minimum population in Canada at less than 200 individuals. A similar estimate, presumably taken from Garcia et al. (1995), was given by Cannings et al. (1999). In the most recent survey, Sarell and Haney (2000) detected a minimum of 60 Spotted Bats in the south Okanagan. They estimated that the total population in this area was 100 to 200 animals and concluded that the entire Canadian population was less than 500. Assuming that the Cariboo-Chilcotin region supports a population similar to the south Okanagan as suggested by Roberts and Roberts (1992) and that the Thompson area also supports 100-200 animals, an estimate of less than 1,000 total Spotted Bats for Canada may be realistic. Because the Spotted Bat's age at sexual maturity is unknown, the number of mature animals cannot be determined. But, given that volant young have been included in some counts, the number of mature animals is less than the total population count.

A comprehensive inventory of the entire Canadian range applying a standard methodology is required to obtain baseline data for monitoring long term population trends. The only region with a sequence of population estimates is the south Okanagan region (Table 3). Seven population counts that span about 20 years demonstrate no evidence for population declines.

Although the population status of Spotted Bats in Washington State is unknown, this species has been detected in Okanogan County near the British Columbia border (Sarell and McGuiness 1993; Johnson and Cassidy 1997). Trans-border movements are likely.

LIMITING FACTORS AND THREATS

Pierson and Rainey (1998) noted that rarity coupled with specialized roosting requirements and a patchy distribution make the Spotted Bat a species of conservation concern throughout its range.

There are no obvious threats to habitats used for foraging and roosting. The availability of suitable roosting sites may be a limiting factor the Spotted Bat in Canada. Sarell and Haney (2000) found that cliff roosts were patchily distributed throughout the southern Okanagan Valley with most separated by 2 km or more. Specific threats to these cliff roosts include rock climbing and helicopter activity near cliffs associated with mountain helicopter training. However, these activities appear to be limited to a few cliffs in the south Okanagan region. Rock quarries, road construction, or forest harvesting at the base of cliffs could also impact roosting Spotted Bats as there is some anecdotal evidence that this species is sensitive noise disturbance (Garcia et al. 1995). Although natural habitats particularly in the southern Okanagan and Similkameen valleys have been modified by agriculture and urban development, the Spotted Bat evidently is flexible in its foraging habitat foraging over hay fields, abandoned fields, and golf courses.

It is unlikely that this species' moth prey base is limiting. According to Don Lafontaine (pers. obser.), moth diversity in the Okanagan valley is highest in the antelope-brush (*Purshia tridentata*) and big sagebrush (*Artemisia tridentata*) steppe. Croplands and orchards are poor in diversity, but they tend to support high densities of a few moth species. In major fruit growing regions such as the Okanagan Valley, pesticides are applied to control agricultural pests. The impact of pesticides on Spotted Bat prey is unknown.

Although disturbance at hibernacula is a major conservation concern for many temperate bats, the location of the Canadian population of Spotted Bats in winter is unknown. Winter surveys of 18 caves and mines within the Canadian range found no hibernating Spotted Bats (Nagorsen et al. 1993). This bat may hibernate in cliff faces within its summer range or migrate to unknown hibernation sites in the United States. Because its day roosts are inaccessible and it forages in flight, predation is rare. There is no evidence that disease is a limiting factor.

SPECIAL SIGNIFICANCE OF THE SPECIES

The Spotted Bat is one of three western North American bat species that is confined to the intermontane grasslands of British Columbia in Canada. The audible, low frequency echolocation calls that can be detected without the aid of electronic bat detectors make this bat an ideal research species. Because its low frequency echolocation calls are inaudible to many moth species, it has been used as a model for studying the co-evolution of predator-prey tactics among moths and bats. Monitoring the audible echolocation calls also provides an effective but simple tool for population inventories. Although one of the most spectacular members of the Canadian mammal fauna, paradoxically few biologists or naturalists have actually observed this animal in the wild because of its nocturnal activity and cliff-dwelling habits. Nevertheless, its audible echolocation calls make it an ideal species for educational programs that promote bat awareness and conservation.

EXISTING PROTECTION OR OTHER STATUS

This species is not listed by the IUCN. It was designated Special Concern by COSEWIC in 1988 (see Balcombe 1988). The global heritage status rank is G4 (apparently secure); national ranks are N3N4 (vulnerable to apparently secure) for the United States and N3 (vulnerable) for Canada. Three states (Montana, Oregon, and Wyoming) rank the Spotted Bat as S1 (critically imperilled); four states rank this species as S1S2 or S2 (critically imperilled or imperilled). British Columbia has designated the Spotted Bat as S3S4 (vulnerable to apparently secure).

In British Columbia, the Spotted Bat is protected from killing under the provincial Wildlife Act. Although this species is not known to roost in trees in British Columbia and is probably little impacted by rangeland practices, it is listed as an Identified Wildlife Species under the revised British Columbia Provincial Forest and Range Practices Code. Species listed under the code are considered to be at risk and require special management by establishing Wildlife Habitat Areas (WHA). Guidelines[2] under the Forest and Range Practices Code specify that WHAs will be established to protect known or potential day roosts and hibernacula of the Spotted Bat. The core of the WHA will include the roost cliff and talus base with a 100 m radius management zone around the roost cliff. Various management prescriptions are recommended relating to road development, forest harvesting, and pesticide use. To date no WHAs have been designated for the Spotted Bat. The Forest and Range Practices Code only applies to provincial crown land; in the southern portion of the Canadian range for example more than 50% of this species' habitat is exempt from the code (Table 2).

[2]Guidelines for this species under the Provincial Forest and Range Practices Code are currently in draft stage.

SUMMARY OF STATUS REPORT

The Spotted Bat is a rare, patchily distributed bat found across western North America. In Canada where it reaches its northern limits, it is confined to the intermontane grasslands of British Columbia. Although it can be inventoried by acoustic surveys of its audible (to humans) echolocation calls of individuals emerging from their day roosts to forage at night, census data for Canada are limited by inconsistencies in methodology and a geographic bias for the southern Okanagan Valley. The available census data suggest that the Canadian population may be less than 1,000 animals and stable. As the known day roosts are in crevices, this species may have specialized roosting requirements. Although it forages in a broad range of habitats including habitats modified for agriculture, its diet appears to consist mostly of large moths. The steppe and grasslands of British Columbia support an abundant and diverse moth fauna. Nothing is known about the distribution of the Canadian population in winter—individuals may hibernate in rock crevices within the summer range or migrate to the United States to overwinter. Limiting factors include disturbance of roosting sites, the loss of riparian habitat and possible impacts of pesticides on its prey. Less than 10% of its Canadian range falls within protected areas and more than 50% of its range is on private or Indian Reserve lands where habitat is excluded from protection under the British Columbia Forest and Range Practices code.

TECHNICAL SUMMARY

Euderma maculatum
Spotted Bat Oreillard maculé
British Columbia

Extent and Area information	
• *extent of occurrence (EO)(km²)*	10,600 km^2
• *specify trend (decline, stable, increasing, unknown)*	Stable
• *are there extreme fluctuations in EO (> 1 order of magnitude)?*	No
• *area of occupancy (AO) (km²)*	Unknown
• *specify trend (decline, stable, increasing, unknown)*	-
• *are there extreme fluctuations in AO (> 1 order magnitude)?*	-
• *number of extant locations*	80*
• *specify trend in # locations (decline, stable, increasing, unknown)*	Unknown
• *are there extreme fluctuations in # locations (>1 order of magnitude)?*	No
• *habitat trend: specify declining, stable, increasing or unknown trend in area, extent or quality of habitat*	Stable?
Population information	
• *generation time (average age of parents in the population) (indicate years, months, days, etc.)*	Unknown
• *number of mature individuals (capable of reproduction) in the Canadian population (or, specify a range of plausible values)*	<1000
• *total population trend: specify declining, stable, increasing or unknown trend in number of mature individuals*	Stable
• *if decline, % decline over the last/next 10 years or 3 generations, whichever is greater (or specify if for shorter time period)*	-
• *are there extreme fluctuations in number of mature individuals (> 1 order of magnitude)?*	No
• *is the total population severely fragmented (most individuals found within small and relatively isolated (geographically or otherwise) populations between which there is little exchange, i.e., ≤ 1 successful migrant / year)?*	No
• *list each population and the number of mature individuals in each*	-
• *specify trend in number of populations (decline, stable, increasing, unknown)*	-
• *are there extreme fluctuations in number of populations (>1 order of magnitude)?*	-
Threats (actual or imminent threats to populations or habitats)	
- disturbance to cliff roosting sites - loss of riparian foraging habitat - impact of pesticides on the moth prey base	

Rescue Effect (immigration from an outside source)	Moderate
• *does species exist elsewhere (in Canada or outside)?*	Yes
• *status of the outside population(s)?*	Rare Idaho S2 Montana S1 Washington S3
• *is immigration known or possible?*	Yes
• *would immigrants be adapted to survive here?*	Yes
• *is there sufficient habitat for immigrants here?*	Yes
Quantitative Analysis	-

*80 occurrences; 40 element occurrences. An element occurrence for small bats is defined by the Heritage Ranking System as sites occupied historically or at present that are separated by 10 km or more

Other Status
COSEWIC: Special Concern 1988
British Columbia: S3S4

Status and Reasons for Designation

Status: Special Concern	**Alpha-numeric code:** [The estimated Canadian population (<1000 adults) met criterion for Threatened D1, but it was designated Special Concern because there is a possibility of rescue effect from neighbouring populations in the United States. Foraging and roosting habitats appear to be secure in Canada.]

Reasons for Designation:

In Canada, this species occurs in the intermontane grasslands of southern British Columbia. It is a distinctively coloured bat that is unmistakable to identify. Unlike any other Canadian species of bat, it has echolocation calls that are within the range of human hearing. It roosts in crevices in large cliff faces. It is considered the most easily and best censused species of bat in Canada. Population estimates, based on relatively good census effort, suggest that there are fewer than 1000 adults. At this time, numbers appear to be stable, and there are relatively few threats to populations or habitats. Perhaps the biggest threat to this species is its small population size. Use of pesticides on its prey, loss of foraging habitat, and disturbance at roosting sites by rock climbers are potential threats. Rescue may be possible from neighbouring populations in the United States; however, movements of individuals between Canadian and US populations are not documented.

Applicability of Criteria

Criterion A (Declining Total Population)**:**
< 1000 adults in Canada.

Criterion B (Small Distribution, and Decline or Fluctuation)**:**
10600 km^2 in Canada.

Criterion C (Small Total Population Size and Decline)**:**
No evidence of population decline.

Criterion D (Very Small Population or Restricted Distribution)**:**
Meets the criterion for Threatened under D1. < 1000 adults in Canada.

Criterion E (Quantitative Analysis)**:**
Probability of extinction in Canada, unknown.

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