Recovery Strategy for the Pallid Bat (*Antrozous pallidus*) in British Columbia

Prepared by the Pallid Bat Recovery Team

BRITISH COLUMBIA
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Ministry of Environment

September 2008

About the British Columbia Recovery Strategy Series

This series presents the recovery strategies that are prepared as advice to the province of British Columbia on the general strategic approach required to recover species at risk. The Province prepares recovery strategies to meet our commitments to recover species at risk under the *Accord for the Protection of Species at Risk in Canada*, and the *Canada - British Columbia Agreement on Species at Risk*.

What is recovery?

Species at risk recovery is the process by which the decline of an endangered, threatened or extirpated species is arrested or reversed, and threats are removed or reduced to improve the likelihood of a species' persistence in the wild.

What is a recovery strategy?

A recovery strategy represents the best available scientific knowledge on what is required to achieve recovery of a species or ecosystem. A recovery strategy outlines what is and what is not known about a species or ecosystem; identifies threats to the species or ecosystem, and what should be done to mitigate those threats. Recovery strategies set recovery goals and objectives, and recommend approaches to recover the species or ecosystem.

Recovery strategies are usually prepared by a recovery team with members from agencies responsible for the management of the species or ecosystem, experts from other agencies, universities, conservation groups, aboriginal groups, and stakeholder groups as appropriate.

What's next?

In most cases, one or more action plan(s) will be developed to define and guide implementation of the recovery strategy. Action plans include more detailed information about what needs to be done to meet the objectives of the recovery strategy. However, the recovery strategy provides valuable information on threats to the species and their recovery needs that may be used by individuals, communities, land users, and conservationists interested in species at risk recovery.

For more Information

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

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

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Recommended citation

The Pallid Bat Recovery Team. 2008. Recovery Strategy for the Pallid Bat (*Antrozous pallidus pallidus*) in British Columbia. Prepared for the B.C. Ministry of Environment, Victoria, B.C. 18 pp.

Cover illustration/photograph

Cover photo provided by Mike Sarell, Ophiuchus Consulting.

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 978-0-7726-6071-8

Cataloguing in Publication: Pending

Disclaimer

This recovery strategy has been prepared by the Pallid Bat Recovery Team, as advice to the responsible jurisdictions and organizations that may be involved in recovering the species. The British Columbia Ministry of Environment has received this advice as part of fulfilling their commitments under the *Accord for the Protection of Species at Risk in Canada*, and the *Canada - British Columbia Agreement on Species at Risk.*

This document identifies the recovery strategies that are deemed necessary, based on the best available scientific and traditional information, to recover Pallid Bat populations in British Columbia. Recovery 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 recovery approaches may be modified in the future to accommodate new objectives and findings.

The responsible jurisdictions and all members of the recovery team 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 on the recovery team. Ron Hall participated in the preparation of this strategy but does not represent his band and his participation does not constitute consultation.

Success in the recovery 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 strategy. The Ministry of Environment encourages all British Columbians to participate in the recovery of the Pallid Bat.

RECOVERY TEAM MEMBERS

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RESPONSIBLE JURISDICTIONS

The British Columbia Ministry of Environment is responsible for producing a recovery strategy for the Pallid Bat under the *Accord for the Protection of Species at Risk in Canada*. Environment Canada's Canadian Wildlife Service also participated in the preparation of this recovery strategy.

ACKNOWLEDGEMENTS

Mike Sarell developed an earlier draft of the strategy and Allison Haney prepared the maps. Daniela Rambaldini wrote the current version of the strategy and the recovery team revised the document. Lucy Reiss and Jeff Brown provided helpful comments on earlier versions and Crystal Klym assisted with revisions and editing. This draft was funded by the B.C. Ministry of Environment, the Habitat Conservation Trust Fund and Okanagan College. Research (2002 - 2005) was generously sponsored by Bat Conservation International, the Brink/M^{c}Lean Grassland Conservation Fund (The Nature Trust of B.C.), the Habitat Conservation Trust Fund, Interdepartmental Recovery Fund (Environment Canada), National Science and Engineering Research Council of Canada, Osoyoos (Nk'Mip) Indian Band, Public Conservation Assistance Fund, Science Horizons Youth Internship Program (Environment Canada), Vancouver Foundation, Toronto Dominion Friends of the Environment Foundation, University of Regina, and Endangered Species Recovery Fund (World Wildlife Fund Canada, Environment Canada). We are grateful for their support.

EXECUTIVE SUMMARY

The Pallid Bat (*Antrozous pallidus*) is a relatively large bat (102 to 135 mm body length) with long, prominent ears and large eyes. The dorsal fur is usually cream-coloured with light grey or light brown tips, ventral fur is ivory or white, and wing membranes are grey or pinkish brown. It has scroll-shaped nostrils and small glands on its muzzle that secrete a musky, skunk-like scent. These bats have been detected in Canada from late May to mid October in cliff, shrub-steppe and open ponderosa pine habitats below 800 meters in the south Okanagan valley of British Columbia.

Pallid Bats are designated as Threatened in Canada due to their small population (200 to 500), restricted distribution, and habitat loss estimated at over 60% of their foraging habitat, due mainly to agricultural development. Potential impacts from pesticide use, wildfire control, intensive grazing and disturbance may also be significant threats but are poorly understood and require additional research.

The recovery goal is to maintain the current population of Pallid Bats within their known Canadian range in the south Okanagan valley, British Columbia.

The following, interim Recovery Objectives for the next 5 years (2009 to 2013) are designed to maintain the species in the short-term while knowledge gaps are addressed.

I. Identify and protect important Pallid Bat habitats including all identified day and maternity roosts, priority night roosts, and foraging habitat within 1.5km of roosts and hibernacula, if any are identified, by 2013.
II. Develop, by 2009, and implement a research program, by 2013, to clarify population distribution, size, trends, demography, and critical habitat for Pallid Bats in Canada.
III. Develop, by 2009, and implement a research program, by 2013, to clarify the impact of potential threats including pollution, fire suppression, grazing, disturbance, persecution and accidental mortality for Pallid Bats in Canada and begin to mitigate high priority threats by 2013.

There is a strong need to encourage and support the voluntary cooperation of landowners and managers in stewardship activities on a variety of land tenures to make recovery activities successful.

One or more action plans will be completed by 2013.

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BACKGROUND

Species Assessment Information from COSEWIC

Date of Assessment: May 2000

Common Name (population): Pallid Bat

Scientific Name: *Antrozous pallidus pallidus*

COSEWIC Status: Threatened

Reason for Designation: Very small distribution; much of critical foraging habitat has been destroyed by agricultural and urban development, and habitat loss is continuing. Rescue effect is possible from adjacent populations in Washington State.

Canadian Occurrence: British Columbia

COSEWIC Status History: Designated Special Concern in April 1988. Status re-examined and designated Threatened in May 2000. Last assessment based on an update status report.

Description of the Species

The Pallid Bat (*Antrozous pallidus*) is a relatively large bat (102 to 135 mm body length) with long, prominent ears and large eyes. The dorsal fur is usually cream-coloured with light grey or light brown tips, ventral fur is ivory or white, and wing membranes are grey or pinkish brown. It has scroll-shaped nostrils and small glands on its muzzle that secrete a musky, skunk-like scent. These bats have been detected in Canada from late may to mid October. It is not known whether they hibernate in Canada (Nagorsen and Brigham 1993).

Populations and Distribution

The Pallid Bat inhabits hot, arid regions across western North America (Figure 1), from southern British Columbia to central Mexico with an isolated population in Cuba (Orr and Silva Taboada 1960; Silva Taboada 1976). Less than 1% of the Pallid Bat's known global distribution is in Canada. Global population trends are not well known but the species is ranked G5 (globally common widespread and abundant) by NatureServe (2007). State/provincial ranks are S1 or S1? (Critically Imperiled) in British Columbia, Kansas, Idaho, and Wyoming; S2 (Imperiled) in Montana and Oregon; S2S3 in Washington; S3 (Vulnerable) in California, Oklahoma, and Nevada; S4 (Apparently Secure) in Colorado and Utah; S4S5 in Arizona; and S5 (Secure) in the Navajo Nation, Texas, and New Mexico.

In Canada, it is known only to occur in the semi-arid shrub-steppe of the southern Okanagan Valley, south of Penticton, in south-central British Columbia at elevations lower than 800 meters (Figure 2). However, the species is difficult to detect using standard bat inventory techniques and

may have a wider distribution, based on the extent of potential habitat. Few species specific surveys have been done outside of the known area. The Canadian population is currently estimated at 200 to 500 individuals (Rambaldini and Brigham 2004). Captured Pallid Bats have generally been male but a few females and juveniles have been reported, confirming that the population is reproductive. Population and distribution trends are not known but may be declining due to a loss of more than 60% of the native foraging habitat within their known B.C. range (B.C. Environment 1998). While most research has been done on the Osoyoos Indian Reserve, Pallid Bats have been captured at a few other sites, including land owned by the National Research Council and The Nature Trust, and have been reported at a few private land sites.

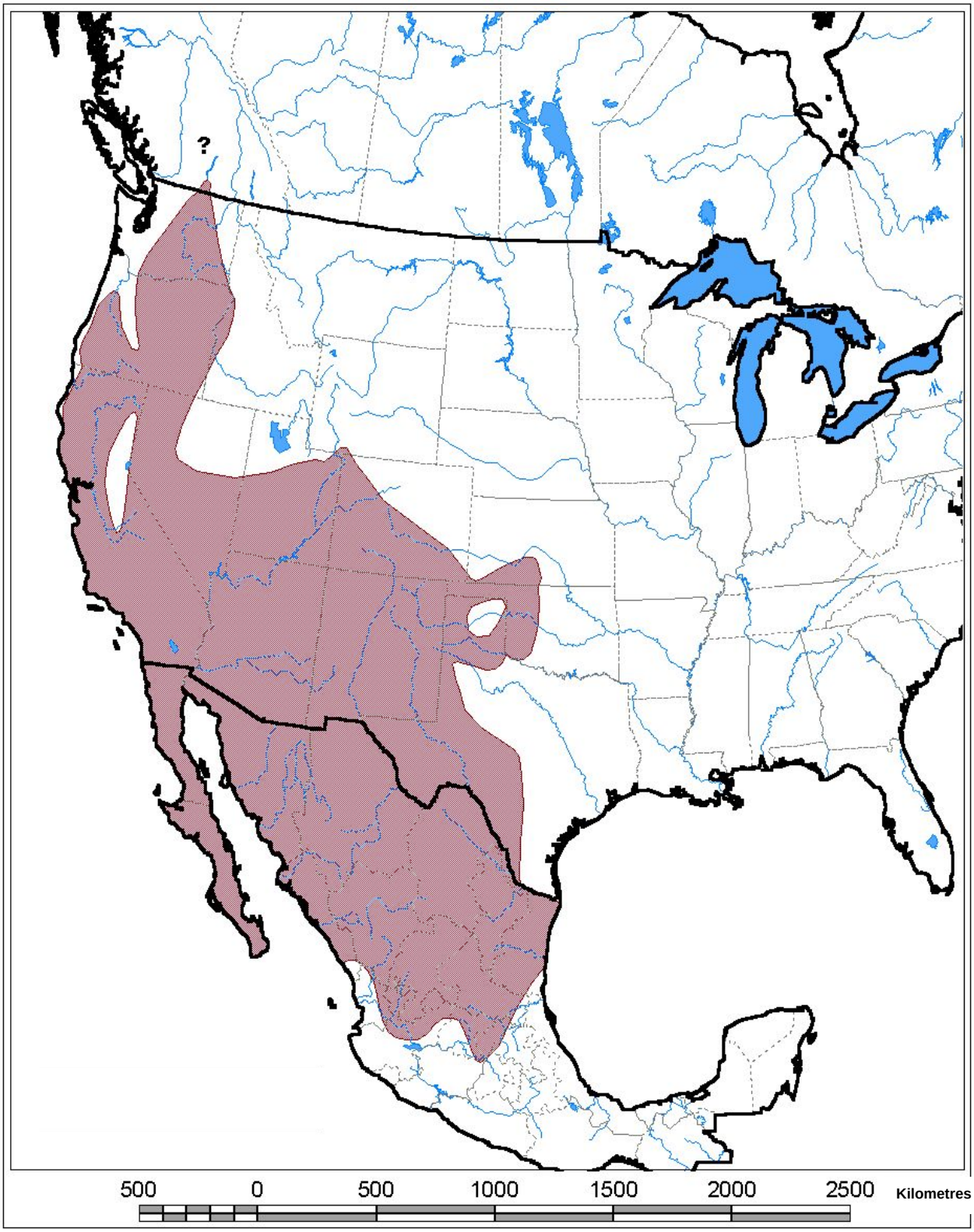

Figure 1. Global distribution of the Pallid Bat, excluding an isolated population in Cuba.

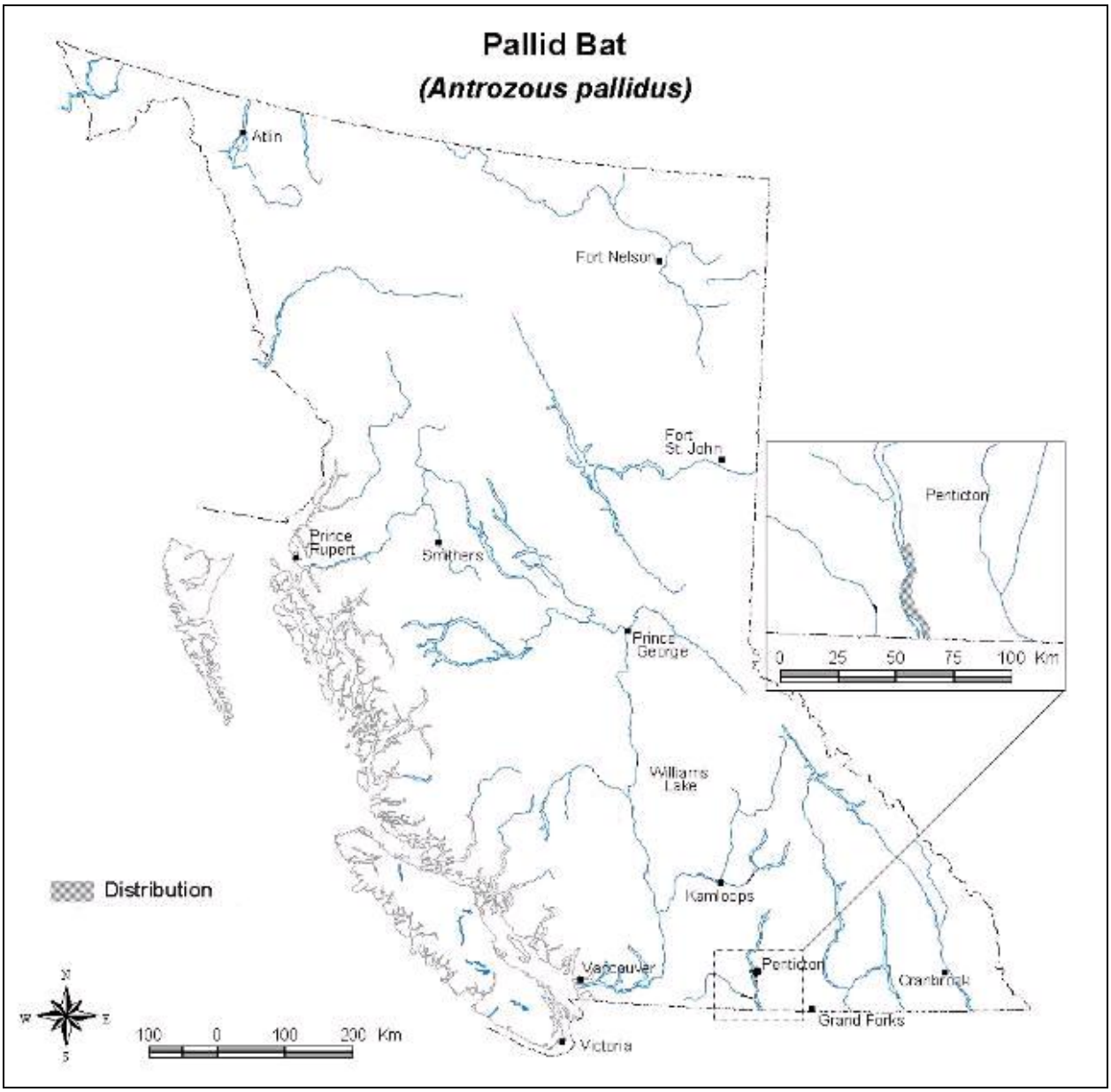

Figure 2. Distribution of the Pallid Bat in British Columbia.

Needs of the Pallid Bat

Habitat and biological needs

Throughout their range Pallid Bats are generally found in low elevation (<1830 m) hot, dry, shrub-steppe or open forest habitats, especially those characterized by rocky outcrops, canyon landscapes, and rugged terrain (Orr 1954; Hermanson and O'Shea 1983). All confirmed Canadian records are from the very hot and dry Bunchgrass and Ponderosa Pine biogeoclimatic subzones (BGxh1 and PPxh1) south of Penticton (Figure 2) below an elevation of 700m (Nagorsen and Brigham 1993; Willis and Bast 2000; Mike Sarell pers. comm. 2006). The B.C.

population appears to be at the northern extent of the species' range. Pallid Bats use a variety of habitats for roosting and foraging.

Roosting Habitat:
The Pallid Bat occupies day roosts (including maternity roosts), night roosts, and hibernacula. Day and night roosts are occupied from early spring to late fall.

Although Pallid Bats at lower latitudes occupy a variety of roosts, including man-made structures, in Canada all recently reported day roosts, including a maternity roost, have been in naturally occurring rock crevices within cliff faces (Chapman et al. 1994; Rambaldini and Brigham 2004; Rambaldini 2006). Roosts generally have warm, stable temperatures (daytime mean 26 – 28 °C) and are high above the ground (Rambaldini and Brigham 2004). One adult male was also found roosting under a pile of stones in a sand pit (Racey 1933). Male Pallid Bats are loyal to specific roosting areas, but switch roosts an average of every 4 days (range: 1–13 d); some roosts, such as those habitually used by large aggregations (*i.e.* 20 – 100+ individuals), are occupied in consecutive years (Rambaldini and Brigham 2004; Rambaldini 2006). Parturition (the process of giving birth) is believed to occur in day roosts in July (Nagorsen and Brigham, 1993). Females generally give birth to 1 or 2 pups (Grinnell 1918; Hall 1946; Orr 1954) but mean litter size in B.C. is unknown.

In Canada, night roost structures and feeding perches include day roosts and other rock crevices, small caves, trees (*e.g.*, ponderosa pine, Douglas fir, deciduous trees in riparian areas, and fruit trees in orchards), and bridges (Chapman et al. 1994; Rambaldini and Brigham 2004; Rambaldini 2006). These are usually located within or near (< 1.5 km) foraging areas and within 2 km of water (Rambaldini and Brigham 2004).

In other parts of their range hibernacula are occupied throughout winter. Exact dates of occupancy vary across the range and between years, depending on climate. In B.C., no hibernacula have been located to date. Local hibernation is not confirmed but is suspected because Pallid Bats in other areas do not migrate long distances between their summer range and winter hibernation sites (Orr 1954; Barbour and Davis 1969;) and some B.C. bats remain in their summer range as late as mid-October (Rambaldini 2006). If hibernation occurs in Canada, hibernation dates likely range from late October to late April. At more southerly latitudes, Pallid Bats hibernate within deep narrow crevices inside caverns, caves, abandoned mines, and buildings where relative humidity remains high and temperature does not drop below freezing throughout the winter (Hall 1946; Twente 1955*a*, 1955*b*; Johnston 2004). Pallid Bats mate in the hibernacula (Orr 1954; Hermanson and O'Shea 1983) or other roosts (*e.g.*, swarming sites; Fenton 1969; Parsons et al. 2003) from October to February.

Pallid Bats in Canada appear sensitive to disturbance (Rambaldini and Brigham 2004) and if they are persistently or severely disturbed, they may vacate roosts (Beck and Rudd 1960; O'Shea and Vaughan 1999). Availability of suitable roosts could also limit Pallid Bat distribution within the Okanagan Valley (Collard 1990; Chapman et al. 1994), especially if warm, south-facing rock aspects are preferred (Vaughan and O'Shea 1976; Rambaldini and Brigham 2004; Rodhouse and Wright 2004).

Foraging Habitat:
Pallid Bats feed on a variety of large arthropods (Hermanson and O'Shea 1983; Johnston and Fenton 2001), occasionally taking small vertebrates (O'Shea and Vaughan 1977; Bell 1982). They may glean, land on the ground, or aerially hawk prey (Grinnell 1918; Huey 1936; Bell 1982). As a result, they often forage in open areas (Bell 1982; Chapman et al. 1994; Ball 2002). Rambaldini (2006) found that over 60% of the volume of captured Pallid Bats' diet in British Columbia consisted of scarab beetles whereas Pallid Bats in Washington State had access to a more diverse, and larger bodied prey base.

Pallid Bats are opportunistic generalists, foraging over open or cluttered native habitat (*i.e.*, grassland, shrub-steppe, and Ponderosa pine habitats); agricultural fields (*e.g.*, ranch pastures, vineyards, and fruit orchards); talus slopes; and gravel roads generally less than 1km from roosts (Chapman et al. 1994; Sarell and Haney 2000; Rambaldini and Brigham 2004; Rambaldini 2006).

Rambaldini (2006) found that Pallid Bats foraged significantly more over native habitat in B.C. than vineyard habitat, and that prey availability is lower in vineyards. The native shrub-steppe habitats also contained more probable prey items than did adjacent vineyard habitats despite the proximity of vineyard habitat to native source habitats and the use of integrated pest management techniques.

Ecological role

The Pallid Bat's ecological role is not well known. It is a predator of large arthropods and may be prey for owls. Its impact on the food chain is likely to be minor in British Columbia because of its small population size and limited distribution in Canada.

Limiting factors

Biologically limiting factors in B.C. are not well known. The small population size and apparently low numbers of females in B.C. may limit population growth and persistence. Prey preferences and foraging strategies may limit adaptability to habitat change. Roosting and foraging requirements may limit potential distribution and abundance. This species may also be limited by climatic factors given their apparent preference for dry, hot climates.

Threats

Threat classification

Table 1. Threat Classification.

1 Crop production		**Threat attributes**	
Threat category	Habitat loss or degradation	**Extent**	Widespread
General threat	Crop production, historically orchards and currently vineyards, with associated road and infrastructure construction.	**Occurrence**	Historic, current and anticipated
		Frequency	Continuous
Specific threat	Habitat conversion, fragmentation, and isolation. Alteration of habitat characteristics.	**Causal certainty**	High
		Severity	High
Stress	Reduced food availability, reduced productivity and fitness, behavioural changes, reduced population size and viability.	**Level of concern**	High
2 Housing development		**Threat attributes**	
Threat category	Habitat loss or degradation	**Extent**	Widespread
General threat	Housing development with associated road construction, utility corridors and infrastructure.	**Occurrence**	Historic, current and anticipated
		Frequency	Continuous
Specific threat	Habitat conversion, fragmentation, and isolation. Alteration of habitat characteristics.	**Causal certainty**	High
		Severity	Moderate
Stress	Reduced food availability, reduced productivity and fitness, behavioural changes, reduced population size and viability.	**Level of concern**	Moderate
3 Pollution		**Threat attributes**	
Threat category	Pollution	**Extent**	Widespread
General threat	Pesticide use for enhanced crop production through pest control.	**Occurrence**	Historic, current and anticipated
		Frequency	Seasonal (spring through fall)
Specific threat	Loss or reduction of prey base, consuming poisoned prey and direct exposure.	**Causal certainty**	Unknown but may range from moderate to low
		Severity	Unknown but may range from moderate to low
Stress	Reduced population size and viability, reduced food availability, reduced productivity or fitness, increased mortality.	**Level of concern**	Moderate to low

4 Fire suppression and intensive grazing		**Threat attributes**	
Threat category	Changes in ecological dynamics or natural processes	**Extent**	Widespread
General threat	Fire suppression, wild or prescribed fire and intensive grazing.	**Occurrence**	Historic, current and anticipated
		Frequency	Seasonal
Specific threat	Loss of open habitats due to tree encroachment, high intensity fires and intensive grazing resulting in removal of vegetation for prey species.	**Causal certainty**	Unknown but may range from medium for fire effects to low for grazing
		Severity	Unknown but may range from moderate to low
Stress	Reduced food availability, reduced productivity and fitness, behavioural changes, reduced population size and viability.	**Level of concern**	Unknown but may range from moderate to low
5 Disturbance and persecution		**Threat attributes**	
Threat category	Disturbance and persecution	**Extent**	Unknown
General threat	Recreational and industrial activities	**Occurrence**	Unknown
		Frequency	Seasonal (spring through fall)
Specific threat	Behavioural disruption	**Causal certainty**	Low (impacts not known to occur in B.C.) to high, if impacts occur (potential exists)
		Severity	Unknown but likely low
Stress	Behavioural changes and possibly reduced productivity or fitness.	**Level of concern**	Low
6 Accidental mortality		**Threat attributes**	
Threat category	Accidental mortality	**Extent**	Localized
General threat	Mortality caused by vehicles and domestic cats	**Occurrence**	Historic and current
		Frequency	Seasonal (spring through fall)
Specific threat	Direct mortality	**Causal certainty**	High
		Severity	Unknown but likely ranges from low to moderate
Stress	Reduced population size and viability, increased mortality.	**Level of concern**	Low

Description of threats

Habitat Loss or Degradation:
The primary threat to the Pallid Bat in Canada is conversion of native foraging habitats into high intensity agricultural operations, residential housing or industrial uses. The main habitat used by the Pallid Bat in Canada is the antelope-brush – needle and thread grass plant community. Greater than 60% of this habitat was converted to agricultural (mainly vineyard) and urban uses between 1860 and 2001 (Dyer and Lea 2003). Habitat conversion continues at an increasing rate of greater than 4% per year. Rambaldini (2006) determined that native antelope-brush habitat provides greater foraging opportunities for Pallid Bats and was used significantly more than vineyards.

Pollution:
Pesticide toxicity resulting from direct exposure or consumption of contaminated prey may be an issue for Pallid Bats in Canada but is currently unquantified. A significant portion of the Pallid Bat's Canadian range is dominated by agricultural land uses. Pallid Bats have been observed foraging and roosting in both vineyards and orchards. Many agricultural operations intensively employ pesticides and other chemicals (Verrin et al. 2004) to facilitate crop production. DDT continues to persist in the Okanagan environment and in wildlife despite being banned since 1985 (Gill et al. 2003). Invertebrate prey availability and abundance is less in vineyards than in natural habitats, possibly due in part to pesticide use. Research is required.

Fire Suppression and Grazing:
Fire suppression has resulted in increased tree density in south Okanagan shrub-steppe habitats (Turner and Krannitz 2001). This results in less open habitats and may alter habitat use and behaviour of Pallid Bats. Fire suppression also appears to contribute to a higher percentage of stand replacing fires when a wild fire does occur and relatively long shrub re-establishment times (Krannitz and Mottishaw 2003). Intensive range use alters invertebrate density, species and abundance but has not been correlated to Pallid Bat prey species. These activities may result in reduced availability of habitat and invertebrate prey for Pallid Bats, but causality is speculative. Research is required.

Disturbance and Persecution:
Disturbance and persecution has not been documented in British Columbia but the potential for disturbance exists and needs to be considered. Numerous studies have demonstrated that bats may abandon roosts as a result of human-caused disturbances (e.g. Tuttle 1979). In addition, disturbances at bat roosts can have severe bioenergetic consequences for bats, particularly when disturbances occur at hibernacula (Thomas 1995a, 1995b; Thomas et al. 1990). Disturbance may include intentional persecution, inadvertent impacts by recreational activities (Tuttle 1979), or indirect disruptive activities near a roost site. Hibernacula, which have not yet been identified in Canada, and day roosts (particularly maternity roosts) are most vulnerable to disturbance (Thomas 1995; Vaughn and O'Shea 1976). Known day roosting locations for Pallid Bats in Canada are relatively inaccessible so intentional persecution of Pallid Bats is likely to be limited.

Accidental Mortality:
Pallid Bats, which frequently forage on or near the ground, are vulnerable to predation by domestic cats and collisions with motor vehicles. Mortality due to these causes is confirmed but likely to be low and localized. However, their impact may be significant due to low population numbers.

Actions Already Completed or Underway

- Ongoing inventory (Grindal et al. 1991; Sarell et al. 1997; Sarell and Haney 2000; Rambaldini and Brigham 2004; Rambaldini 2006; Sarell pers. comm. 2006).
- Habitat use and population demographics research (Chapman et al. 1994; Rambaldini and Brigham 2004; Rambaldini 2005, 2006; Sarell, unpublished data, 2006).
- Habitat protected through acquisition (Vaseux Bighorn National Wildlife Area; provincial protected areas; fee simple acquisitions by The Nature Trust of B.C.).
- Education programs and outreach initiatives (Osoyoos (Nk'Mip) Indian Band; Bat Conservation International; Ecommunity Network /SOSCP; Nk'Mip Desert & Cultural Centre; Osoyoos Desert Centre, and En'owkin Learning Centre).

Knowledge Gaps

- Population distribution, size, density, demographics and trends
- Hibernacula, maternity, day and night roost locations
- Foraging habitat quality and distribution requirements including prey relationships
- Significance of pesticide impacts
- Population viability, especially in relation to long term habitat loss
- Threat clarification

RECOVERY

Recovery Feasibility

The recovery of this species is feasible. Individuals still persist within the species' historical range in British Columbia at numbers that appear to be relatively stable. A substantial amount of habitat is still available and the species appears to use human-modified habitats such as agricultural fields, although habitat quality appears poor at these sites. Threats from habitat loss can be reduced through a variety of standard tools such as habitat protection within protected areas, habitat management through existing government regulations and cooperative habitat stewardship programs on private land. The primary recovery technique is through habitat protection which could be effective if strategically implemented.

Recovery Goal

The recovery goal is to maintain the current population of Pallid Bats within their known Canadian range in the South Okanagan Valley, British Columbia.

Rationale for the Recovery Goal

The recovery goal focuses on maintaining the current population within the known range of the species. An increase in population numbers was not considered for three reasons: (1) historic population numbers are not available to allow setting a credible target for a restored population; (2) habitat that has been lost to urban and agricultural development is not likely to be restored; and (3) the Canadian population is likely part of a larger, contiguous population in Washington State and is assumed to be viable in that context.

Few surveys for Pallid Bats have been conducted outside of the known range but suitable habitat appears to be available. If the species is detected in other areas in the future, the recovery goal will change to incorporate the range extension.

Recovery Objectives

The following, interim Recovery Objectives for the next 5 years (2009 to 2013) are designed to maintain the species in the short term while knowledge gaps are addressed.

I. Identify and protect important Pallid Bat habitats including all identified day and maternity roosts, priority night roosts, and foraging habitat within 1.5km of roosts and hibernacula, if any are identified, by 2013.
II. Develop, by 2009, and implement a research program, by 2013, to clarify population distribution, size, trends, demography and critical habitat for Pallid Bats in Canada.
III. Develop, by 2009, and implement a research program, by 2013, to clarify the impact of potential threats including pollution, fire suppression, grazing, disturbance, persecution and accidental mortality for Pallid Bats in Canada and begin to mitigate high priority threats by 2013.

Approaches Recommended to Meet Recovery Objectives

A broad strategy to address threats will include habitat protection, habitat management, inventory and monitoring, research and outreach. These tasks generally will be accomplished through voluntary stewardship and partnerships such as the South Okanagan-Similkameen Conservation Program (SOSCP). Habitat protection may take many forms including stewardship agreements and conservation covenants, land use designations, and protected areas.

Recovery planning table

Table 2. Strategies and approaches to achieve recovery objectives.

Objective	Threat categories addressed	Broad strategy to address threats	Recommended approaches to meet recovery objectives
Objective I, III	• Habitat loss or degradation	• Research • Habitat protection • Habitat management	• Identify important habitats that require protection • Develop habitat management guidance including best management practices to mitigate threats • Develop options for cooperative habitat protection with owners/managers of important habitats • Develop cooperative habitat stewardship agreements • Develop and deliver an outreach strategy to key audiences
Objective II, III	• Habitat loss or degradation • Pollution • Fire suppression and intensive grazing • Disturbance • Persecution • Accidental mortality	• Research	• Develop a prioritized research strategy to address knowledge gaps and threats, identify funding options and potential partners • Develop partnerships with academic institutions and researchers • Initiate and coordinate priority research projects • Continue inventory to clarify distribution and abundance • Monitor known sites to determine population and habitat trends • Assess impacts from potential threats related to pollution, fire suppression, intensive grazing, habitat loss or degradation, and disturbance • Clarify habitat use and needs, especially in relation to agriculture

Performance Measures

Key performance questions are identified below:

- Important Pallid Bat habitats including day and maternity roosts, priority night roosts, and foraging habitat within 1.5km of roosts and hibernacula, are identified and protected by 2013.
- A research program is developed by 2009, and implemented, by 2013, to clarify population distribution, size, trends, demography and critical habitat for Pallid Bats in Canada.
- A research program is developed, by 2009, and implemented, by 2013, to clarify the impact of potential threats including pollution, fire suppression, grazing, disturbance, persecution and accidental mortality for Pallid Bats in Canada.
- High priority threats are mitigated by 2013.

Critical Habitat

Identification of the species' critical habitat

No critical habitat, as defined under the federal *Species at Risk Act* [S.2], is proposed for identification at this time. While some information is known about the habitat needs of the species and is included within this recovery strategy, more definitive work must be completed before any specific sites can be formally identified as critical habitat. It is expected that critical habitat will be identified following completion of outstanding work required to quantify specific habitat and area requirements for this species, as outlined in the schedule of studies below. Once a draft identification of critical habitat has been developed, consultation with affected parties will be necessary before the final proposal is brought forward for consideration.

Recommended Schedule of studies to identify critical habitat

Table 3. Schedule of studies.

Description of activity	Outcome/rationale	Timeline
Conduct research to address knowledge gaps related to habitat use, diet and prey availability, population demographics, and connectivity to the United States and quantify impacts from potential threats such as pesticides, habitat loss, intensive grazing and disturbance.	- Quantify habitat requirements, distribution, quality, use and impacts of potential threats. - Quantify foraging requirements, prey availability and potential toxicity. - Quantify population demographics and genetic connectivity to U.S. populations. - Provide information for development of effective recovery actions.	2009 to 2013
Inventory and monitor species distribution, abundance, habitat occupancy (roosts, hibernacula, and foraging sites) and potential habitat.	Clarification of population size, distribution, site occupancy over time, land ownership, and site specific threats.	2009 to 2013

Notwithstanding the above, current knowledge of general habitat needs is provided in the Needs of the Pallid Bat section.

Existing and Recommended Approaches to Habitat Protection

There is a strong need to encourage and support the voluntary cooperation of landowners and managers in stewardship activities on a variety of land tenures to make recovery activities successful. This stewardship approach includes different kinds of activities, such as: following guidelines or best management practices, land use designations, conservation agreements, covenants, eco-gifts or sale of private lands by willing landowners. To be useful, protected habitat needs to be large enough and in adequate condition for this species to carry out its seasonal activities and life history functions, including hibernating, roosting, breeding, and foraging.

The only known roosting habitat on currently protected land is within the Vaseux-Bighorn National Wildlife Area (NWA) (Rambaldini and Brigham 2004). Foraging habitat is protected in the Vaseux-Bighorn NWA, Vaseux Protected Area managed by B.C. Parks, several conservation

properties owned by The Nature Trust of B.C., and land owned by the National Research Council (NRC). The majority of Pallid Bat captures, roost sites, and foraging habitat occur within Indian Reserve lands (Chapman et al. 1994; Rambaldini and Brigham 2004; Rambaldini 2006).

Known roost sites and foraging habitats in low elevation rugged terrain, antelope-brush, other shrub-steppe plant communities and open ponderosa pine habitats, within the known range of Pallid Bats, should be a priority for protection through stewardship agreements or other mechanisms.

Effects on Other Species

Pallid Bat recovery may have little direct effect on other species or ecological processes, especially since there is no intent to enhance the population(s) above natural carrying capacity. Many species will benefit indirectly from recovery efforts. Other listed bats could be opportunistically studied at the same time and protecting foraging habitats will benefit several other SARA listed species such as the Western Rattlesnake (*Crotalus oreganus*), Great Basin Spadefoot (*Spea intermontana*), Behr's Hairstreak (*Satyrium behrii*) and Badger (*Taxidea taxus*).

Recommended Approach for Recovery Implementation

Recovery implementation should include habitat conservation at a landscape scale and consider a multi-species approach, incorporating bats and other species dependant on antelope-brush and open ponderosa pine ecosystems in the south Okanagan valley. These species include Spotted Bat (*Euderma maculatum*), Western Rattlesnake, Behr's Hairstreak, Badger, Great Basin Spadefoot and others. A single species approach may be required to address some knowledge gaps and threats that may be specific to Pallid Bats such as prey species selection, habitat use and potential impacts from pesticides and intensive grazing. The participation of First Nations, especially the Osoyoos Indian Band, is vital to recovery success. A habitat and multi-species Action Plan, including all SARA listed species within the Pallid Bat's range, should be considered.

Socioeconomic Considerations

Potential socio-economic considerations include impacts or costs associated with urban development, agricultural development, and pesticide use. These considerations may apply in low elevation shrub-steppe and open ponderosa pine forest in the southern Okanagan valley of British Columbia. The magnitude of potential impacts will not be known until clear recovery goals can be identified but may be moderate to high. Pallid bats may provide socioeconomic benefits by consuming various arthropods, such as Scarab beetles, which could be agricultural pests. In addition, benefits of recovery include human health and social benefits associated with natural habitat conservation (Maller et al. 2005), economic tourism values (Filion et al. 1991; i.e. Nk'mip Desert and Heritage Centre), education and research values. Recovery also contributes to addressing international commitments (i.e. Convention on Biodiversity) for this species and others, the interests of Canadians in conserving species at risk (Filion et al. 1991) and conservation of First Nations traditional use sites (Jeanette Armstrong pers. comm. 2006).

Statement on Action Plans

One or more action plans will be completed by 2013.

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