

# Recovery Strategy for the Western Rattlesnake (*Crotalus oreganus*) in British Columbia



Prepared by the Southern Interior Reptile and Amphibian Recovery Team



Ministry of  
Environment

January 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 its 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; it also 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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## Disclaimer

This recovery strategy has been prepared by the Southern Interior Reptile and Amphibian 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 its 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 Western Rattlesnake 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.

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 Western Rattlesnake.

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## **RESPONSIBLE JURISDICTIONS**

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

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## EXECUTIVE SUMMARY

The Western Rattlesnake (*Crotalus oreganus*) is a large, stout snake with a triangular head, narrow neck, and tail that ends with a rattle. The body is brown, olive, or grey with a series of large dark-brown blotches surrounded by light-coloured borders, or “halos,” running down the middle of the back, with smaller, similar blotches along the side. They occur in the Southern Interior of British Columbia in the Bunchgrass, Ponderosa pine, and Interior Douglas-fir biogeoclimatic zones and are often associated with rock outcrops, talus, shrub-steppe, open forest, and riparian habitats. The species is venomous but, due to its passive disposition and warning rattle, unprovoked bites are relatively uncommon. They are specialized predators of small mammals including rodent pests.

The main identified threats to the species are habitat loss, degradation, and fragmentation resulting from land conversions associated with agricultural and urban development. Direct mortality through road/rail kill and persecution is also an important threat.

Rattlesnake recovery will require a stewardship approach that engages the voluntary cooperation of landowners and managers on various land tenures to protect this species and the habitat it relies on. Habitat protection will be accomplished through various mechanisms that could include voluntary stewardship agreements, conservation covenants, eco-gifts, sale of private lands by willing landowners, land use designations, and protected areas.

The **recovery goal** is to maintain self-sustaining populations of the Western Rattlesnake throughout its range within each of four population areas in British Columbia with sufficient protected habitats that include access to suitable hibernacula, foraging, and gestation sites.

The interim recovery objectives (2008–2012) are to:

1. Protect and manage threats on a minimum of 16,000 ha of habitat, consisting of suitably connected priority sites with sufficient habitat for hibernation, foraging, gestation, and seasonal movements to support self-sustaining populations, distributed throughout all four population areas by 2012.
2. Reduce road kill mortality of snakes to a sustainable level at a minimum of three priority sites by 2012.
3. Develop and begin to implement a prioritized research program by 2009 to increase knowledge of Western Rattlesnake distribution, population size and demography, habitat use, movements, and threats so recovery targets can be accurately quantified, threats can be mitigated and critical habitat can be fully described by 2012.
4. Build sufficient understanding of the species and support for habitat protection so that Objectives 1, 2, and 3 can be achieved and threats, particularly from persecution, can be reduced to sustainable levels by 2012.

One or more Recovery Action Plans will be completed by 2012.

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## BACKGROUND

### Species Assessment Information from COSEWIC

**Date of Assessment:** May 2004

**Common Name (population):** Western Rattlesnake

**Scientific Name:** *Crotalus oreganus*

**COSEWIC Status:** Threatened

**Reason for designation:** This species is threatened by rapid expansion of human activities including urbanization, agriculture, forestry, and range management in south-central dry valleys of British Columbia. This snake is particularly vulnerable to roads both from direct mortality and from habitat fragmentation. Rattlesnakes are subject to direct persecution and to destruction of critical habitat (hibernacula). The adult rattlesnake population is small, likely fewer than 5000, and dispersed among only four valleys, probably with little interchange of snakes between valleys. Threats to the species are increased in effect because this snake has late maturity (~8 years), small litters, and only breeds about once every 3–4 years.

**Canadian Occurrence:** British Columbia

**COSEWIC Status History:** Designated Threatened in May 2004. Assessment based on a new status report.

### Description of the Species

The Western Rattlesnake (*Crotalus oreganus*) is a large, stout snake with a triangular head, narrow neck, and tail that ends with a rattle. Adults typically range from 38 to 91 cm in length (St. John 2002). The background body colour of mature snakes is brown, olive, or grey. A series of large dark-brown blotches surrounded by light-coloured borders, or “halos,” run down the middle of the back, with smaller, similar blotches along the side. Juveniles have lighter but more contrasting patterns.

The Western Rattlesnake occurs in the Southern Interior of British Columbia in the Bunchgrass, Ponderosa Pine, and Interior Douglas-fir biogeoclimatic zones, and is often associated with rock outcrops, talus, shrub-steppe, open forest, and riparian habitats. It is venomous but, due to its passive disposition and warning rattle, unprovoked bites are relatively uncommon. The Western Rattlesnake is a specialized predator of small mammals (Gregory and Campbell 1984) including rodent pests.

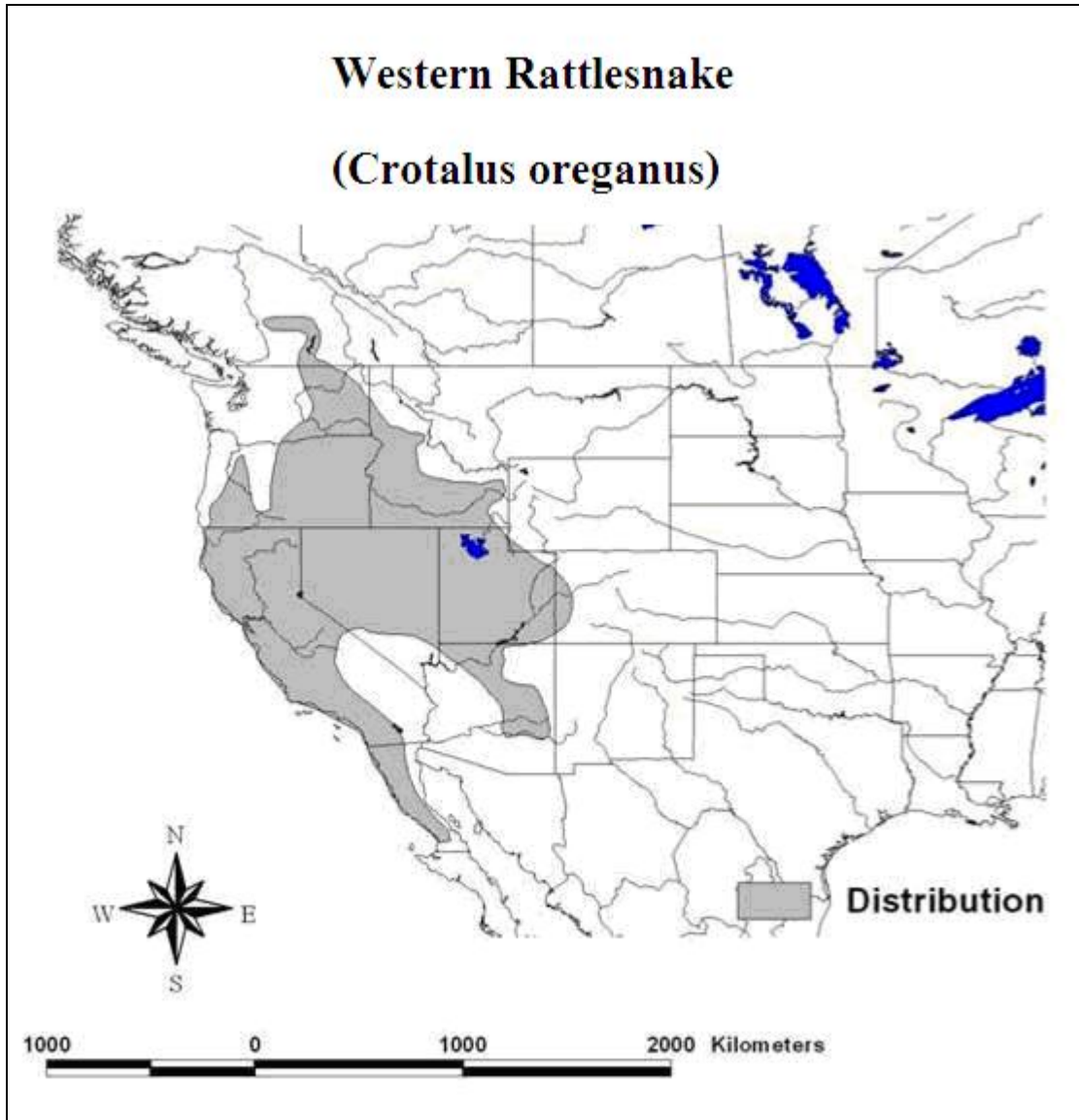
### Populations and Distribution

Globally, the Western Rattlesnake is found in western North America from southern British Columbia, south to California and Mexico, and east to the Rocky Mountains (COSEWIC 2004) (Figure 1). Western Rattlesnake populations in southern British Columbia, Washington, Idaho, Oregon, and northern California are the *oreganus* subspecies (*C. oreganus oreganus*) (St. John 2002). Canada has less than 5% of the global distribution of this species, based on distribution maps.

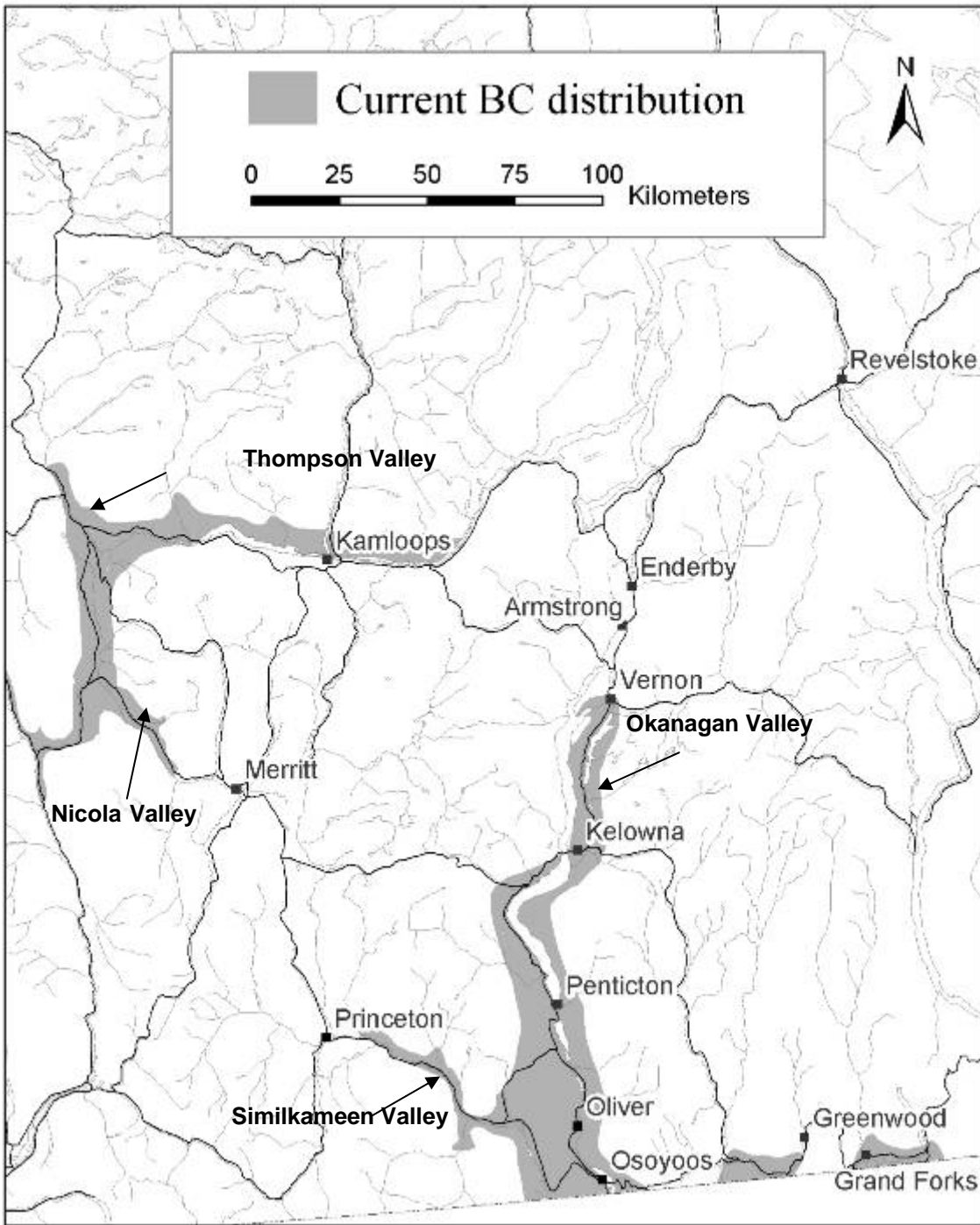
In British Columbia, the Western Rattlesnake is restricted to the Thompson-Okanagan dry belt in the Southern Interior of the province (Gregory and Campbell 1984) (Figure 2). It occurs in the Fraser, Thompson, Okanagan, Lower Similkameen, Kettle, and Granby drainages (COSEWIC 2004). In southern B.C., rattlesnake distribution is contiguous with the Washington distribution (Cassidy *et al.* 1997) but populations may not be well connected. The number of separate populations in B.C. is not clear but we tentatively identify four separate management areas for recovery planning, based on sightings and mapping of suitable habitat: Fraser-Thompson (including the Nicola Valley); Okanagan-Similkameen; Kettle (Rock Creek to Midway); and Granby (Grand Forks to Christina). The latter three may be connected through corridors in Washington State, but this is not confirmed. The Fraser-Thompson-Nicola area is not connected to the Okanagan population, based on available data.

Population trends for the Western Rattlesnake are not well understood. The population estimate in British Columbia is less than 5000 adult rattlesnakes (COSEWIC 2004). However, accurate counts are not available throughout most of the range and the COSEWIC estimate is likely quite low (J. Brown, pers. comm., 2007). The highest densities of this species are found in two disjunct populations: the Okanagan/Similkameen valleys and Thompson/Nicola valleys. Populations are presumed to be declining as a result of past and present habitat loss, degradation, and fragmentation arising from urban and agricultural development, road/rail mortality persecution by humans (Hobbs and Sarell 2000, 2001; Hobbs 2001; Bertram *et al.* 2001; COSEWIC 2004). Anecdotal evidence suggests some populations in the Thompson and Okanagan valleys have likely been extirpated (Sarell 1993; COSEWIC 2004; Sarell *et al.* 2004).

NatureServe (2007) lists the status of the Western Rattlesnake globally as G5 (secure). In British Columbia, the Western Rattlesnake is ranked S3 (vulnerable). State ranks are S5 (demonstrably widespread, abundant, and secure) for Arizona, California, Nevada, Oregon, Washington, and Wyoming, and SNR (unranked) for Utah, Colorado, Idaho, Navajo Nation, and New Mexico.



**Figure 1.** Global distribution of the Western Rattlesnake (map provided by Jeff Brown, based on Macartney 1985).



**Figure 2.** Distribution of the Western Rattlesnake in British Columbia (B.C. Ministry of Environment 2006).

## Needs of the Western Rattlesnake

### Habitat and biological needs

The Western Rattlesnake occupies the Bunchgrass, Ponderosa Pine, and Interior Douglas-fir biogeoclimatic zones found in the Southern Interior of British Columbia (Hobbs 2001). Within these zones, they are strongly associated with rock outcrops and talus slopes, shrub-steppe/grassland, riparian, and ponderosa pine habitats (Macartney 1985; Bertram *et al.* 2001). They also use urban and agricultural areas. Rattlesnakes use these habitats seasonally for hibernation, foraging, gestation, and migration so they must be interconnected, in close proximity, with secure movement corridors.

**Hibernation:** Winter hibernacula (dens) are most often located in steep south-facing rock outcrops associated with talus slopes (Diller and Wallace 1984; Gregory and Campbell 1984; Macartney 1985; Sarell 1993; Hobbs and Sarell 2000, 2001; Bertram *et al.* 2001; Hobbs 2001). Although individual hibernation sites vary, they typically consist of deep rock fissures that allow snakes to remain below the frost line throughout the winter (Macartney *et al.* 1987; Hobbs and Sarell 2000; 2001; Hobbs 2001). Talus slopes also provide important basking (sunning) habitat in the spring and fall. Hibernacula are normally found in the middle or lower regions of rocky slopes but can also be found at elevations up to 1000 m (Macartney 1985).

The Western Rattlesnake hibernates communally and shows considerable site fidelity, returning to the same hibernation site each year (Macartney 1985; J. Brown, pers. comm., 2007). Hibernacula vary in size and support a few to several hundred individuals (Gregory and Campbell 1984; Macartney *et al.* 1987; Hobbs and Sarell 2000, 2001; Bertram *et al.* 2001; Hobbs 2001). Rattlesnake hibernacula are often used by small numbers of other species at risk including: Gopher Snake (*Pituophis catenifer deserticola*) (threatened); Racer (*Coluber constrictor*) (special concern); and Night Snake (*Hypsiglena torquata*) (endangered) (Macartney 1985; Sarell 1993; Hobbs and Sarell 2000, 2001; Hobbs 2001).

**Foraging:** In the spring, Western Rattlesnakes disperse from hibernation sites to summer foraging habitat. Shrub-steppe/grasslands comprise the most significant component of foraging habitat, but they also are associated with riparian and ponderosa pine habitats during the summer foraging period (Macartney 1985; Bertram *et al.* 2001). Rattlesnakes also use urban and agricultural habitats for foraging but these sites often expose the snakes to higher levels of mortality. The species has also recently been found in Interior Douglas-fir ecosystems during the foraging period at elevations up to 1400 m (L. Gomez, pers. comm., 2005).

The diet of the Western Rattlesnake consists mainly of small mammals (Macartney 1989), and it is a specialized ambush predator. As a result, cover objects are important habitat features for these snakes because they are used for both hunting and thermoregulation. Bertram *et al.* (2001) and Brown (2006) found rattlesnakes associated with cover objects including rocks (large boulders and rock piles), vegetation (dead and live shrubs, dead trees, and bark), and rodent burrows.

**Gestation:** Gestation sites are typically located on hibernation rock outcrops or table rock piles within a few hundred metres of a hibernation site (Macartney 1985). Gestation sites are exposed to direct sunlight with some limited cover objects (shrubs and rocks) to allow gravid females to maintain optimal body temperatures and escape predation. Females reproduce on a triennial cycle, producing an average of 4.6 young per litter (Macartney and Gregory 1988). Gestation occurs over a 4- to 5-month period between ovulation in June and parturition in September (Macartney 1985). During this time gravid females aggregate at communal gestation sites and remain within 0.16–0.22 ha of the dens (Macartney 1985) until after parturition.

**Migration:** In the spring and fall, the species makes rapid and direct movements between hibernation and foraging habitats. During this migration, individuals follow specific dispersal corridors (Macartney 1985). Individuals typically disperse up to 1 km, in a straight line distance, from their hibernation site (Bertram *et al.* 2001; Macartney 1985; Brown 2006), although distances up to 7 km have been recorded (L. Gomez, pers. comm., 2005).

## Ecological role

This species is a specialized predator of small mammals (Gregory and Campbell 1984) but its diet includes other snakes, lizards, amphibians, and birds. It is preyed upon by other species such as skunks, bears, badgers, and raptors (COSEWIC 2004).

## Limiting factors

Western Rattlesnakes require several interconnected habitats to perform their life history functions (hibernation, gestation, or mating aggregation and foraging). Extensive seasonal movement between habitats and high site fidelity to home ranges and hibernacula make the species particularly vulnerable to disturbance, which could have substantial effects locally (Macartney 1985). In addition, because they are venomous, they are perceived as dangerous and are persecuted by humans. Long seasonal movements and the cryptic nature of rattlesnakes make monitoring and studying the ecology of populations difficult (Charland 1987).

Western Rattlesnakes in British Columbia typically reproduce on a triennial cycle (Macartney 1985). This low reproductive rate is compounded by a late age at maturity (5–7 years for females) and small litter size (average of 4.6 young per female) (Macartney *et al.* 1987), which potentially limits population growth and recovery potential.

## Threats

### Threat classification

**Table 1.** Threat classification.

1 Urban development		Threat attributes	
<b>Threat category</b>	Habitat loss or degradation	<b>Extent</b>	Widespread
<b>General threat</b>	Housing development, road/rail construction, utility corridors, and	<b>Occurrence</b>	Historic and current
		<b>Frequency</b>	Continuous

	infrastructure.		
<b>Specific threat</b>	Habitat conversion, fragmentation, and isolation. Alteration of habitat characteristics, disturbance and persecution	<b>Causal certainty</b>	High
		<b>Severity</b>	High
<b>Stress</b>	Reduced population size and viability, increased mortality, reduced ability to migrate safely	<b>Level of concern</b>	High
<b>2 Agricultural development</b>		<b>Threat attributes</b>	
<b>Threat category</b>	Habitat loss or degradation	<b>Extent</b>	Widespread
<b>General threat</b>	Agricultural development, road/rail construction, infrastructure, irrigation	<b>Occurrence</b>	Historic and current
		<b>Frequency</b>	Continuous
<b>Specific threat</b>	Habitat conversion, fragmentation, and isolation. Alteration of habitat characteristics, disturbance, and persecution	<b>Causal certainty</b>	High
		<b>Severity</b>	High
<b>Stress</b>	Reduced population size and viability, increased mortality, reduced ability to migrate safely	<b>Level of concern</b>	High
<b>3 Road kill mortality</b>		<b>Threat attributes</b>	
<b>Threat category</b>	Accidental mortality	<b>Extent</b>	Widespread
<b>General threat</b>	Road/rail development and increased human population growth	<b>Occurrence</b>	Historic and current
		<b>Frequency</b>	Seasonal (emergence to hibernation)
<b>Specific threat</b>	Crushed by vehicles	<b>Causal certainty</b>	High
		<b>Severity</b>	Likely ranges from high locally to low regionally
<b>Stress</b>	Reduced population size and viability, reduced ability to migrate, increased mortality	<b>Level of concern</b>	High
<b>4 Discriminate killing</b>		<b>Threat attributes</b>	
<b>Threat category</b>	Disturbance and persecution	<b>Extent</b>	Widespread
<b>General threat</b>	Discriminate killing	<b>Occurrence</b>	Historic and current
		<b>Frequency</b>	Continuous
<b>Specific threat</b>	Direct mortality by humans	<b>Causal certainty</b>	High
		<b>Severity</b>	Known to be high, locally, at some agricultural operations, campgrounds and urban sites but unclear throughout most of the distribution.

<b>Stress</b>	Reduced population size and viability, increased mortality	<b>Level of concern</b>	High, locally, at some agricultural and urban sites; low throughout most of the distribution
<b>5 Pest control</b>		<b>Threat attributes</b>	
<b>Threat category</b>	Pollution	<b>Extent</b>	Widespread
<b>General threat</b>	Pesticide use	<b>Occurrence</b>	Historic, current, and anticipated
		<b>Frequency</b>	Seasonal
<b>Specific threat</b>	Loss of prey base, possible direct toxicity impacts to individuals	<b>Causal certainty</b>	Unknown but may be moderate to low
		<b>Severity</b>	Unknown but may range from moderate to low
<b>Stress</b>	Reduced population size and viability, increased mortality	<b>Level of concern</b>	Unknown but may range from moderate to low
<b>6 Fire suppression and intensive grazing</b>		<b>Threat attributes</b>	
<b>Threat category</b>	Changes in ecological dynamics or natural processes	<b>Extent</b>	Widespread
<b>General threat</b>	Fire suppression, wild or prescribed fire and intensive grazing	<b>Occurrence</b>	Historic, current and anticipated
		<b>Frequency</b>	Seasonal
<b>Specific threat</b>	Loss of open habitats, high intensity fires, removal of vegetation, soil compaction	<b>Causal certainty</b>	Unknown but may range from medium for fire effects to low for grazing
		<b>Severity</b>	Unknown but may range from moderate to low
<b>Stress</b>	Reduced suitable habitat, population size and viability, increased mortality	<b>Level of concern</b>	Unknown but may range from moderate to low

### Description of the threats

**Urban and agricultural development:** Habitat loss or degradation due to urban and agricultural development represents the most significant broad threat to the Western Rattlesnake in British Columbia (Bertram *et al.* 2001; Hobbs 2001). Land conversion to urban developments and intensive agricultural uses, such as vineyards and orchards, results in the loss of important habitats and is threatening populations throughout the species' range in British Columbia, especially in high-quality valley bottom habitats (MWLAP 2004). Habitat fragmentation resulting from land conversions, road building, and other human activities are occurring throughout the species' range, potentially impeding movements and isolating populations (MWLAP 2004). Recent surveys of known hibernacula throughout the species' range indicated that no hibernation sites were completely free of human disturbance (Sarell 1993; Hobbs and Sarell 2000, 2001; Hobbs 2001).

Gravel extraction and rock quarrying may be limited locally, but may have significant impacts at single communal hibernacula, basking, and gestation sites.



**Road kill mortality:** Accidental mortality caused by vehicles is a widespread threat with significant and ongoing impacts to the survival of rattlesnake populations (Shewchuk 1996; Bertram *et al.* 2001; Hobbs 2001; MOE data files), and can potentially result in excessive loss of breeding adults where roads or railways intersect seasonal habitats or movement corridors (MWLAP 2004). Like other snakes, rattlesnakes use warm surfaces of paved roads for thermoregulation and are therefore particularly vulnerable to road mortality (Sullivan 1981). Road mortality can substantially reduce snake populations, as documented for other species (Rosen and Lowe 1994). Mortality of snakes from agricultural machinery during haying, tilling, and other crop management activities has been reported from the Thompson–Fraser River region and the Okanagan (COSEWIC 2004; MWLAP 2004) but the level of impact is unknown. Quarrying, road/rail construction, and utility corridor construction can result in mortality.

**Discriminate killing:** Persecution by humans of individual snakes and hibernacula are also significant threats to the ongoing survival of rattlesnake populations (Bertram *et al.* 2001; Hobbs 2001), and may seriously reduce numbers, locally, especially by removing breeding adults. This threat was severe and widespread historically. It appears to continue to be widespread but the impact has not been quantified, with some important exceptions. It continues to be a severe threat, locally, at some agricultural operations, campgrounds and urban sites where dens are close to human developments. The impact of the overall loss of habitat created by new urban and residential developments near grasslands may be accentuated by the killing of snakes that habitually return to these areas, even after the construction is completed, until few snakes remain. Domestic animals, such as cats and dogs, occasionally kill snakes but the severity and extent of this impact is not well documented and requires research.

**Pest control:** Rodent control programs, including the use of pesticides, have the potential to reduce the availability of prey for rattlesnakes. The degree of threat due to direct mortality from secondary poisoning is unknown. This is an emerging, potential issue and requires clarification. Sales of strychnine-based rodent poison at major distribution centres within the rattlesnake's distribution ranged from 9000 to 23,000 kg/yr and averaged 12,000 kg/yr between 1991 and 2002 (J. Vakenti, pers. comm., 2006). The poison is used mainly for pocket gopher control in agricultural settings. Pocket gophers are a significant prey species for rattlesnakes.

**Fire suppression and intensive grazing:** Fire suppression reduces the open nature of habitats, as noted in the Thompson Region (COSEWIC 2004); it also increases probability of high-intensity, catastrophic fires that are thought to be detrimental to snake populations (Rudolph *et al.* 1998; Smith *et al.* 2001). Heavy livestock grazing may result in the reduction of cover for snakes and could increase mortality through predation (MWLAP 2004). Cover or shelter with suitable structural and thermal conditions is an essential habitat requirement for snakes (RISC 1998). These threats require additional research.

## **Actions Already Completed or Underway**

The following selected actions have been completed or are underway for the Western Rattlesnake in British Columbia:

- Research on demographics, ecology, and potential impacts on rattlesnakes have been conducted by Macartney (1985, 1989), Macartney *et al.* (1987), Charland (1987), Bertram *et al.* (2001), Nk'Mip Desert and Heritage Centre (2002, unpublished data), Brown (2006), Gomez (in prep.), and Hobbs (in prep.).
- Habitat modeling as well as inventory of hibernacula and habitat is ongoing: Sarell (1993), Macartney (1994), Sarell *et al.* (1998), Hobbs and Sarell (2000), Hobbs (2001), Haney and Sarell (2004), and Sarell *et al.* (2004).
- Habitat has been conserved and managed through habitat acquisitions by The Nature Trust of B.C., establishment of Protected Areas and Wildlife Habitat Areas by the Province of B.C., and management plans (Parsons and Martin 1988; Sarell 2005; Sarell and Haney 2005; TRUE Consulting 2005).
- Public outreach and communication have been undertaken by the South Okanagan – Similkameen Stewardship Program (e.g., Snake Smart brochures, video, posters, brochures in English and Punjabi, agricultural awareness workshops [Valley *et al.* 2005]), the Nk'Mip Desert and Heritage Centre, Osoyoos Desert Centre, Alan Brooks Nature Centre, and Thompson Rivers University (<http://www.bcreptiles.ca/>).

## Knowledge Gaps

### Inventory and monitoring requirements

The general limits of distribution for the Western Rattlesnake in British Columbia are fairly well known. However, additional surveys are required within the known range at unsurveyed and historical locations to clarify current, local distribution and meta-population connections. Long-term population monitoring is required to address population dynamics, trends, and persistence. Monitoring is also required to assess the effects that public outreach activities are having on increasing conservation behaviours.

### Biological and ecological research requirements

Population size, density, and demographics throughout the range of the rattlesnake are poorly understood. This information is required to determine recruitment and survival trends, quantify population viability and conservation targets, and assess recovery efforts.

General habitat requirements are known but microhabitat use and significance to survival are not understood. More information is required on home range size, critical elements of summer forage habitat including requirements for shelter sites (related to climate and predation), basking sites, movement or dispersal, and prey density. This information is required to better understand rattlesnake habitat requirements, including critical habitat, and to inform management decisions.

Juvenile and neonate rattlesnakes are seriously undersampled, resulting in limited information on survival and basic ecology of younger age classes.

### Threat clarification research requirements

The significance and extent of impacts on populations due to predation by natural predators, domestic pets, and human-caused accidental (i.e., road mortality) or discriminate mortality is poorly known. The extent and rate of presumed population decline throughout the British Columbia distribution, as well as the current and projected habitat loss or degradation, are

unquantified. Potential impacts to habitat quality or populations due to livestock grazing and wild or prescribed fire are not understood. The scope and degree of impact from pesticides on prey and secondary poisoning require assessment. Further, the ability for rattlesnakes to adapt to habitat characteristics that have been altered by increased human activity is unknown. All potential threats require clarification.

## **RECOVERY**

### **Recovery Feasibility**

The recovery of this species is feasible. Populations still persist over much of the species' historical range in British Columbia. A substantial amount of habitat is available, and the snakes can use human-modified habitats such as agricultural fields to some extent, as long as required habitat features and connectivity among them are maintained and human caused mortality is not high. Threats from habitat loss can be reduced through various standard tools such as habitat protection within protected areas; habitat management through existing government regulations; and cooperative, habitat stewardship programs on private land. Threats due to road mortality may be mitigated through fencing and underpasses. Recovery techniques consist of threat mitigation, as previously discussed.

### **Recovery Goal**

To maintain self-sustaining populations of the Western Rattlesnake throughout its range within each of four population areas (see "Populations and Distribution" section) in British Columbia with sufficient protected<sup>1</sup> habitats that include access to suitable hibernacula, foraging, and gestation sites.

Suitable information is not currently available to quantify long-term targets for populations and habitats, including number of individuals and habitat areas required to maintain a viable population. These knowledge gaps will begin to be addressed over the next 5 years through the development and implementation of an action plan.

### **Rationale for the Recovery Goal**

Sufficient information to quantify long-term population and habitat targets is not available. Short-term objectives recommend clarification of knowledge gaps. Knowledge gaps will be addressed through one or more action plans for this species to help clarify recovery goals in the future. It is necessary to maintain the species in the short term while knowledge gaps are addressed. Short-term habitat protection targets to maintain the species are presented in the objectives below.

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<sup>1</sup> Protected habitat is Western Rattlesnake habitat (see "Habitat and biological needs" section) that is managed to protect and maintain the species over a long period (100+ years). This may involve protection in any form including voluntary stewardship agreements, best management practices to address threats, conservation covenants, sale of private lands by willing vendors, land use designations, and protected areas.

## Recovery Objectives

1. Protect and manage threats on a minimum of 16,000 ha<sup>2</sup> of habitat, consisting of suitably connected priority sites<sup>3</sup> with sufficient habitat for hibernation, foraging, gestation, and seasonal movements to support self-sustaining populations, distributed throughout all four population areas by 2012.
2. Reduce road kill mortality of snakes to a sustainable level at a minimum of three priority sites by 2012.
3. Develop and begin to implement a prioritized research program by 2009 to increase knowledge of Western Rattlesnake distribution, population size and demography, habitat use, movements, and threats so recovery targets can be accurately quantified, threats can be mitigated and critical habitat can be fully described by 2012.
4. Build sufficient understanding of the species and support for habitat protection so that Objectives 1, 2, and 3 can be achieved and threats, particularly from persecution, can be reduced to sustainable levels by 2012.

## Approaches Recommended to Meet Recovery Objectives

A broad strategy to address threats will include habitat protection, habitat management, inventory and monitoring, research, and outreach (Table 2). These tasks generally will be accomplished through voluntary stewardship and partnerships. Habitat protection may take many forms including stewardship agreements and conservation covenants on private lands, land use designations, and establishment of protected areas. A multi-species action plan, including all COSEWIC-listed snake species (Gopher Snake, Night Snake, Racer, Rubber Boa (*Charina bottae*)) within the Western Rattlesnake's range in B.C., should be developed to reduce costs and

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<sup>2</sup> The habitat protection objective (16,000 ha) provides an interim target meant to provide reasonable and achievable habitat protection for the Western Rattlesnake in the next 5 years, based on existing government and non-government conservation programs, while knowledge gaps are addressed and population viability targets are quantified. Portions of the area included in this habitat protection target are likely to overlap with habitat protection targets for several other species at risk including Gopher Snake and Night Snake. A Geographic Information System (GIS) was used to identify currently known, occupied sites based on clusters of rattlesnake sightings or rattlesnake dens. The land ownership of occupied sites was identified where possible and areas of suitable habitat were estimated on federal and provincial lands, including protected areas, and private land conservancies (15,000 ha). Habitat protection, management, and threat abatement can be reasonably influenced on this land base through existing processes such as land use plans, parks and protected areas, wildlife habitat areas, range use plans, inter-ministry agreements and other existing tools. Targets for occupied sites in key areas where only private land was available were estimated based on existing, voluntary acquisition and landowner stewardship programs through non-governmental organizations in the South Okanagan-Similkameen Conservation Program (1,000 ha). This interim target will be revised when new information becomes available.

<sup>3</sup> Priority sites include important communal hibernacula, associated foraging and travel corridors or sites where inventory data show concentrations of snakes. Priority sites will be identified in the action plan based on analysis of available information.

impacts and maximize opportunities for protecting areas used by more than one species. Snake conservation also should be included in the B.C. Grasslands Recovery Strategy, currently in preparation.

## Recovery planning table

**Table 2.** Broad recovery strategies for the Western Rattlesnake in British Columbia.

Objective #	Threats or concerns addressed	Broad approach/ strategy	Priority	Activities
1	Urban and agricultural development	Habitat protection and management	Urgent	Analyze available information to identify potential sites for identification and protection of habitat
			Urgent	On federal and provincial Crown lands secure priority sites through appropriate tools (e.g., existing protected areas, wildlife habitat areas, management or stewardship agreements, Land Act reserves)
			Urgent	Explore conservation options with First Nations groups
			Urgent	Provide information on priority sites to landowner contact and habitat acquisition programs; encourage voluntary stewardship and conservation acquisitions on private land
			Urgent	Work with municipal and regional governments to conserve habitat by using legislative tools, zoning, and planning guidelines (e.g., consideration of rattlesnake habitat in Official Community Plans, adoption of best management practices or guidelines, and designation of Environmentally Sensitive Development Permit Areas)
			Urgent	Encourage use of best management practices (MWLAP 2004)
2	Road kill mortality	Habitat protection and management	Urgent	Develop and implement mitigation measures to reduce road/rail kill at priority sites, selected through analysis of available information and, where needed, additional study (see "Research")
3	Knowledge gaps	Inventory	Necessary	Refine and expand spatial coverage of existing habitat suitability models and use them to direct inventory efforts
			Necessary	Inventory areas containing high-quality habitat where the species is suspected to occur to identify new sites for protection
		Monitoring	Necessary	Monitor selected known sites, including those associated with communal hibernacula, to document persistence and status of populations
		Research	Urgent	Conduct mark-recapture and radio-telemetry studies at selected sites within the ranges of both the northern and southern management areas to clarify population demographics, habitat use, potential threats including road/rail, pet or human-caused mortality, agricultural activities and habitat management regimes

<b>Objective #</b>	<b>Threats or concerns addressed</b>	<b>Broad approach/ strategy</b>	<b>Priority</b>	<b>Activities</b>
			Urgent	Conduct genetic analyses to clarify population status and meta-population structure, including isolation of subpopulations
			Urgent	Collect and analyze road/rail mortality data throughout the range to identify significant mortality areas for mitigation
			Urgent	Work with First Nations groups to continue to gather traditional knowledge
			Urgent	Conduct population and habitat modeling to quantify conservation targets and population viability and identify critical habitat
			Necessary	Develop partnerships with academic institutions to encourage research
			Necessary	Clarify the potential impacts related to pesticide use on key prey species.
			Beneficial	Clarify the potential impact of fire management on rattlesnake habitat and prey species
			Beneficial	Clarify the potential impact of range management on rattlesnake habitat and prey species
4	Threats	Outreach	Urgent	Conduct a community-based social marketing analysis to elucidate attitudes and barriers in target communities toward conservation efforts for the Western Rattlesnake
			Urgent	Develop and implement an outreach strategy to increase awareness and support for conservation of the species
			Urgent	Develop and implement a targeted outreach strategy to reduce discriminate killing
			Necessary	Ensure that interpretive materials are readily available, especially in communities near priority sites
			Necessary	Develop and implement an outreach strategy to reduce pesticide use on key prey species e.g., Pocket Gopher, if research determines this is a serious threat

## Performance Measures

- Have 16,000 ha of habitat been protected by 2012?
- Have three sites with high road mortality been identified by 2008?
- Has road mortality been reduced to sustainable levels at three sites by 2012?
- Has a prioritized research strategy been developed to address knowledge gaps by 2008?
- Have priority research questions been answered by 2012?
- Has a targeted communication strategy been developed by 2009?
- Has sufficient awareness and support for Western Rattlesnake recovery been achieved by 2012.
- Has discriminate killing been reduced to sustainable levels by 2012?
- Has the potential impact of pesticides been clarified through research and, if determined to be a significant threat, has the impact been reduced to sustainable levels by 2012?
- Has at least one action plan been developed by 2012?

## 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 is known about the habitat needs of the species included within this recovery strategy, more definitive work must be completed before any specific sites can be formally proposed as critical habitat. It is expected that critical habitat will be proposed within one or more recovery action plans following: (1) consultation and development of stewardship options with affected landowners and organizations and (2) completion of outstanding work required to quantify specific habitat and area requirements for these species. A schedule of studies outlining work necessary to identify critical habitat is in Table 2 and the outcome of the studies will be addressed in detail in an Action Plan.

### Recommended schedule of studies to identify critical habitat

**Table 3.** Schedule of studies.

Description of activity	Outcome/Rationale	Timeline
Conduct research to quantify habitat requirements and use	Quantification of dispersal distance and habitats, home range foraging, hibernacula, gestation, and habitat connectivity requirements	2007–2012
Inventory and monitor species distribution, abundance, occupied habitat, and potential recovery habitat	Clarification of population size, distribution, persistence, movement barriers, land ownership, and site-specific threats	2007–2012
Develop a population viability model	Identification of options for establishing a network of managed habitat to support	2010–2012

a viable population over a long term  
(>100 years)

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Notwithstanding the above, current knowledge of general habitat needs is provided in the “Habitat and biological needs” section

## Existing and Recommended Approaches to Habitat Protection

For successful implementation in protecting species at risk and the habitats they rely on, there is a strong need to encourage and support the voluntary cooperation of landowners and managers in stewardship activities on various land tenures. 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. Several federal, provincial, and private protected areas and provincial wildlife habitat areas (WHAs) currently provide some protection for the Western Rattlesnake. (e.g., Kalamalka Lake Park, Okanagan Mountain Park, Lac Du Bois Grasslands Park, Vaseux Bighorn National Wildlife Area, and land owned by the Nature Trust of British Columbia and managed for conservation). To effectively conserve the species, habitat secured and managed needs to be large enough and in adequate condition for this species to carry out its seasonal activities and life history functions, including hibernating, basking, breeding, and foraging. Habitat protection should prioritize areas where more than species can be protected on the same land base. The Western Rattlesnake will benefit from integrating habitat protection with other snake species, especially Gopher Snake, Night Snake and Racer.

## Effects on Other Species

Several other species at risk occur in shrub-steppe and open ponderosa pine and Interior Douglas-fir habitats within the range of the Western Rattlesnake in British Columbia (Hobbs 2001). Examples of species at risk that occupy Western Rattlesnake habitat include the Gopher Snake, Racer, Night Snake, Rubber Boa, Western Skink (*Eumeces skiltonianus*), Great Basin Spadefoot (*Spea intermontana*), Tiger Salamander (*Ambystoma tigrinum*), and Pallid Bat (*Antrozous pallidus*). Habitat protection and stewardship activities outlined in this strategy are likely to benefit these species as well. Opportunities for a multi-species approach exist when planning inventories and habitat protection for the Western Rattlesnake. Species like the Western Harvest Mouse (*Reithrodontomys megalotis*), assessed by COSEWIC as Special Concern, may be prey for the Western Rattlesnake but impacts are likely to be minimal and part of natural predator–prey interactions.

## Socioeconomic Considerations

Potential socioeconomic considerations include impacts or costs associated with urban development, agricultural development, transportation corridor mitigation, and pesticide use. These considerations may apply throughout low elevation grassland and open forest habitats in the Southern Interior of British Columbia. The magnitude of potential impacts will not be known until clear recovery goals can be identified. Benefits of recovery include human health and social benefits associated with natural habitat conservation (Maller *et al.* 2005), reduction of global warming



effects through carbon sequestering in natural habitats, 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, interests of Canadians in conserving species at risk (Filion *et al.* 1991), and conservation of First Nations traditional use sites (J. Armstrong, En'owkin Centre, pers. comm., 2005).

## **Recommended Approach for Recovery Implementation**

Recovery implementation should include habitat conservation at a landscape scale and consider a multi-species approach, incorporating other species dependent on talus, rock outcrops, shrubs, grassland, riparian areas, and dry forest ecosystems in the Southern Interior of British Columbia. Snake conservation also should be included in the B.C. Grasslands Recovery Strategy, currently in preparation. A multi-species action plan should include Western Rattlesnake, Gopher Snake, Night Snake, Racer, Rubber Boa, and Western Skink. There is considerable overlap in habitat use by Rattlesnakes, Gopher Snakes, Racers and Night Snakes where their ranges coincide, including hibernating and foraging habitat. Recovery approaches are very similar in draft strategies for the Western Rattlesnake, Gopher Snake and Night Snake and should be implemented in a coordinated manner to achieve greater effectiveness. Habitat protection should prioritize areas where more than one species can be protected on the same land base. Management plans have not been developed for the Racer or Rubber Boa at this time but are likely to have many similarities with the other snakes. Western Skink has been included because it appears to be a major prey item for Night Snakes and uses very similar habitats. A single-species approach may be required to address some knowledge gaps and threats that may be specific to Western Rattlesnakes such as biological/ecological research and threat clarification. Recovery implementation will generally be accomplished through voluntary stewardship and partnerships.

## **Statement on Action Plans**

One or more recovery action plan(s) will be completed by 2012.

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