Recovery Strategy for the Gopher Snake, *deserticola* Subspecies (*Pituophis catenifer deserticola*) in British Columbia

Prepared by the Southern Interior Reptile and Amphibian Recovery Team

BRITISH COLUMBIA
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Ministry of Environment

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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 Gopher Snake, *deserticola* subspecies 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 Gopher Snake, *deserticola* subspecies.

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RESPONSIBLE JURISDICTIONS

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EXECUTIVE SUMMARY

The Gopher Snake, *deserticola* subspecies is a relatively large snake with a tan background colour, dark blotches along the back and sides, a dark facial mask, and round pupils. It is harmless to humans and preys mainly on small mammals, including rodent pests. In Canada, the species occurs in the arid interior of British Columbia within the Okanagan, lower Similkameen, Kettle, Granby, Nicola, Thompson, and Fraser River valleys. The Gopher Snake, *deserticola* subspecies, was listed under the Species at Risk Act (SARA) in 2005 as Threatened.

Gopher Snakes inhabit grasslands, shrub-steppe, deciduous and coniferous woodlands, and other open habitats below 1700 m elevation. Rock outcroppings, talus slopes, and rodent burrows provide important habitat for overwintering sites (hibernacula). Shrub-steppe and riparian areas are used for foraging. Sandy, south-facing slopes are important for egg laying. Each of these habitat components must be available in close proximity to support the species.

The main identified threats to the species are habitat loss, degradation, and fragmentation resulting from land conversions associated with agricultural and urban development. The most productive habitats for Gopher Snakes are at low elevations (below 700 m) in the Southern Interior of British Columbia where development pressure is high. Mortality, through road kill and persecution, are also important threats that affect some local sites.

Gopher Snake 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 voluntary stewardship agreements, conservation covenants, eco-gifts, sale of private lands by willing landowners, land use designations and management, and protected areas.

The **recovery goal** is to maintain self-sustaining populations of the Gopher Snake, *deserticola* subspecies throughout its range within each of four population areas in British Columbia in protected habitats that include access to suitable hibernacula, foraging, mating, and nesting sites.

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

1. Protect a minimum of 16,000 ha of habitat, (15,000 ha provincial or federal; 1,000 private) consisting of suitably connected priority sites with sufficient habitat for hibernation, egg laying, foraging, and seasonal movements to support self-sustaining populations, distributed throughout all four population areas by 2012.
2. Address road kill of snakes at a minimum of three priority sites[1] where road kill observations are clustered, by 2012.
3. Develop and begin to implement a prioritized research program by 2009 to increase knowledge of Gopher Snake distribution, demography, habitat use, movements, and threats so recovery targets can be accurately quantified and critical habitats can be fully described by 2012.

[1] Priority sites include important communal hibernacula, associated foraging and egg-laying habitat, 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.

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 action plans will be developed by 2012.

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Species Assessment Information from COSEWIC

Date of Assessment: May 2002
Common Name (population): Great Basin Gopher Snake
Scientific Name: *Pituophis catenifer deserticola*
COSEWIC Status: Threatened
Reason for Designation: There has been a significant loss of habitat as more agricultural land is converted from range land and shrub-steppe to orchards, vineyards and houses. There has been increased mortality through intentional and accidental killings in agricultural areas. Increasing numbers of roads and traffic also increase mortality rates.
Canadian Occurrence: British Columbia
COSEWIC Status History: Designated Threatened in May 2002. Assessment based on a new status report.

Description of the Species

Gopher Snakes (*Pituophis catenifer*) are large, robust snakes with adults ranging from about 76 to over 180 cm in total length (St. John 2002). The Gopher Snake, *deserticola* subspecies (*P. catenifer deserticola*) is one of several subspecies found in western North America and the only extant form of the Gopher Snake[2] present in British Columbia. The background colour is tan or cream, and a row of dark blotches occurs along the middle of the back and tail with a series of smaller blotches on the sides. Characteristic features that help to distinguish the species from other blotched snakes in British Columbia include a dark mask across the top of the head between the eyes and from the eyes to the back of the jaw, keeled scales along the back but not the sides resulting in a rough texture, and eyes with a round pupil. The Western Rattlesnake (*Crotalus oreganus*) and Night Snake (*Hypsiglena torquata*) have similar blotched patterns but the pupils are vertical. The head of the rattlesnake is distinctly triangular, the blotches are circular, surrounded by light halos, and the tail tip is modified into a rattle. Juveniles of the Racer (*Coluber constrictor*) are blotched and can be easily distinguished from the Gopher Snake by their smooth, unkeeled scales; adult racers do not have blotches.

Gopher Snakes are non-venomous and harmless to humans. They are predators of small mammals including rodent pests that cause agricultural losses. Gopher Snakes are of high significance to First Nations (Secwepemc) groups, mainly due to their environmental, resource management, and educational values (Markey and Ross 2005). Gopher Snakes are considered beneficial in some Secwepemc communities, where they are believed to keep mice away.

[2] Another subspecies, the Pacific Gopher Snake (*P. catenifer catenifer*), is now extirpated from British Columbia.

Populations and Distribution

The Gopher Snake, *deserticola* subspecies is widely distributed in western North America but occurs mostly east of the Cascade Mountains (St. John 2002) (Figure 1). The species reaches its northernmost distribution in south-central British Columbia. In the United States, its range extends eastward to western Colorado and southward to southeastern California and northern Arizona and New Mexico.

In Canada, the species occurs in the dry interior of south-central British Columbia within the Okanagan, Similkameen, Kettle, Granby, Nicola, Thompson, and Fraser watersheds (Figure 2) (Gregory and Campbell 1984; COSEWIC 2002). No comprehensive inventory has been made of Gopher Snake populations, and fewer than 100 occurrences have been reported in British Columbia (COSEWIC 2002). The number of separate populations in B.C. is not clear but four separate populations are tentatively identified 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. COSEWIC (2002) suggests Trail as a fifth population but no sightings of the species have been confirmed in this area so it has not been considered here (J. Dulisse, pers. comm., 2007). The distribution of the Gopher Snake in Washington State is contiguous with those of the southern populations in British Columbia (COSEWIC 2002). Canada has less than 5% of the global distribution of the Gopher Snake, *deserticola* subspecies.

Population trends of the Gopher Snake are poorly understood but are presumed to be declining due to historical and current habitat loss and fragmentation resulting from urban developments, agriculture, and other human uses (COSEWIC 2002). Anecdotal observations suggest population declines throughout much of the species' range in British Columbia (Bertram *et al.* 2001; Hobbs 2001; M. Sarell, pers. comm., 2007).

NatureServe (2005) lists the global status of the Gopher Snake, *deserticola* subspecies as G5T5 (5 denotes widespread, abundant, and secure), nationally in the United States as N5, and nationally in Canada as N3 (3 denotes vulnerable to extirpation). The subnational status ranks are Arizona: S4 (4 denotes apparently secure); Colorado: S4; Navajo Nation: S5; Nevada: S5; Wyoming: S3; and British Columbia: S3.

Figure 1. Global range of the Gopher Snake, *deserticola* subspecies. (Adapted from Hobbs and Sarell 2002.)

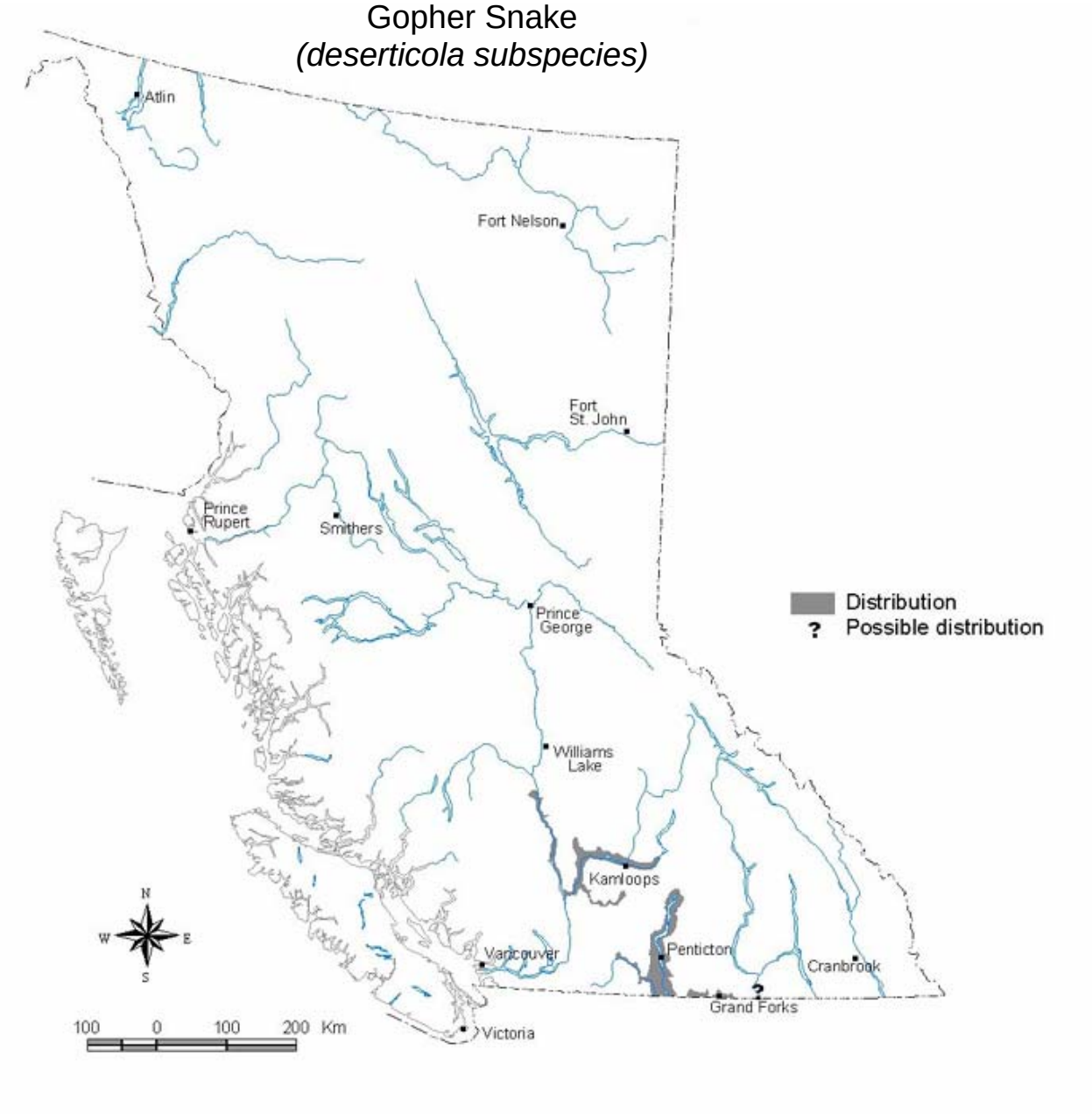

Figure 2. Distribution of the Gopher Snake, *deserticola* subspecies in British Columbia.

Needs of the Gopher Snake, *deserticola* Subspecies

Habitat and biological needs

The Gopher Snake, *deserticola* subspecies is restricted to the arid interior of British Columbia, where it occupies the Bunchgrass, Ponderosa Pine, and Interior Douglas-fir biogeoclimatic zones. The snakes use a variety of open and semi-open habitats (Gregory and Campbell 1984). Valley bottoms and lower slopes below 700 m provide the highest quality habitats, but the species has been found at elevations up to 1676 m in British Columbia (Waye 2000). The Gopher Snake, *deserticola* subspecies requires different seasonal habitats used for hibernation, foraging, and egg laying, which must be close to each other. This species shows a weaker association with rock habitats and has more generalized habitat requirements than the Western Rattlesnake (Diller and Wallace 1996).

Hibernation habitat: Hibernation occurs underground and is associated with a variety of habitat features including cliff, rock outcrops, talus slopes, road or railroad fill, and rodent burrows (COSEWIC 2002). Gopher Snakes often hibernate communally with other snake species, but sometimes hibernate singly or in small groups with other Gopher Snakes (Bertram *et al*. 2001; COSEWIC 2002). Little information exists on habitat use by first-year young, which appear to hibernate separately from adults (Shewchuck 1996) but are sometimes found in communal dens (K. White, pers. comm., 2006).

Foraging habitat: In the spring, the snakes move from hibernation sites to summer foraging areas in grasslands, shrub-steppe, meadows, riparian areas, open ponderosa pine, or other open habitats where they feed primarily on small mammals but also eat lizards and birds or bird eggs (COSEWIC 2002; MWLAP 2004). Marshes and riparian areas with access to sandy ridges with rodent burrows or other shelter appear to provide particularly good foraging habitat (Shewchuk 1996).

Egg-laying habitat: Egg laying occurs in rodent burrows, on talus slopes, in rock fissures, under decaying wood, or in other sheltered sites (reviewed in COSEWIC 2002). Egg-laying sites are often located in open areas exposed to the sun and where perennial vegetation is lacking. Loose, sandy substrate on a south-facing aspect appears to be important (K. White, pers. comm., based on 8 Okanagan sites identified in 2006). Rodent burrows are sometimes modified and enlarged by the female (Shewchuk 1996). Gopher Snakes sometimes lay eggs communally with several individuals including other Gopher Snakes or Racers.

Migration movements: In the spring and autumn, the snakes undertake relatively rapid, directional movements (completed within 1–2 days) between hibernation sites and summer foraging areas (Shewchuk 1996). Migration distances of 0.28–1.3 km have been documented for radio-tagged snakes in British Columbia (Shewchuk 1996; Bertram *et al.* 2001). Most movements were less than 1 km, as also reported for the snakes in the United States (Parker and Brown 1980). Habitat configuration is likely to influence movement distances in particular areas (Shewchuk 1996).

Ecological role

This species is a predator of small mammals, birds, and lizards. They are preyed upon by other species such as skunks, coyotes, weasels, badgers, and birds (COSEWIC 2002).

Limiting factors

Gopher Snakes depend on a variety of different, interconnected habitats for their life history functions, including hibernation, egg laying, and foraging (COSEWIC 2002). Relatively long movements between seasonal ranges and use of several different habitats complicate conservation efforts. Gopher Snakes often hibernate communally with other snakes of the same or different species (COSEWIC 2002). Disturbance to communal hibernation sites has the potential to disturb a large proportion of the population and adversely affect snakes within a broad area surrounding the hibernaculum. Individual home ranges in southern British Columbia were 13.9 ha for females and 5.3 ha for males (Shewchuk 1996). This species occurs at the northern extent of its range where temperature may limit distribution and affect hatchlings, possibly slowing population recovery (COSEWIC 2002).

Threats

Description of the threats

Urban and agricultural development
Known threats with widespread impacts:

- Land conversion to urban developments and intensive agricultural uses, such as vineyards and orchards, results in the loss of essential habitats and is threatening populations throughout the species' range in British Columbia, especially in high-quality valley bottom habitats (COSEWIC 2002).
- Habitat fragmentation resulting from land conversions, associated high density road building, and other human activities are occurring throughout the species' range, potentially impeding movements and isolating populations (COSEWIC 2002). This results in both habitat loss and degradation.
- These threats are widespread and ongoing with a high level of impact on the population and a high level of management concern.

Possible threats with local impacts:

- Quarrying, and utility corridor construction can result in direct mortality and destroy important habitats on local scales.
- Direct mortality from agricultural machinery during haying, tilling, and other crop management activities has been reported from the Thompson–Fraser River region and the Okanagan (COSEWIC 2002). The level of impact from this threat is not clear but may be severe at some sites.
- Causal certainty and severity regarding population impacts from these ongoing threats is poorly understood and requires research.

Road mortality
Known threats with widespread impacts:

- Mortality from road kill has been documented in many areas (Shewchuk 1996; Bertram *et al.* 2001) and can potentially result in excessive loss of breeding adults where roads or railways intersect seasonal habitats or movement corridors between foraging and hibernation sites (COSEWIC 2002). Road mortality can substantially reduce snake populations, as documented for other species (Rosen and Lowe 1994). Gopher Snakes use warm surfaces of paved roads for thermoregulation and are therefore particularly vulnerable to road mortality (Sullivan 1981). This threat is widespread and increasing, with high impacts on local populations and a high level of management concern.

Disturbance and persecution
Known threat with local impacts:

- Persecution by humans occurs in many parts of the species' range as a result of confusion with the venomous Western Rattlesnake (Bertram *et al.* 2001; COSEWIC 2002). Persecution has potential to seriously reduce populations by removing breeding adults and is likely localized in areas of high human density.

Pest control
Possible threats with local impacts:

- Rodent control programs, including the use of poisons, have the potential to cause secondary poisoning in snakes and reduce the availability of both prey and burrows for Gopher Snakes. The level of impact and extent of the threat is not clear and requires research but is estimated to be low over the range of the species and moderate locally.

Fire suppression, intensive grazing, and recreation
Possible threats with local impacts:

- Intensive recreational activities, including use of all-terrain vehicles, have the potential to cause direct mortality, damage habitat, and disturb snakes. At present, these activities are limited in extent in the vicinity of known hibernacula (MWLAP 2004).
- Fire suppression reduces the open nature of habitats, as noted in the Thompson region (COSEWIC 2002); 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).
- Intensive livestock grazing results in the reduction of cover for snakes through removal of vegetation and soil compaction (MWLAP 2004). Intensive cattle grazing potentially degrades habitat in the vicinity of several snake dens on Crown lands (MOE 2005).
- Causal certainty and severity regarding population impacts from these ongoing threats is unknown and requires research.

Actions Already Completed or Underway

The following projects or activities have been completed or initiated for the Gopher Snake, *deserticola* subspecies in British Columbia:

- Investigation of the ecology of the Gopher Snake in the South Okanagan (Nelson 1992).

- Hibernacula inventories and habitat assessment in the South Okanagan/Similkameen (Sarell 1993; Sarell and Haney 1998; Hobbs and Sarell 1999, 2001; Sarell and Alcock 2004; Sarell 2005a); North Okanagan (Macartney 1994; Sarell *et al.* 2004); Boundary (Sarell *et al.* 1998); and Thompson/Fraser areas (Hobbs 2001).
- Establishment of protected areas by the provincial government and land acquisition by non-government agencies, such as the Nature Trust of BC, at some hibernacula.
- A study of life history, movements, and habitat associations in the South Okanagan, as a part of M.Sc. thesis (Shewchuk 1996).
- A study of life history, movements, and habitat associations in the South Thompson area (Bertram *et al.* 2001).
- Establishment of South Okanagan–Similkameen Conservation Program (SOSCP) in 2000; Landscape Recovery Strategy in preparation.
- Snake Smart materials and workshops prepared for, and delivered to, agricultural workers, golf course and campground managers available in Punjabi, Spanish, and English by the South Okanagan Similkameent Stewardship Program in 2006.
- Habitat suitability models prepared for 5 areas in the Okanagan-Similkameen (Warman *et al.* 1998; Sarell *et al.* 2002; Sarell and Haney 2003; Haney and Sarell 2005a; Haney and Sarell, in prep.).
- Twelve wildlife habitat areas (WHA; 2094 ha in total) approved as part of the provincial Identified Wildlife Management Strategy (as of December 2007); 2 in the Arrow Boundary Forest District, 2 in the Cascades Forest District, and 8 in the Okanagan Shuswap Forest District; management recommendations prepared (MWLAP 2004).
- A conservation assessment prepared for the species' entire range in the province (Haney and Sarell 2005b).
- Indicators for monitoring the effectiveness of Gopher Snake Wildlife Habitat Areas identified (Ovaska *et al.* 2004).
- A mitigation plan prepared on the Vernon Military Camp on DND lands (Sarell 2005b).
- Telemetry study addressing movements initiated in 2005 by Canadian Wildlife Service.

Knowledge Gaps

Distribution

- Distribution is poorly known in some areas, such as within the northern portion of the species' range.

Population biology

- Reproductive biology of females (frequency of reproduction; age and size at first reproduction) is limited.
- Demographic parameters, including population sizes and densities survivorship patterns, are poorly understood.
- Meta-population structure and conductivity is unknown.

Habitat use and requirements

- Characteristic descriptions of egg-laying sites and fidelity are limited.

- Migration distances between hibernation and foraging areas and fidelity to particular routes are required.
- The characteristics of hibernation sites and site fidelity, particularly for non-communal hibernacula and juveniles, require clarification particularly in the northern part of the range.

Threat clarification

- The distribution and extent of projected future habitat loss have not been quantified.
- The significance of road and rail mortality to local and regional populations is not quantified.
- Impacts of different intensities of livestock grazing on habitat quality for snakes; how grazing regimes in grasslands correlate with small mammal populations (prey base) is poorly known.
- Extent of mortality from agricultural practices, including mowing or haying, pesticide use (especially for pocket gopher control), and intentional killing are not quantified.

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 substantial. 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, and habitat stewardship programs on private land. It may be possible to mitigate threats due to road mortality through fencing and underpasses. Recovery techniques consist primarily of addressing the threats as outlined.

Recovery Goal

To maintain self-sustaining populations of the Gopher Snake, *deserticola* subspecies throughout its range within each of four population areas (see "Populations and Distribution" section) in British Columbia in protected[3] habitats that include access to suitable hibernacula, foraging, mating, and nesting sites.

Suitable information is not currently available to quantify long-term targets for populations and habitats, including number of individuals and area of habitat required to maintain a viable

[3] Protected habitat is Gopher Snake habitat (see "Habitat and biological needs" section) that is managed to maintain the species over a long period (100+ years). Examples include provincial protected areas, national wildlife areas, private nature conservancies, private land covenants, and other areas with stewardship agreements where written management statements follow best management practices for maintaining this species and its habitat.

population. These knowledge gaps will begin to be addressed over the next 5 years through activities undertaken following 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, which 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.

Recovery Objectives (2008 to 2012)

1. Protect a minimum of 16,000 ha[4] of habitat (~15,000 ha provincial or federal; 1,000 private), consisting of suitably connected priority sites with sufficient habitat for hibernation, egg-laying, foraging, and seasonal movements to support self-sustaining populations, distributed throughout all four population areas by 2012.
2. Address road kill of snakes at a minimum of three priority sites[5] where road kill observations are clustered, by 2012.
3. Develop and begin to implement a prioritized research program by 2009 to increase knowledge of Gopher Snake distribution, demography, habitat use, movements, and threats so recovery targets can be accurately quantified and critical habitats 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.

[4] The habitat protection objective (16,000 ha) provides an interim target meant to provide reasonable and achievable habitat protection for Gopher Snakes 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. A geographic information system (GIS) was used to identify currently known, occupied sites based on clusters of Gopher Snake sightings or rattlesnake dens (used as a surrogate for Gopher Snake dens because of communal use and greater ease of detecting rattlesnakes at dens). The land ownership of occupied sites was identified where possible and areas of suitable habitat were estimated on federal and provincial lands where habitat management could be reasonably influenced based on existing processes (15,000 ha). Targets for occupied sites in key areas where only private land was available were estimated based on existing landowner contact programs in the South Okanagan–Similkameen Conservation Program (1000 ha). This interim target will be revised when new information becomes available. A large portion of the target area overlaps with habitat protection targets proposed for the Western Rattlesnake and Night Snake.

[5] Priority sites include important communal hibernacula, associated foraging and egg-laying habitat, 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.

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 1).

Table 1. Recovery planning table

Objectives	Threats or concerns addressed	Broad approach/ strategy	Priority	Activities
1, 2	Habitat loss and degradation	Habitat protection	Urgent	Analyze available information to identify potential sites for protection and critical habitat (see "Schedule of studies" section)
			Urgent	On federal and provincial Crown lands secure priority habitat through appropriate tools (e.g., protected areas, wildlife habitat areas, management or stewardship agreements, Land Act reserves)
			Urgent	Provide information on priority sites to landowner contact and habitat acquisition programs; encourage voluntary stewardship and conservation acquisitions on private land
			Urgent	Explore conservation options with First Nations groups
			Urgent	Work with municipal, regional, and provincial governments to conserve habitat by using legislative tools, zoning, and planning guidelines (e.g., consideration of Gopher Snake habitat in Official Community Plans, adoption of best management practices or guidelines, and designation of Environmentally Sensitive Development Permit Areas)
1, 2	All threats	Habitat management	Necessary	Develop and promote best management practices for habitat management in Gopher Snake country
			Urgent	Develop and implement mitigation measures to reduce road and rail kill at priority sites, selected through analysis of available information and, where needed, additional study (see "Research")

Objectives	Threats or concerns addressed	Broad approach/ strategy	Priority	Activities
			Urgent	Develop and implement mitigation measures to reduce mortality due to some agricultural management practices and direct persecution.
			Urgent when research is complete	Refine and adjust management of secured sites as indicated by habitat and population monitoring (see "Inventory and monitoring", below)
3	Habitat loss and degradation	Inventory and monitoring	Urgent	Refine and expand spatial coverage of existing habitat suitability models and use them to direct inventory efforts and to identify priority habitats
			Urgent	Inventory areas containing high-quality habitat where the species is suspected to occur to identify new sites for protection
			Necessary	Monitor selected known sites, including those associated with communal hibernacula, to document persistence and status of populations
			Necessary	Monitor condition and key habitat parameters at secured sites
2, 3	Knowledge Gaps	Research	Urgent	Conduct mark-recapture and radio-telemetry studies at selected sites within the northern and southern parts of the range to clarify population demographics, habitat use and potential threats including road mortality, agricultural activities, and habitat management regimes
			Urgent	Collect and analyze road and rail mortality data throughout the range to identify significant mortality areas for mitigation
			Urgent	Conduct population and habitat modeling to quantify conservation targets and population viability
			Urgent	Work with Aboriginal groups to continue identify traditional knowledge about the species
			Urgent	Conduct genetic analyses to clarify population status and meta-population structure, including isolation of subpopulations

Objectives	Threats or concerns addressed	Broad approach/ strategy	Priority	Activities
4	All Threats	Communication & outreach	Necessary	Conduct a community-based social marketing analysis to elucidate attitudes and barriers in target communities toward conservation efforts for the Gopher Snake
			Necessary	Support and help establish community-based conservation initiatives
			Necessary	Ensure that interpretive materials and best management practices are readily available, especially in communities near priority sites and distributed to road and rail maintenance crews, contractors and corporations.
			Beneficial	Increase media exposure of the species, its conservation needs, and benefits to society

Performance Measures

Key performance measures are identified below.

- Have three sites with high road mortality been identified by 2008?
- Has a prioritized research strategy been developed to address knowledge gaps by 2008?
- Has a targeted communication strategy been developed by 2009?
- Have 16,000 ha of habitat been protected by 2012?
- Has road mortality been reduced to sustainable levels at three sites by 2012?
- Have priority research questions been answered by 2012?
- Has sufficient awareness and support for the Gopher Snake recovery been achieved by 2012.
- Has discriminate killing 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. Critical habitat for the Gopher Snake, *deserticola* subspecies will be identified in the action plan(s) as appropriate.

Recommended schedule of studies to identify critical habitat

Additional analyses and fieldwork are needed to accurately identify critical habitat for this species. Studies, which are required to describe the distribution and spatial requirements of the snakes more accurately, will take many years to complete. To speed up the process of critical habitat identification, the following, step-wise approach is recommended.

Table 2. Schedule of studies

Outcome/rationale	Description of the Activity	Timeline
Clarify knowledge gaps, identify habitat suitability, and examine habitat and population connectivity to identify potentially important habitat.	1. Update the B.C. Ministry of Environment (MOE) Gopher Snake database with new information. 2. Clarify traditional knowledge to increase support for recovery. 3. Complete habitat suitability mapping for each population. 4. Conduct a spatial analysis centred on hibernacula to examine habitat and population connectivity.	2008 to 2010
Design and implement inventory and research activities to address knowledge gaps and identify important habitats.	1. Conduct surveys within highly suitable habitat, particularly in the northern portion of the species' range where the snakes appear to hibernate individually, to locate hibernacula and areas with high densities of snakes. 2. Conduct radio-telemetry studies at selected sites to address knowledge gaps relating to habitat requirements (hibernacula, egg-laying sites, foraging areas), travel routes, demographics and threats. 3. Conduct population and habitat modeling (population viability analysis) to determine the number of breeding adults,	2008 to 2012

	and the size and number of areas within the range of each of the four populations needed to support viable population(s).

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 Gopher Snake. (e.g., Kalamalka Lake 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 Gopher Snake will benefit from integrating habitat protection with other snake species, especially Western Rattlesnake, Night Snake and Racer. Protected habitats for Gopher Snake will overlap substantially with protected habitats for other snake species, particularly Western Rattlesnake and Racer.

Effects on Other Species

Several species at risk share habitat with Gopher Snakes, including: the Western Rattlesnake, Racer, Night Snake, Rubber Boa (*Charina bottae*), Western Skink (*Eumeces skiltonianus*), Great Basin Spadefoot (*Spea intermontana*), Prairie Falcon (*Falco mexicanus*), Sage Thrasher (*Oreoscoptes montanus*), Burrowing Owl (*Athene cunicularia*), and Pallid Bat (*Antrozous pallidus*). Habitat protection and stewardship activities outlined in this strategy are likely to benefit these species, particularly other snakes. Potential impacts on prey species such as the Western Harvest Mouse (*Reithrodontomys megalotis*) are likely to be minimal and are part of natural ecosystem processes.

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, long-term targets for populations and habitats 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), pest control (rodents), 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, 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. These species may include Western Rattlesnake, Night Snake, Racer, Rubber Boa, Western Skink, and others. A single-species approach may be required to address some knowledge gaps and threats that may be specific to Gopher Snakes such as biological/ecological research and threat clarification. Recovery implementation will generally be accomplished through voluntary stewardship and partnerships. A multi-species action plan, including all COSEWIC-listed snake species within the range of the Gopher Snake, should be considered.

Statement on Action Plans

One or more action plans will be developed by 2012.

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