

Effectiveness evaluation for wildlife in British Columbia under the Forest and Range Practices Act

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ABSTRACT

Through the Forest and Range Practices Act (FRPA) Resource Evaluation Project (FREP), the Ministry of Forests and the Ministry of Water, Land and Air Protection cooperate to evaluate the effectiveness of practices under FRPA. Responsibilities include Wildlife Habitat Areas (WHAs) for species at risk, and Ungulate Winter Ranges (UWRs). We initiated the development of tools and approaches to effectiveness evaluation for wildlife using a selection of six species from among many potential wildlife candidates. Progress is generally at an early stage, encompassing project definition (mountain goat Oreamnos americanus UWRs), the identification of indicators and monitoring methods (for white-headed woodpecker Picoides albolarvatus, marbled murrelet Brachyramphus marmoratus), and the development of monitoring protocols for testing in pilot projects (for Great Basin gopher snake Pituophis catenifer deserticola, Rocky Mountain and coastal tailed frog Ascaphis montanus, A. truei). The focus in these projects has been on WHAs, but the need to expand to the landscape level is recognized. Two conservation analyses (Great Basin gopher snake, Rocky Mountain tailed frog) will examine the role of WHAs within the spatial context of species habitat across private and public lands and other forms of protected area. Although designed within the context of recovery planning, a similar project for jeffersonii American badger (Taxidea taxus jeffersonii) may also lay a foundation for evaluations at the landscape level. From the initial work on these species, it is hoped that general approaches can be developed which can be used to evaluate protection measures for others of the 39 species at risk and ungulates (8 species) currently covered by wildlife conservation provisions on forest and rangelands in British Columbia. Next steps will include testing and implementing the work to date in pilot projects; expanding to other species and habitat elements; and considering how to address effectiveness evaluations for other management tools.

Keywords: effectiveness evaluation for wildlife; Forest and Range Practices Act; Identified Wildlife Management Strategy; species at risk; wildlife habitat areas; ungulate winter range.

INTRODUCTION

British Columbia's new FRPA applies a more "results-based" approach than the old Forest Practices Code (the code), which directed forest management more prescriptively in British Columbia. Consequently, monitoring is essential to evaluating the success of objectives and standards developed under FRPA.

The Ministry of Forests and the Ministry of Water, Land and Air Protection are responsible for wildlife under the FRPA Resource Evaluation Project (FREP), which was initiated to assess the effectiveness of FRPA (FPRA Resource Evaluation Working Group 2004). We initiated the development of tools and approaches to effectiveness evaluation for wildlife for the FREP program (Ministry of Forests, no date). The particular focus for wildlife includes WHAs for species at risk, and UWRs. WHAs

are mapped areas, established on Crown land regulated by the code and FRPA. They include important habitat, and follow size and configuration criteria in order to meet WHA planning objectives. Any WHA established under the code has been grandparented under FRPA. Legal authority for establishment also remains in place under the new legislation.

The Identified Wildlife Management Strategy (IWMS) was initially developed under the code as a joint conservation program between the Ministry of Environment, Lands and Parks (now the Ministry of Water, Land and Air Protection) and the Ministry of Forests. It is designed to address the habitat needs of species affected by forestry or range practices on Crown land. The strategy serves as part of the provincial response to the National Accord on the Protection of Species at Risk (see Erickson et al. 2004). Volume 1 of the strategy, released in 1999, consists of species and plant community accounts, procedures and management measures for 40 at-risk taxa and plant communities. To date, the strategy is being implemented for 18 of these elements by establishing WHAs with General Wildlife Measures (GWMs), and making recommendations for landscape-level resource management plans.

WHAs are established under the IWMS over areas of important habitat or areas containing important habitat features. Identified Wildlife is a provincial category of species or plant communities that have been determined to require special management of forestry or range practices. The IWMS was established under the code, and continues under FRPA. WHAs are managed through implementation of General Wildlife Measures (GWMs) and objectives. GWMs are required management actions or prohibitions relating to specific forest/range practices such as access, silviculture, range use, and timber harvesting. Examples of management recommendations for Great Basin gopher snake applied under the code and FRPA are shown in Appendices 1 and 2, respectively.

Under the Code (as of February 2004) a total of 160 WHAs covering 49,120 ha were established. Some highlights by species include the 34 WHAs established for marbled murrelet nesting habitat and the 15 WHAs established for Queen Charlotte goshawk (*Accipiter gentilis laingi*) nesting and foraging habitat. The terrestrial habitat needs of several species are now thought to have been met on Crown forest lands, including American white pelican (*Pelecanus erythrorhynchos*), ancient murrelet (*Synthliboramphus antiquus*) and Cassin's auklet (*Ptychoramphus aleuticus*). Important feeding lakes for American white pelican are now covered by 19 WHAs established to prevent disturbance. Breeding colonies for ancient murrelet and Cassin's auklet are similarly protected by 18 WHAs. Additional WHA proposals are in the approval process, including those for Queen Charlotte goshawk, Great Basin gopher snake, Coeur D'Alene salamander (*Plethodon idahoensis*), Queen Charlotte northern saw-whet owl (*Aegolius acadicus brooksi*), western screech owl (*Megascops [Otus] kennicottii macfarlanei*), and prairie falcon (*Falco mexicanus*).

Approval has been received for listing under FRPA the 39 species, subspecies and populations negatively affected by forestry or range practices on Crown land, and listed by the Committee on the Status of Endangered Wildlife in Canada (COSEWIC) as of December 2001 (Table 1). They form a part of a proposed revision of the identified wildlife strategy developed over the last five years. New accounts and measures address the habitat needs of the 39 listed elements (species, species-pairs, subspecies, populations, population units, or plant communities), and are currently proposed for 46 more priority-ranked red and blue-listed elements. All are potentially affected by forest or range practices to a moderate or strong degree.

Table 1. "Category of Species at Risk" in B.C. (established under FRPA by provincial order May 6, 2004).

Fish

Vananda Lake Limnetic Stickleback
Gasterosteus sp. 16
Vananda Lake Benthic Stickleback
Gasterosteus sp. 17

Reptiles

“Great Basin” Gopher Snake Pituophis
catenifer deserticola

Birds

Ancient Murrelet Synthliboramphus antiquus
Burrowing Owl Athene cucularia
Flammulated Owl Otus flammeolus
idahoensis
Great Blue Heron Ardea herodias fannini
Lewis’s Woodpecker Melanerpes lewis
Long-billed Curlew Numenius americanus
Marbled Murrelet Brachyramphus
marmoratus
“Queen Charlotte” Goshawk Accipiter
gentilis laingi
Sage Thrasher Oreoscoptes montanus
Short-eared Owl Asio flammeus
Spotted Owl Strix occidentalis
“Interior” Western Screech-Owl Otus
kennicottii macfarlanei
White-headed Woodpecker Picoides
albolaryvatus
Yellow-breasted Chat Icteria virens

Amphibians

Great Basin Spadefoot Spea intermontana
Tiger Salamander Ambystoma tigrinum
Red-legged Frog Rana aurora
Rocky Mountain Tailed Frog Ascaphus
montanus
Northern Leopard Frog Rana pipiens
Coastal Giant Salamander Dicamptodon
tenebrosus
Coastal Tailed Frog Ascaphus truei
Coeur d'Alene Salamander Plethodon
idahoensis

Mammals

Keen's Long-eared Myotis Myotis keenii
Pacific Water Shrew Sorex bendirii
Fringed Myotis Myotis thysanodes
Badger Taxidea taxus jeffersonii
Vancouver Island Marmot Marmota
vancouverensis
Caribou (3 populations - mountain, boreal and
northern) Rangifer tarandus caribou
Spotted Bat Euderma maculatum
Grizzly Bear Ursus arctos
Wolverine (2 subspecies) Gulo gulo luscus
Gulo gulo vancouverensis

Plants

Scouler's Corydalis Corydalis scouleri
Tall Bugbane Cimicifuga elata

UWRs are areas that contain habitat that is necessary to meet the winter habitat requirements of an ungulate species. UWR management has been ongoing for more than 20 years in some portions of the province. Formal legal establishment of UWRs and associated objectives began under the code, and FRPA provides for continued establishment. UWRs are based on our current understanding of ungulate habitat requirements in winter, as interpreted by the Ministry of Water, Land and Air Protection regional staff and based on current scientific and management literature, local knowledge and expertise.

FRPA provides continuity from the Code with the declaration of a Category of Ungulate species (Table 2) for use in UWR establishment. The purpose is to provide the habitat requirements for the winter survival of these animals, such as sufficient forage and forest cover for thermal protection and snow interception. As of September 2004, a total of 18 UWRs had been officially established, conserving seven species with a total area of 919,463 ha. Most of this total is comprised in one large UWR (803,306 ha) for Mountain Caribou in the Omineca region.

Table 2. Provincial category of ungulate species for winter range designation (established under FRPA by order May 6, 2004).

Ungulate species

Mule, and Black-tailed deer Odocoileus hemionius
White-tailed deer Odocoileus virginianus

Elk *Cervus elaphus*

Mountain Goat *Oreamnos americanus*

Caribou *Rangifer tarandus*

Bighorn sheep *Ovis canadensis*

Thinhorn sheep *Ovis dalli*

Moose *Alces alces*

Approach to the development of effectiveness evaluations

Our purpose is to initiate the development of tools and approaches to effectiveness evaluation. We have outlined seven steps in the process of effectiveness evaluation for wildlife areas:

1. Develop key effectiveness monitoring questions
2. Review and select appropriate indicators to address monitoring questions
3. Develop monitoring protocols for routine, extensive and intensive indicators
4. Pilot test monitoring protocols
5. Revise protocols as necessary
6. Implement protocols on a regional basis
7. Develop recommendations for changes to species management.

The main objective of the WHA effectiveness evaluations is to determine whether an established, or, in some cases, proposed WHA, is achieving its intended goals and objectives. Generally the goals of a WHA are to minimize disturbance of important habitats, often during important life history stages (e.g., breeding), and maintain the habitat conditions and features necessary for continued, successful use by the target species. Ultimately, the question is whether the WHA meaningfully contributes to the conservation of the species at risk by maintaining habitat and the use of the area.

FREP implements a three tiered approach consisting of routine, extensive and intensive effectiveness evaluations, defined as follows (Ministry of Forests, no date).

1. Routine: low intensity overview evaluations that use indicators that can be obtained at most sites (relatively simple qualitative measures, such as visual estimates and yes/no answers).
2. Extensive: moderate intensity evaluations that include categorical data collection (rapid collection of quantitative data) by visual estimation of specified indicators at randomly selected sites
3. Intensive: detailed evaluations that involve quantitative data collection and analysis with comparison to controls.

In addition to examining the effectiveness of individual WHAs, there is a need to consider how well all WHAs and landscape-level provisions are meeting the stated species objectives. It should be possible to evaluate the effectiveness of WHAs across population ranges, both regionally and provincially. In this way, both the contribution of WHAs to the conservation of the species at risk and potential recommendations for improvement can be addressed.

Progress in the development of wildlife effectiveness evaluation

The process of evaluation development was initiated for a selection of six species from among many potential wildlife candidates. The ultimate intention is to test whether WHAs or UWRs for these species are achieving intended goals and objectives. The specific focus has been on WHAs: whether they are maintaining important habitats, whether they continue to be occupied by the species, and whether their location, configuration and size are adequate to achieve management objectives.

Progress is generally at an early stage, encompassing project definition (mountain goat *Oreamnos americanus* UWRs), the identification of key questions, indicators and potential monitoring methods (white-headed woodpecker *Picoides albolarvatus*, marbled murrelet *Brachyramphus marmoratus*), and the development of monitoring protocols for testing in pilot projects (Great Basin gopher snake *Pituophis*

catenifer deserticola, Rocky Mountain and coastal tailed frog *Ascaphis montanus*, *A. truei*). The initial focus has been on WHAs, but the need to expand to the landscape level is recognized. Two conservation analyses (Great Basin gopher snake, Rocky Mountain tailed frog) will examine the role of WHAs within the spatial context of species habitat across private and public lands and other forms of protected areas. Although designed within the context of recovery planning, a similar project for *jeffersonii* American badger (*Taxidea taxus jeffersonii*) may also lay a foundation for evaluations at the landscape level. Final reports resulting from these projects will be posted under Wildlife on the FREP effectiveness evaluation website (Ministry of Forests, no date: see http://www.for.gov.bc.ca/eefinder/3-11_wildlife.asp).

From the initial work on these species, it is hoped that general approaches can be developed and applied to other species covered by wildlife conservation provisions on forest and rangelands in British Columbia. The two projects developing monitoring protocols for snakes and tailed frogs expand on preliminary work that identified key effectiveness monitoring questions and ranked appropriate indicators. The two projects will advance these preliminary recommendations by:

- Refining the monitoring questions;
- Expanding on recommended methodologies for measuring indicators;
- Framing the sample design;
- Defining effectiveness for the species and WHA; and
- Testing draft protocol recommendations.

An example of indicator development: Great Basin gopher snake Wildlife Habitat Area sampling protocol

Great Basin gopher snake WHAs are established to maintain important habitat features for snakes by guiding forest and range management practices within defined areas surrounding these important features. Specific monitoring objectives of a Great Basin gopher snake WHA effectiveness evaluation might include:

- Confirming continued presence of Great Basin gopher snakes within WHAs
- Confirming continued suitability or improvements in Great Basin gopher snake habitats and habitat features within WHAs and their use by Great Basin gopher snakes
- Documenting and evaluating threats/risks to Great Basin gopher snake populations within WHAs and in the areas immediately surrounding a WHA
- Evaluating accessibility of important habitat features and habitats that may not be within WHAs, and
- Assessing mortality risk and population security (viability) within WHAs.

Important questions to consider in an effectiveness evaluation directly relate to the objectives of a WHA: whether a WHA is effective at maintaining snake use of the important habitat features, and, more importantly, how WHAs contribute to maintaining healthy snake populations in British Columbia.

Step 1: Develop key effectiveness monitoring questions

As the first step, the Great Basin gopher snake monitoring project will address the following key monitoring questions:

1. Do WHAs provide habitat features to meet the life history requirements of the Great Basin gopher snake?
2. Are the key habitat features within the WHA used by Great Basin gopher snakes?
3. Are secure travel routes available between important habitats (such as egg-laying, denning, and foraging areas) within the WHA?
4. Are secure travel routes available for dispersal of snakes to and from the WHA?
5. Does the WHA act as a population “sink” for snakes (now or in foreseeable future) and can mortality be reduced?
6. What is the sub-population status and trend compared to other sub-populations within the region, and is the sub-population using the WHA considered to be viable over the long-term?

7. Is habitat connectivity and gene flow among regional populations maintained?
8. Do WHAs and GWMs contribute to maintaining regional snake populations?

Step 2: Review and select appropriate indicators to address monitoring questions

Generally, a routine evaluation is the first level of assessment in an effectiveness evaluation and may or may not be followed by a more extensive or intensive evaluation. Although routine evaluations can be conducted independent of a extensive evaluation, for the purposes of evaluating WHAs the routine and extensive evaluation will be conducted together to make an assessment of the effectiveness of a WHA. The majority of routine indicators for evaluating WHAs are measured through spatial GIS analysis. These will be followed by an extensive field evaluation. Both routine and extensive indicators may signal an early warning of the need for more intensive monitoring. The following routine and extensive indicators for Great Basin gopher snake were selected based on a detailed review of potential indicators and their relevance to the key monitoring questions (Ovaska and Sopuck 2004). Routine and extensive indicators for Great Basin gopher snake effectiveness evaluation are shown in Table 3.

Indicator	Description	Monitoring question	Priority for monitoring
Road density	Index of fragmentation and road mortality risk	7	High
Road mortality	Index of the impact of roads on snake populations	3, 4	High
Land use	Index of habitat loss, alteration and fragmentation from human uses	7	High
Land status	Index of protected area vs private and available options for conservation	7	High
Catastrophic fire - historic	Index of habitat alteration and potential mortality risk from ‘natural’ disturbance	7	High
Catastrophic fire – likelihood	Risk of fire within or adjacent to WHA	5	High
Den occupancy	Index of status of regional populations and confirmed continued use of WHA by snakes	2, 5, 6	High
Habitat feature disturbance	Index of habitat quality and integrity.	1, 5	Moderate
Vegetation condition	Index of habitat quality specifically maintenance of important habitat features	1	Moderate
Shelter & egg-laying habitat availability	Index of quality & density of potential breeding and cover objects for snakes.	1	Moderate
Snake disturbance & persecution	Indication of snake sightings and possible persecution incidence	5	Low

An effectiveness evaluation should consider the area surrounding a WHA in order to determine outside influences from adjacent management or land use, and to help evaluate causes of success or failure. Therefore effectiveness will need to be defined for several spatial scales: WHA, local and population, and most likely also on the provincial scale.

There are five routine Great Basin gopher snake WHA indicators which are considered high priority for monitoring, and are derived from GIS spatial analysis (Table 4).

Table 4. Routine indicators for Great Basin gopher snake effectiveness evaluation

Indicator	Measure	Scale	Monitoring
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			Frequency
Road density	km of primary paved, secondary paved, unpaved and railway	population, local & WHA	5 year
Land use	ha in urban, agricultural, forestry, ranching, mining. Summarize as percent area for each land use.	population, local & WHA	5 year
Land status	ha of crown, IR, private and protected lands	population, local & WHA	5 year
Catastrophic fire - historic	ha of protected areas and WHAs affected by fires of different intensities. Summarize as percent	population	5 year
Catastrophic fire – likelihood	ha of high, moderate, low categories of likelihood of fire	Local & WHA	5 year

There are five indicators (Table 5) that require field sampling, knowledge of snake biology, species identification, and sampling standards (Resources Inventory Committee 1998). Methods are still under development for sampling field based indicators. Snake disturbance and persecution by humans is a further indicator derived from questionnaires or surveys of locals.

Table 5. Extensive and routine indicators for Great Basin gopher snake effectiveness evaluation from field sampling

Indicator	Measure	Monitoring Frequency	Scale	Method
Road mortality	# of road-killed snakes per km	2 x / year	Local, WHA	Transect sampling
Den occupancy	# and species of snakes within 50m of den entrance	3 years	Population, WHA	Qualitative assessment
Habitat feature disturbance	observations, t.b.d.	3 years	WHA	Presence/not detected
Vegetation condition	Height of key herbaceous species Structure & type of vegetation Properly functioning condition	3 –5 years	WHA	Stratified random sampling of plots
Shelter & egg-laying habitat availability	#, type (rodent burrow, CWD, rock, talus) and size of cover objects	3-5 years	WHA	Transects stratified by habitat
Snake disturbance & persecution	# snake encounters # persecution events	annually	Local, WHA	Interviews or questionnaires

Ideally, effectiveness should be defined prior to implementing an evaluation. The conceptual base for both effectiveness and thresholds could be a product of consultations between MWLAP and the Recovery Team/Recovery Implementation Group for the species at risk. Effectiveness definitions could use thresholds for selected indicators organized into functional categories. Preliminary conceptual definitions of effectiveness for Great Basin gopher snake WHAs are as follows:

Effective or functioning:

- a) Habitat conditions within the WHA are likely to remain suitable/stable or possibly improve and where key habitat features will likely be maintained in abundance;
- b) Site continues to be used by species and populations appear stable; and

c) The WHA is likely to withstand changes from all but catastrophic events.

Functioning but at risk:

- a) Conditions within the WHA may be stable or result in short term declines;
- b) Key habitat elements may be limiting productivity; and
- c) The WHA may not withstand disturbances.

Functioning but at high risk:

- a) Conditions are likely to result in declines;
- b) Key habitat elements are limiting productivity; and
- c) The WHA is unlikely to withstand disturbances.

Not effective or non-functioning:

- a) Conditions are likely resulting in significant declines;
- b) The species will likely be extirpated from the WHA; or
- c) The WHA is acting as a population sink; and
- d) Successful immigration is unlikely.

These four categories are organized by relative impairment of function and possible management intervention. “Functioning but at risk” (above) denotes that there is cause for concern about practices. “Functioning but at high risk” represents significant concern about practices. A major impact has occurred when a site is deemed “Not effective or non-functioning”. Scoring of impact assessment results from routine-level indicators will provide a quantitative basis for these assignments.

Step 3: Develop monitoring protocols for routine, extensive and intensive indicators

Both the development of monitoring protocols for routine and extensive indicators, and testing them in a pilot project are within the current scope. The descriptions of the indicators from the tables above go a long way toward the protocol, and definitions of the indices, etc. and will in many cases define portions of the protocol.

Intensive indicators are not within the current project scope, so are dealt with here only at the first two steps. However WHAs require more intensive monitoring when routine and extensive indicators signal an early warning of risks and the potential decline of values. Intensive evaluations are only recommended for those WHAs that are either not effective or not fully effective. Preliminary intensive indicators for Great Basin gopher snake effectiveness are shown in Table 6.

Table 6. Preliminary intensive indicators for Great Basin gopher snake effectiveness evaluation

Indicator	Description	Monitoring question	Priority to monitor
Movement and habitat use patterns	Tracking seasonal movements, home range size and habitat use by radio-tagged snakes	1, 2, 3, 4	High
Relative abundance	Relative abundance of snakes at selected WHAs measured for each regional population	5, 6	Moderate
Reproductive and recruitment rates	% of females gravid; recapture rates/proportion of young in samples	5, 6	Moderate

Next Steps

The work outlined in the Great Basin gopher snake example, on refining the key monitoring questions and reviewing appropriate indicators, will set the scene for the remaining steps for the process of effectiveness evaluation development. Monitoring protocols will be developed for the indicators (Step 3). They will be tested in pilot projects (Step 4), revised as necessary (Step 5), and implemented on a regional basis (Step 6). From this experience, recommendations will be made as necessary for changes to species management (Step 7). Over time, evaluations for these species will be implemented by operations staff, and the approach will be expanded to other species, habitat elements; and management tools.

An added dimension for the future may be involvement of forest licensees (tenure holders) in effectiveness monitoring programs. Currently, for example, Canfor has been involved on the British Columbia coast in adaptive management/effectiveness monitoring for marbled murrelet and Queen Charlotte goshawk (Manning et al. 2004), and in British Columbia's central interior for mountain goat. Under the FRPA, licensees will be involved in planning to meet wildlife objectives, providing that:

- These objectives have not already been addressed by a WHA, UWR, GWM, or wildlife habitat feature;
- They have been notified regarding the amount, distribution, and attributes of wildlife habitat.

With these criteria being met, Forest Stewardship Plans must specify a result or strategy with regard to the wildlife objectives. It is discretionary whether licensees commit to monitoring the effectiveness of these results or strategies, but experience to date suggests that they may do so.

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APPENDIX 1. 1999 WILDLIFE HABITAT AREA MANAGEMENT RECOMMENDATIONS FOR GREAT BASIN GOPHER SNAKE APPLIED UNDER THE CODE

Goals

- Maintain denning habitat and dispersal routes.
- Minimize disturbance and mortality, particularly road mortality, near snake hibernacula.
- Maintain critical structural elements such as wildlife trees, coarse woody debris and rock outcrops and concentrations of boulders.
- Minimize disturbance to riparian areas to maintain foraging opportunities.
- Maintain microclimatic conditions of hibernacula.

Measures

Access

- Place roads as far as practicable from hibernacula and known snake dispersal routes. Avoid construction between April and October when snakes are active unless the district manager and regional fish and wildlife manager are satisfied there is no other practicable option and the variance is approved by the district manager and regional fish and wildlife manager.
- Rehabilitate temporary access roads immediately after use.
- Where determined to be necessary by MELP, use snake drift fences and drainage culverts where known dispersal routes cross roads to divert snakes from high mortality areas. Drift fences should be approximately 50 cm high. Length will vary by site depending on area used by snakes. Consult MELP for more information. Seasonal use restrictions may be appropriate for some roads.
- Do not remove rock or talus.

Range

- Do not allow cattle to concentrate (i.e., do not use water troughs, salt blocks, or corrals or drive cattle through WHA) during spring dispersal (March/April) and fall aggregations as specified by MELP.
- When hay cutting or prescribed burning is planned, consult with MELP for the preferable times (i.e., after snakes have returned to dens).
- Avoid soil compaction and maintain understorey vegetative structure in riparian areas.
- Recreation
- Do not establish recreation sites within WHA.

APPENDIX 2. 2004 WILDLIFE HABITAT AREA MANAGEMENT RECOMMENDATIONS FOR GREAT BASIN GOPHER SNAKE APPLIED UNDER FRPA

Goals

- Maintain and link denning and foraging habitat, travel corridors, and egg-laying sites within and between adjacent populations.
- Minimize disturbance and mortality, particularly road mortality.
- Maintain critical structural elements such as rock outcrops, talus slopes, friable soils, coarse woody debris, friable soils, rodent burrows, concentrations of boulders, or other unconsolidated materials and vegetative cover.
- Maintain microclimatic conditions of hibernacula.
- Maintain moderate to dense cover to conceal snakes and maintain foraging opportunities.
- Maintain WHA in a properly functioning condition.

Measures

Access

- Place roads as far as practicable from hibernacula and known snake travel corridors. Avoid construction between April and October when snakes are active. When recommended by MWLAP, rehabilitate temporary access roads immediately after use or gate less temporary roads to reduce traffic.
- Where determined to be necessary by MWLAP, use snake drift fences and drainage culverts at intersections of roads and known travel corridors. Drift fences should be ≥ 75 cm high. Length will vary by site depending on area used by snakes. Consult MWLAP for more information. Seasonal use restrictions may be appropriate for some roads. Do not remove or disturb rock or talus.

Harvesting and silviculture

- Do not harvest within 200 m of den sites. Retain coarse woody debris.

Pesticides

- Do not use pesticides.