12. A Bat Hibernaculum

1) Definition

A bat hibernaculum (plural: hibernacula) means a site where one or more bats hibernate in winter. Figure 43 shows the entrance to a cave hibernaculum.

Figure 43. Townsend's Big-Eared Bat hibernaculum located in a cave. (Photo: Anna Roberts)

2) Importance of a Bat Hibernaculum

A bat hibernaculum is a site where bats hibernate over the winter. A specific hibernaculum may only be used for part of the winter and may or may not be used every year. The lack of use in a given year does not mean that the hibernaculum has been abandoned. Hibernacula occur most often in caves (Figure 43), rock or cliff crevices (Figure 44), or abandoned mines. ***Note: Only naturally occurring bat hibernacula are considered wildlife habitat features.***

Hibernacula provide cold, constant temperatures and protection from weather and predators. Rock features with suitable characteristics for hibernation by bats are relatively scarce across the landscape and therefore are typically used by several species of bats at once.

The cool, moist microclimate of a hibernaculum allows bats to enter a torpid state where breathing rate, metabolic rate and heart rate are significantly decreased from active levels and body temperatures drop to match the air temperature. Bats naturally awaken infrequently over the winter from this torpid state. Recent work on wintering bats in British Columbia has revealed that bats are far more active in winter than previously assumed. Movements appear to occur during warmer periods in winter. During these periods' bats may move to different roosting areas within the hibernation site or move outside the underground feature to roost in adjacent large roost trees

within 500 m of a hibernaculum opening. Like summer roost trees, winter trees tend to be large, with dbh >50 cm, showing moderate decay with decay class 2-5, and with defects or features that provide roosting sites for bats. Although it is still unclear how many winter tree roosts are required, the features appear to be important for some bat species.

Human disturbance such as presence, noise or changes in site conditions can cause awakening and arousal of bats in winter. These disturbance-related arousals deplete a bats' limited energy reserves. Continued disturbance to bats during hibernation can prove fatal by causing bats to starve once their energy reserves are depleted.

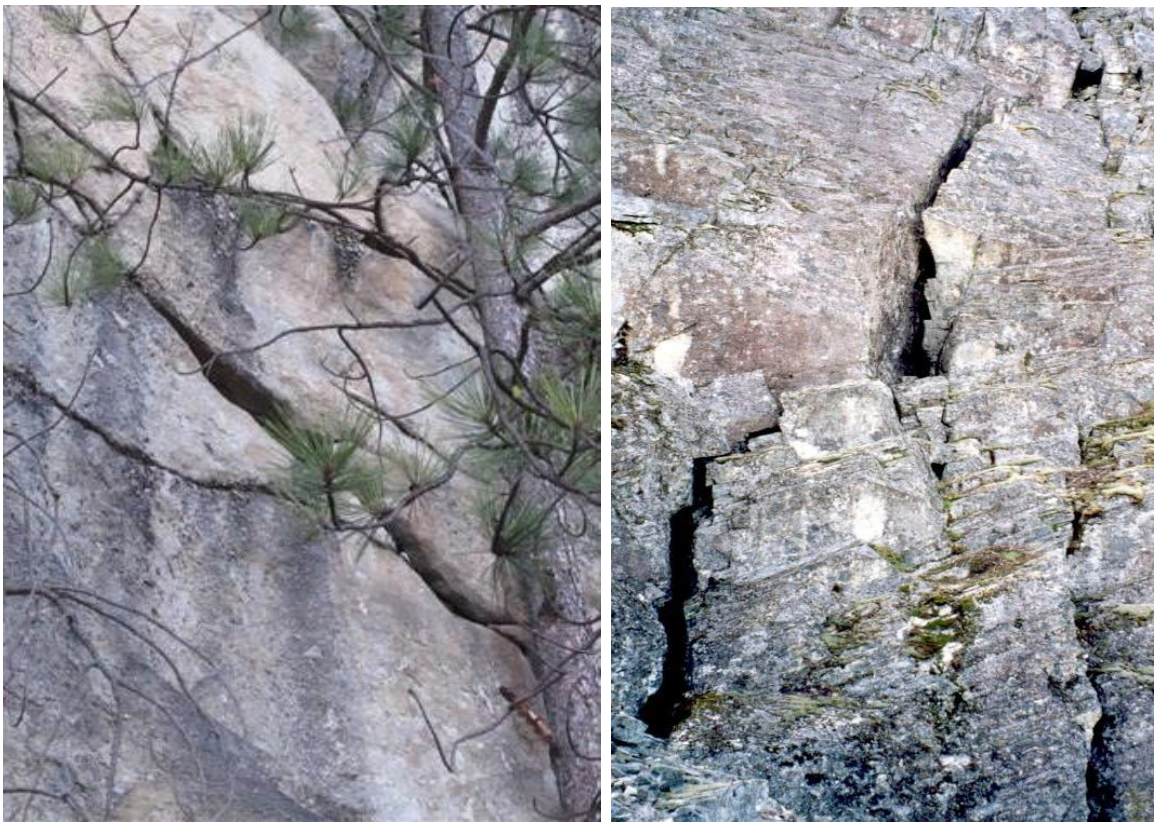

Figure 44. Bat hibernacula in cliff crevices. (Photo: (left) Cori Lausen, (right) Province of British Columbia)

Secure hibernacula are important for protection of bats from white-nosed syndrome. White-nose syndrome is a disease that affects hibernating bats and is caused by an introduced fungus, *Pseudogymnoascus destructans*, or Pd for short. The Pd fungus and white-nose syndrome has resulted in the death of millions of bats across North America since it was first detected in 2006. In affected hibernacula, documented overwinter mortality rates of little brown myotis was 90-95% and Northern myotis (Figure 45) up to 98%. Although white-nose syndrome has not yet been detected in British Columbia, it has been detected in Washington State. Do not enter a hibernaculum without consulting a qualified professional biologist with specific and current experience with bats (herein referred to as a bat specialist) and ensuring use of the most up-to-date protocols for limiting the spread of infection.

Figure 45. Northern Myotis exhibiting symptoms of white-nose syndrome. (Photo: Kirstin Alvey-Mudd)

3) What to Look For

Thirteen of British Columbia's fifteen recorded bat species hibernate within the province (Table 44).

The entrances of bat hibernacula may be large and conspicuous, such as a cave or a large fissure in a rock face. Alternatively, entrances may be small and easily overlooked, such as a ground sinkhole or a narrow rock crevice. In underground features such as caves, the pattern of use may depend on bat species. Microclimate within the hibernation site is critical for bats. Generally, bats prefer temperature ranges above freezing but less than about 9°C, with high relative humidity. Bats are sensitive to water-loss during hibernation, so increases in airflow can result in dehydration. As more is learned about bats it is becoming apparent that there may be species-specific micro-climate requirements. Table 45 summarizes what to look for when identifying bat hibernacula.

Crevice habitat may be very important to wintering bat populations however our current understanding of how bats use crevices in winter is limited. Recent work in the Kootenay Boundary Region found bats roosting in rock crevices. Crevice habitat used by wintering bats requires an entrance at least 1-2 cm wide (or larger) and must run deep enough underground to provide roosting spaces below the frostline with stable, cold temperatures above freezing. One limited study found that bats may prefer rock crevice features on cool aspects (north and northeast-facing). Further information is needed to accurately classify winter crevice-habitat for hibernating bats, but its importance should be noted. As well, in coastal British Columbia, bats may overwinter in very large diameter trees with defects that offer roost spaces. Bats, including little brown myotis, have been found wintering in spaces under root wads.

If an entrance is large enough, cautiously inspect the suspected hibernaculum by shining a flashlight into the chamber to look for evidence of use including presence of live or dead bats, urine staining, and possibly small amounts of bat guano or insect parts on the floor of the hibernaculum. Table 46 summarizes the types of evidence of use that may be visible at a hibernaculum site.

Table 44. Bat conservation status and distribution of hibernating bat species by region in British Columbia.[1]

Species	Conservation Status (COSEWIC/ British Columbia)	Region							
		Cariboo	Kootenay Boundary	Northeast	Omineca	Skeena	South Coast	Thompson Okanagan	West Coast
Pallid Bat (*Antrozous pallidus*)	Threatened/ Red-listed		X					X	
Townsend's Big-eared Bat (*Corynorhinus townsendii*)	Not assessed/ Blue-listed	X	X				X	X	X
Big Brown Bat (*Eptesicus fuscus*)	Not at risk	X	X	X	X	X	X	X	X
Spotted Bat (*Euderma maculatum*)	Special Concern/ Blue-listed	X	X					X	
Silver-haired Bat (*Lasionycteris noctivagans*)	Not at risk	X	X	X	X	X	X	X	X
Californian Myotis (*Myotis californicus*)	Not at risk	X	X			X	X	X	X
Western Small-footed Myotis (*Myotis ciliolabrum*)	Not assessed/ Blue-listed	X	X					X	
Long-eared Myotis (*Myotis evotis*)	Not at risk	X	X	X	X	X	X	X	X
Little Brown Myotis (*Myotis lucifugus*)	Endangered/ Not assessed	X	X	X	X	X	X	X	X
Northern Myotis (*Myotis septentrionalis*)	Endangered/ Blue-listed	X	X	X	X	X			
Fringed Myotis (*Myotis thysanodes*)	Not assessed/ Blue-listed	X	X				?	X	?
Long-legged Myotis (*Myotis volans*)	Not at risk	X	X	X	X	X	X	X	X
Yuma Myotis (*Myotis yumanensis*)	Not at risk	X	X			X	X	X	X

[1] Modified from Best Management Practices for Bats in British Columbia (2016).

Table 45. Bat hibernacula: what to look for.

Description of a Bat Hibernaculum
Temperature: A key feature of hibernacula is stable temperature. Generally preferred temperatures are above freezing and below 9°c. Preferred temperature range may vary by species. **Relative Humidity:** Most bats prefer very high relative humidity (90-100%) within hibernation sites. Preferences may be species specific based on a species' tolerance to water loss. **Airflow:** Prefer sites with very little airflow to limit water loss. **Light levels:** Hibernacula are generally dark. **Disturbance:** Hibernacula are secluded sites with little disturbance from human activity. **Size:** Size of hibernacula varies widely. There seems to be no pattern regarding size. Depth of underground features ranges from as little as 30 m to depths of 150-700 m underground. **Caves and caverns:** Most caves in British Columbia occur in karst features. Other caves and caverns can form depending on the geomorphology of a region. How and where bats roost within the feature may be dependent on bat species. Bat use may also vary depending on the depth and structure of the feature. • size of openings used by bats is highly variable • sites where openings are covered by vegetation may not be useable by bats • bats generally avoid sites that flood, although cave hibernation sites often have interior water sources **Rock crevice/erosion crevice:** Rock crevices in any type of rock may function as a hibernation site for bats. Erosion crevices may occur in river banks where deep cavities form in soils that have durable matrices with high clay content that form a stone-like consistency when dry. • a crevice/fissure must be 1-2 cm wide or more • must provide a protected, dark, quiet area • must run deep enough under the frostline to have stable temperatures **Root wad/Trees:** Little brown myotis have been found hibernating in a cavity under a large stump in a root wad. Recent work in the Kootenay Boundary region found a group of bats using both a rock crevice for hibernation as well as a nearby large ponderosa pine. It is unknown how commonly bats use trees as winter roosts. Winter tree hibernacula likely require similar characteristics as summer nursery roosts. • moderate decay (tree classes 2–5) • large diameter (>50 cm dbh in the interior dry zones and >70 cm dbh on the Coast and Interior Cedar–Hemlock zone). • vertical hollow cavity accessed via a stem scar or woodpecker excavations • deep stem cracks; hollows created at points where branches have broken off at the bole • any defect that results in a crevice 1-2 cm wide (or more) and 10 cm deep (or more) • peeling bark is unlikely to provide adequate site conditions in winter

Table 46. How to determine if a bat hibernaculum is occupied.

Identifying an Occupied Hibernaculum
Bats flying at an entrance: • In autumn, at dusk, bats may be seen emerging from, or flying around, the entrance to underground features. • Sites with a great deal of bat activity in the fall may indicate a "swarming site", where bats congregate for pre-hibernation courtship and mating. • Bats may also use swarming sites for hibernation. The presence of autumn bat activity may indicate the location of a hibernaculum. **Bats present:** • The presence of live bats (Figure 46) or dead bats/bat bones (Figure 47) indicates the presence of bats. • Hibernating bats may cluster together in groups (possibly to maintain water balance); clusters may be obvious on ceilings or walls. • Other species may roost singly and may jam themselves into small cracks or spaces in the walls of the hibernaculum and may be very challenging to find. • Groups of bats may consist of a single species or multiple species. **Bat guano (feces):** • Small amounts of bat guano may be present (Figure 48). While bats do not generally forage or eat during the hibernation period, in late fall, bats may still forage and return to roost inside the hibernation site. • Bat guano is similar in size, shape and colour to mouse droppings; however, bat guano pellets easily crush into a rough powder of undigested insect parts (especially indigestible hard bits of exoskeletons, wings and legs). Mouse droppings are typically hard and claylike. **Urine stains:** • There may be visible urine staining on roost surfaces (although staining may be limited). • Stains may be white or brown and concentrated in the roosting area (Figure 49) **Discarded food items:** • Bats eat the soft, nutritious parts of their insect prey but discard the wings, heads and legs. • Insect parts on the floor of the site may be an indication of the presence of bats. **Body Oil Staining:** • Bat fur contains oils that may leave a residue or mark on roost surfaces. • These darkened areas are usually where bats have roosted for many years. If occupancy is not easily determined from these signs or methods, confirming occupation will require the services of a bat specialist. The methods used by bat specialists require specialized training and equipment.

Figure 46. Cluster of hibernating bats. (Photo: Martin Davis)

Figure 47. Signs of bat occupancy in a cave or rock crevice may also include dead or live bats or bat skeletal remains. (Photo: Martin Davis)

Figure 48. Bat guano from two species, Big Brown Bat on the left and slightly smaller Little brown bat on the right. (Photo: Cory Olson)

Figure 49. Staining from roosting bats. (Photos: Martin Davis)

Management activities around hibernacula have the potential to negatively affect a hibernaculum. Blocking or damaging the entrances to hibernacula can prevent bats from entering them or change the microclimate of the roost (e.g., air flow can be affected by changes to an entrance) thereby rendering the sites unsuitable. Care must also be taken in the immediate area above ground at a hibernation site for bats. Above ground removal of vegetation or changes in drainage patterns can significantly affect the features below ground and possibly change the microclimates available to bats in the underground feature. This is especially important at sites in karst features. Table 47 summarizes information to consider when conducting primary forest activities near a bat hibernaculum.

Table 47. Information to consider when conducting primary forest activities near a bat hibernaculum.

Information to Consider
• The hibernation period for bats occurs between November 1 and April 1, however there may be tremendous variation among regions, between years, and among species. When available, local information should be used to inform timing windows for management. • Establish the total hibernaculum area by describing a polygon that encompasses the entire area of the underground feature and all portals. • Establish a buffer around the hibernaculum polygon. • Incorporate the hibernaculum and buffer into a forested retention area or other retention patch. • Do not harvest or salvage trees within the retention area without first consulting a bat specialist. • Minimize adjacent disturbance during critical times, generally November 1 to April 1. • Consider installing a bat-friendly gate or other means of limiting human disturbance/access to known hibernacula. • Establish additional special management zone outside of the core area to avoid disturbances that may affect the functionality of the hibernaculum. • Develop prescriptions to ensure harvest management adjacent to the core area protects it from windthrow. • Conserve understory vegetation along core area boundaries and leave some green trees in the adjacent opening, especially near the edge of the patch. Removal of all vegetation may alter air flow or hydrology in the area, rendering the temperature or humidity conditions of the hibernaculum unsuitable. • Blasting may occur during periods when bats are not occupying the hibernaculum, however, ensure that the hibernaculum habitat is not degraded. Blasting itself is variable in intensity and effect. Larger blasts close to a feature have a different effect than small blasts further away. For a bat hibernaculum located within a karst landscape: o Establish a minimum two-tree-length reserve (based on the average height of the dominant and co-dominant trees at 100 years) extending outward from the mouth of the cave entrance; o Design an adjacent management zone of an appropriate size to protect the reserve from windthrow; o Maintain understory vegetation along reserve boundaries and leave some green trees in the adjacent opening, especially near the edge of the reserve. These measures help maintain interior microclimatic conditions and inhibit the encroachment of edge species into the interior habitat of the reserve • For more details on managing bat hibernacula located within a karst landscape refer to the *Karst Management Handbook for British Columbia* (Section 5) and the *Best Management Practices for Bats in British Columbia* (Chapters 2 and 3).

Construction of bat-friendly gates in portals of known roosts is often considered to control access for people because of safety and liability considerations. Gates should only be installed when necessary as they can disrupt airflows and may prevent access for some bat species if improperly installed. There are numerous options for bat-friendly gates. Appropriate gate design is site-specific due to the variation in bat species, the size and type of opening for the gate, and the geomorphology of an area. Any bat-gate installation should involve a bat specialist. There are numerous sources of information on the variety of gate designs available. Bat Conservation International (www.batcon.org) continues to be one of the best resources.

4) Regional Information – Kootenay Boundary

In this section, we provide guidance on specific timing windows and disturbance buffers for the Kootenay Boundary Region. This information may vary from provincial guidance and may not be applicable outside of the Kootenay Boundary Region because of regional specificity.

Bats occur throughout the Kootenay Boundary Region, although habitat types and hibernacula structures vary among species (Table 48). Hibernacula occur throughout a species' range, and are restricted by topographic features, not vegetation type. Bats are sensitive to disturbance.

Bats begin hibernating in the Kootenay Boundary Region around early October, depending on the autumn weather, and emerge during spring when temperatures warm. This creates a potential ***sensitive period of October 1–April 30***.[2] Based on weather observations in a specific year, the length of this sensitive period can be refined.

[2] Best Management Practices for Bats in British Columbia (2016).

Table 48. Biogeoclimatic zones and characteristics of hibernacula structures within species' distributions in the Kootenay Boundary Region.[2,3]

Species	Biogeoclimatic Zone[4]					Hibernacula Structures
	PP	IDF	MS	ICH	ESSF	
Pallid Bat (may occur in Boundary)	X					Rock crevices
Townsend's Big-eared Bat	X	X		X		Caves, mines
Big Brown Bat	X	X	X	X		Rock crevices, mines, buildings
Spotted Bat	X					Cliffs, mines
Silver-haired Bat (migrates)	X	X	X	X	X	Dead/dying/live trees, mines, buildings.
Californian Myotis	X	X	X	X	X	Caves, mines, buildings
Western Small-footed Myotis	X	X				Caves, mines, buildings
Long-eared Myotis	X	X	X	X	X	Mines, buildings
Little Brown Myotis	X	X	X	X	X	Caves, mines
Northern Myotis				X		Mines
Fringed Myotis	X	X				Mines
Long-legged Myotis	X	X	X	X	X	Caves, mines
Yuma Myotis	X	X	X	X		Caves, mines

Two different management zones (Habitat Reserve Zone and Disturbance Management Zone) are prescribed for bat hibernacula (Figure 50).

1. The 100-m **Habitat Reserve Zone** is a zone of retention (no harvest) designed to protect the feature from damage (from wind, harvest-related injury or damage or disturbance from other activities such as blasting) and to retain microclimatic features of the Wildlife Habitat Feature.
2. The 1-km **Disturbance Management Zone** is not a retention zone. Within the Disturbance Management Zone recommendations are provided on the timing of specific activities that represent different levels of disturbance and on how to manage habitat within these zones to benefit bats.

[3] BC Species and Ecosystems Explorer – Species Summaries.

[4] A Field Guide for Site Identification and Interpretation for the Nelson Forest Region (1992); PP = Ponderosa Pine; IDF = Interior Douglas-fir; MS = Montane Spruce; ICH = Interior Cedar–Hemlock; ESSF = Engelmann Spruce–Subalpine Fir.

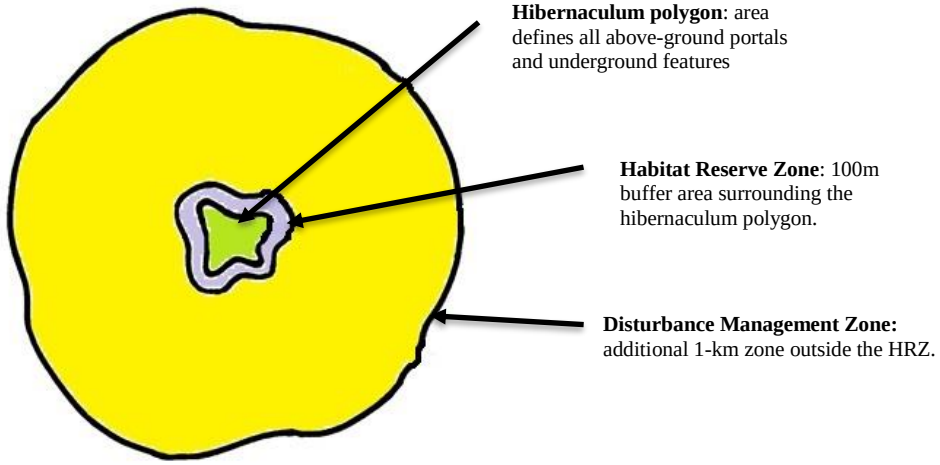

Figure 50. Hibernaculum polygon, 100-m Habitat Reserve Zone, and additional 1-km Disturbance Management Zone around a bat hibernaculum Wildlife Habitat Feature.
(Figure: Susan Holroyd)

Table 49 provides guidance on disturbance buffers and acceptable activities for a bat hibernaculum. Disturbance recommendations are more stringent in the Habitat Reserve Zone than in the Disturbance Management Zone. Habitat management within both zones should be used to help retain connectivity between the Wildlife Habitat Feature and surrounding habitats for bats. Additional protection or alternative measures may be needed, depending on the nature of the disturbance, existing landscape and cover, or other factors. Table 50 provides information to consider when conducting primary forest or range activities near a bat hibernaculum.

Once an occupied or known bat hibernaculum is discovered, consultation with a bat specialist is recommended. Hibernation features are vital to the conservation of local bat populations so are relevant to local wildlife managers. Forestry personnel are unlikely to find many of these sites as these features are difficult to identify due to both their cryptic nature and restricted period of use. Most bat species are relatively flexible and adaptable in their behaviour and habitat use; in many cases, a bat specialist can assess a situation and offer a workable strategy that suits both forestry operations and bat conservation goals.

The Kootenay Boundary Region has a rich history of mining and the landscape is riddled with old mines that are likely being used by bats. Mines are not classified as a Wildlife Habitat Feature, however there are “Best Management Practices for Bats in British Columbia” that includes a chapter devoted to mine habitat used by hibernating bats as well as a chapter devoted to Cave and Crevice Management for Bats.

Table 49. Guidance on disturbance buffers and acceptable activities for bat hibernaculum.

Level of Disturbance	**Time Period** Oct 1-Apr 30	**Habitat Reserve Zone** (100-m around hibernaculum polygon)	**Disturbance Management Zone** (additional 1-kilometre buffer)
Low Impact (i.e., livestock attractants, activities on foot, small groups; examples include layout, cruising, reconnaissance)	Outside	**Acceptable**	**Acceptable all-year**
	During	**May be acceptable** if bats and hibernaculum will not be negatively affected by the disturbance generated. If in doubt, consult a bat specialist.	
Medium Impact (i.e., light mechanized activities, larger groups/duration; examples include fence building, spacing, planting)	Outside	**May be acceptable** if bats and hibernaculum will not be negatively affected by the disturbance generated. If in doubt, consult a bat specialist.	**Acceptable**
	During	**Not acceptable**	**Acceptable with caution.** Use extra caution immediately adjacent to the hibernaculum. If in doubt, consult a bat specialist.
High Impact (i.e., mechanized activities; examples include road construction, falling and yarding, landing sites)	Outside	**Not acceptable**	**Acceptable**
	During		**May be acceptable** if bats and hibernaculum will not be negatively affected by the disturbance generated. Consult a bat specialist.
Very High Impact (i.e., blasting, helicopter logging)	Outside	**Not acceptable**	**Acceptable with caution.** Use extra caution immediately adjacent to the hibernaculum. If in doubt, consult a bat specialist.
	During		**May be acceptable** if bats and hibernaculum will not be negatively affected by the disturbance generated. Consult a bat specialist.

Table 50. Information to consider when conducting primary forest activities near a bat hibernaculum.

Information to Consider

General management considerations:
• Maintain habitat connectivity on the landscape. Habitat connectivity is vital for some of the smaller bat species.
• Connectivity can be maintained with non-merchantable timber or tall (e.g. 3 m) shrub cover provided a contiguous line of vegetation (with gaps less than 10-20 m wide) connects hibernaculum areas to large forest retention zones on the landscape.
• Designating narrow (1 to 3 m wide) "no-machine" zones within blocks may be an effective means of keeping habitat connectivity for small bat species. Adjacent blocks with green-up heights of 2-3 metres may also function as an edge that connects habitats.
 	
Habitat Reserve Zone:
• Do not harvest within the 100 m core area without first consulting a bat specialist.
• Minimize all other disturbance adjacent to hibernaculum sites during the sensitive period (October 1 to April 30)
• Do not blast, remove rock or talus, or constructing new roads within the Habitat Reserve Zone at any time.
• Consult a bat specialist to determine whether High or Very High impact activities can be conducted safely outside of the sensitive timing window.
 	
Disturbance Management Zone:
• Low and medium impact activities may take place within the Disturbance Management Zone throughout the year without concern.
• High and Very High impact activities may take place in the Disturbance Management Zone throughout the year. Assessment by a bat specialist is recommended to ensure the activities do not compromise the effectiveness of the feature.
• Use caution in the Disturbance Management Zone to ensure that High and Very High impact activities do not disrupt roosting bats with excessive noise or vibration.
  ○ Excessive noise includes loud (>80dB) high frequency sound between 20-200kHz
  ○ For blasting and jackhammer-type activities ensure;
  ▪ Sound concussion of less than 150 decibels
  ▪ Shock waves of less than 15 p.s.i.
  ▪ Peak particle velocity of less than 15 mm/second
• If Very High Impact activities are planned in the unoccupied period use protective methods (such as blast mats) to ensure the feature remains unchanged (see British Columbia Best Management Practices for Bats: Cave and Crevice Management for further details).

5) Additional Information

A Field Guide for Site Identification and Interpretation for the Nelson Forest Region, Land Management Handbook No. 20:
https://www.for.gov.bc.ca/hfd/pubs/docs/lmh/lmh20.htm

BC Species and Ecosystems Explorer–Species Summaries for Bat Species:
http://a100.gov.bc.ca/pub/eswp/search.do?method=reset

Best Management Practices for Bats in British Columbia:
http://a100.gov.bc.ca/pub/eirs/viewDocumentDetail.do?fromStatic=true&repository=BDP&documentId=12460

Karst Management Handbook for British Columbia:
http://www.for.gov.bc.ca/hfp/publications/00189/Karst-Mgmt-Handbook-web.pdf

Identified Wildlife Management Strategy–additional guidance concerning the management of any *Forest and Range Practices Act* species at risk associated with a bat hibernaculum:
http://www.env.gov.bc.ca/wld/frpa/iwms/accounts.html

Species at Risk Public Registry–additional information for each bat species:
http://www.registrelep-sararegistry.gc.ca/species/default_e.cfm