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Report Title: *Peace River Wildlife Surveys - Inventory and Habitat Use of Bat Species in the Peace River Corridor 2006 Report*
Project: Peace River Site C Hydro Project
Prepared By: Kingbird Biological Consultants Ltd. & Keystone Wildlife Research Ltd.
Prepared for: BC Hydro

NOTE TO READER:

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For environmental studies, the focus is on the development of an environmental and socio-economic baseline around the area of the potential Site C Project. Baseline studies are generally a survey of existing conditions within a project study area.

This report and other information may be used for future planning work or an environmental assessment or regulatory applications related to the potential Site C Project.

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PEACE RIVER WILDLIFE SURVEYS –

Inventory and Habitat Use of Bat Species in the Peace River Corridor - 2006

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Inventory and Habitat Use of Bat Species in the Peace River Corridor - 2006

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EXECUTIVE SUMMARY

In 2005, BC Hydro and Power Authority contracted Keystone Wildlife Research Ltd. to complete a preliminary inventory of bat species in the Peace River Valley, in north eastern BC. That study confirmed the presence of the little brown myotis (*Myotis lucifugus*), long-legged myotis (*M. volans*) and northern myotis (*M. septentrionalis*). Acoustic surveys also resulted in potential detections of hoary bat (*Lasiurus cinereus*), silver-haired bat (*Lasionycteris noctivagans*), big brown bat (*Eptesicus fuscus)*, and eastern red bat (*L. borealis*).

In 2006, additional surveys were undertaken to collect additional data on bat species presence, identify roosting habitat and determine relative activity of roosting / foraging areas. This study was conducted as a baseline study, commissioned by BC Hydro toward the development of an environmental baseline around the area of the potential Site C Project. Baseline studies are preliminary to and not intended to be environmental effects assessment studies. Baseline studies are generally a survey of existing conditions within a project study area.

Thirty-five bats of six species were captured in 2005 and 2006. Species captured included the hoary bat, little brown myotis, long-legged myotis, northern myotis, silver-haired bats and big brown bats. All species were confirmed to be reproducing except the big brown bat.

Comparison of relative activity across six broad habitat types indicated that balsam poplar (*Populus balsamifera*) stands are heavily used by bats, primarily for roosting, while wetlands and slow-moving creeks support the greatest amount of foraging activity. Lesser amounts of foraging and commuting activity were reported along the Peace River itself, in forest edge habitats, and within aspen forests.

Twelve bats of five species were radio-tagged in 2006, and 22 roosting structures were identified from the ten bats that could be relocated. The average distance between foraging (capture) and roosting sites was 730 m and roost-roost distances averaged 290 m. Of the roost structures identified, 64% were balsam poplar, 23% were aspen, 9% were steep cutbanks and 4% were buildings. Use-availability analyses using TEM habitat types showed that roosting bats had strong preference for balsam poplar-horsetail habitats. Cutbanks were also selected in relation to availability. Other forest types did provide roost sites where appropriate microsites were present, but these stands were not used more than available.

Results indicate that there is a diverse bat population in the Peace River valley. Key habitat types used by bats included wetlands, slow-moving creeks, cutbanks, and balsam poplar stands. Balsam poplars appear to be particularly important roosting habitat features in the Peace River Valley. This selection likely reflects the open nature of the stands providing good access and sun exposure, proximity to foraging areas, and abundance of suitable roost microsites. This study provided little information on the Blue-listed northern myotis with only four individuals captured and one female radio-tagged. However, a reproductive population was confirmed and one maternity roost identified in a steep cutbank above the Peace River.

Future work should attempt to link relative bat activity levels to mapped TEM ecosystem units. This would verify the assumed habitat associations between bats and the mapped ecosystem units and enable production of habitat suitability maps that can be used to predict the distribution of bats in the study area. Mist-netting and radio-telemetry should also be a component of future work to continue to investigate species presence and roosting habitat selection. Any additional work should also provide more information on the northern myotis.

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1.0 INTRODUCTION

In 2005, B.C. Hydro and Power Authority initiated a field study program designed to fill information gaps for wildlife species occurring in the Peace River Corridor from Hudson's Hope to the Alberta border. These field studies were targeted at species for which there was limited inventory data and were designed with the following objectives:

- to determine the presence and, where possible, relative abundance of target taxa within the core study area, and
- to develop habitat suitability ratings for the target taxa and confirm their reliability through habitat assessment and wildlife inventory surveys.

This study was conducted as a baseline study, commissioned by BC Hydro toward the development of an environmental baseline around the area of the potential Site C Project. Baseline studies are preliminary to and not intended to be environmental effects assessment studies. Baseline studies are generally surveys of existing conditions within a project study area.

The results of eight days of sampling for bats in 2005 included the confirmation of a reproductive population of little brown myotis; confirmation of a reproductive population of long-legged myotis, a species that has not been previously documented in the region; and the capture of a Blue-listed species, northern myotis. Additional species were detected through acoustic surveys but they were not captured and therefore could not be confirmed. Recommendations for future studies included:

1. Conduct a more intensive inventory program. More effort is required to determine species presence and their reproductive status in the study area.

2. Identify roosting habitat in the Peace River Corridor. Habitat for maternity colonies is particularly important, given that maternity roosts are essential for the survival of bat populations.

3. Determine the relative activity of roosting / foraging areas. Baseline data on activity levels should be collected using bat detectors. These data can be used to verify the assumptions for the preliminary habitat assessment.

Additional studies were funded by B.C Hydro in 2006 to fulfill these objectives.

1.1 Background

The Peace River Corridor is ecologically distinct from surrounding boreal regions because of the climatic influence of the Rocky Mountains and the presence of a large river. The rich floodplain habitats and surrounding agricultural landscapes likely influence bat species presence and activity.

Knowledge of bats in the Peace River Corridor is limited to early collections at Hudson's Hope in 1931 (mentioned in Nagorsen and Brigham 1993), specimens from the general region in 1977-1981 (in Caceres and Pybus 1997) and studies of silver-haired bats and big brown bats (Schowalter *et al.* 1978 and Schowalter and Gunson 1979, in Nagorsen and Brigham 1993). There is also a growing body of literature on bats in boreal ecosystems, including research in the BWBS biogeoclimatic zone at the Liard River, about 700 km northwest of Dawson Creek

(Wilkinson *et al*. 1995; Vonhof *et al*. 1997), and Prophet Rivers, located 250 km northwest of Fort St. John (Crampton *et al.* 1997). At least four studies have been conducted in the boreal mixedwood forests in northwestern Alberta (Patriquin and Barclay 2003), northcentral Alberta (Crampton and Barclay 1998), and northeastern Alberta (Hubbs and Schowalter 2003; Stefan 2004).

Nine bat species potentially occur in the Peace River Corridor (Table 1), based on Nagorsen and Brigham (1993), the studies mentioned above and the 2005 inventory program. Details of each species' distribution are discussed below. All nine species are insectivores and will forage anywhere insects concentrate, including in open forests, over slow-moving water or ponds, and along cliffs. Body size, manoeuvrability, and flight speed vary between species and smaller, more maneuverable bats can forage in dense forests, while larger species tend to fly over the canopy or along cliff edges (Nagorsen and Brigham 1993).

All nine species are known to roost in trees, with some documented also using buildings, rock crevices, or cliffs. In boreal forests, the limited research done to-date on roost selection by little brown myotis, northern myotis, and silver-haired bat suggests that these bats predominantly roost in dying or dead poplar trees (balsam poplar - *Populus balsamifera* and trembling aspen - *P. tremuloides*) (Vonhof *et al*. 1997; Crampton and Barclay 1998). Bats commonly roost beneath loose bark or within cracks or cavities, or in foliage clusters (hoary and red bats), in large trees or snags in old, open forest stands (Barclay and Brigham 1996).

All bats in BC mate in the late summer or fall, prior to hibernation. Females store sperm over the winter, and fertilization occurs in the spring (Nagorsen and Brigham 1993). Most pregnant female bats gather in maternity colonies of the same species, and the young are born in June or July. The developmental rate of the foetus is temperature dependent; thus in cooler climates, birth may occur later in the summer. In the Liard area in 1995, bats gave birth between the last week of June and the first week of July, with the first post-lactating female captured in late July (Wilkinson *et al*. 1995). In the same region in 1997, bats were lactating throughout July and the first post-lactating female was caught in August (Vonhof *et al*. 1997). In 2005, a post-lactating female and a pregnant female were captured in late August in the Peace River Corridor.

Table 1. Bat species potentially occurring in the Peace River Corridor, BC, listed by size.

Species	Common name	Existing records from Northeastern BC	Average weight and range (g) [1]
Myotis californicus	Californian Myotis	Yes	4.4 (3.3-5.4)
Myotis evotis	Long-Eared Myotis	Yes	5.5 (4.2-8.6)
Myotis lucifugus	Little Brown Myotis	Yes	6.2 (6.2–10.2)
Myotis septentrionalis	Northern Myotis	Yes	6.5 (5.0–10.0)
Myotis volans	Long-legged Myotis	Yes	7.2 (5.5-10.0)
Lasionycteris noctivagans	Silver-haired bat[2]	Yes	9.0 (5.8-12.4)
Lasiurus borealis	Eastern Red Bat[2]		(7.0-16.0)
Eptesicus fuscus	Big Brown Bat[2]	Yes	15.2 (8.8-21.9)
Lasiurus cinereus	Hoary Bat[2]	Yes	28.4 (20.1-37.9)

1 Data from Nagorsen and Brigham (1993) except *L. borealis* (Alberta SRD)

2 Species considered “big bats”

1.2 Review of Known Species Distributions

Californian Myotis *(Myotis californicus)*

The Californian myotis is generally considered to be a southern bat, ranging to central BC and the Alaska panhandle (Nagorsen and Brigham 1993). Wilkinson *et al*. (1995) reported this species in the Liard area, where it was the second most commonly-captured species after little brown myotis. The Californian myotis has not been documented elsewhere in northeastern BC or in Alberta. The Californian myotis uses rock crevices, tree cavities, spaces under the bark of trees, mine tunnels, buildings and bridges for day roosts and maternity colonies (Nagorsen and Brigham 1993).

Long-eared Myotis *(Myotis evotis*)

The long-eared myotis has also been reported in the Liard River area (Vonhof *et al*. 1997). Generally, this species is considered a more southern and western counterpart to the northern myotis (Nagorsen and Brigham 1993). Differentiation between these species using physical characteristics is very difficult, and is generally based on colouration (Nagorsen and Brigham 1993; Burles 2004). The long-eared myotis has been found roosting in buildings, under bark, in caves, sink holes and fissures in cliffs, with maternity colonies located in buildings (Nagorsen and Brigham 1993). This bat has also been documented on Vancouver Island roosting in south-facing cliffs and in snags (Kellner and Rasheed 2002).

Little Brown Myotis *(Myotis lucifugus*)

The little brown myotis is widely distributed and common (Nagorsen and Brigham 1993). It has been recorded in boreal forests in BC (Prophet River - Crampton *et al.* 1997; Liard River – Vonhof *et al*. 1997), and in the mixedwood boreal forest across northern Alberta (Crampton and Barclay 1998; Hubbs and Schowalter 2003; Patriquin and Barclay 2003). Little brown bats have been observed roosting in tree cavities, rock crevices, caves, human structures and under bark (Nagorsen and Brigham 1993).

Northern Myotis *(Myotis septentrionalis*)

The northern myotis is currently Blue-listed (Vulnerable) in BC and Alberta, due to lack of information on distribution, its perceived rarity, and suspected requirement for mature and old forests (BC CDC 2005; Caceres and Pybus 1997; Nagorsen and Brigham 1993). Its range includes the northcentral US, and southern Canada east of the Rocky Mountains (BC CDC 2005). The northern myotis is believed to be associated with boreal forests and to occur across northeastern BC and northern Alberta (Nagorsen and Brigham 1993; Caceres and Pybus 1997).

In BC, locations of this species include Hudson's Hope in 1931 (Nagorsen and Brigham 1993), and the Revelstoke area (SW BC) in the 1980s (Nagorsen and Brigham 1993) and 1990's (Rasheed and Holroyd 1995; Caceres 1998). Recently, reproductive populations have been found at the Prophet and Liard Rivers (Crampton *et al.* 1997; Vonhof *et al.* 1997; Vonhof and Wilkinson 2000). Locations from western Alberta include the Peace River valley, Grand Prairie, and the Spirit River (Caceres and Pybus 1997). The northern myotis is also found in the mixedwood boreal forests of northern Alberta (Crampton and Barclay 1998; Hubbs and Schowalter 2003; Patriquin and Barclay 2003), and two hibernacula have been located in Wood Buffalo National Park and Cadomin Cave, Alberta (Caceres and Pybus 1997). Roosting may occur in buildings and under the loose bark of trees (Nagorsen and Brigham 1993).

Long-legged Myotis *(Myotis volans*)

The long-legged myotis is widespread across southern and western BC, but has also been reported from northwestern and northern BC (Kispiox and Atlin) (Nagorsen and Brigham 1993), and southern Alberta north to Jasper and Cadomin (Holroyd and Van Tighem 1983). Reproductive populations have been found at Liard River (Vonhof *et al*. 1997), showing that this species is obviously tolerant of northern climes. However, the long-legged myotis was not found in surveys of the mixedwood boreal forest in Alberta (Crampton and Barclay 1998; Hubbs and Schowalter 2003; Patriquin and Barclay 2003) or at the Prophet River in BC (Crampton *et al*. 1997). This species may roost in buildings, crevices in rock cliffs, fissures in the ground and under the bark of trees (Nagorsen and Brigham 1993).

Silver-haired Bat *(Lasionycteris noctivagans*)

The silver-haired bat has been captured in mixedwood boreal forests (Crampton and Barclay 1998; Hubbs and Schowalter 2003; Patriquin and Barclay 2003). The species was not captured at the Prophet (Crampton *et al*. 1997) or Liard (Vonhof *et al*. 1997) rivers, but it was possibly heard on detectors. There is at least one record of a silver-haired bat around the Peace River / Taylor area (Nagorsen and Brigham 1993). This species may be found roosting under the bark of trees, in tree trunk crevices, and in abandoned woodpecker cavities and bird nests (Nagorsen and Brigham 1993).

Eastern Red Bat *(Lasiurus borealis*)

A foliage-roosting bat of southern and eastern Canada and the U.S., the eastern red bat was first documented in the Fort McMurray area of Alberta in 2001 (Patriquin 2001). Calls have recently been recorded in the same area (Stefan 2004). The distribution of this bat in northern BC and Alberta is unknown, and it is included as a potential species in the Peace River area based on the Alberta locations and its affinity for boreal forests. The eastern red bat roosts in thick forest foliage (Alberta SRD 2008).

Big Brown Bat *(Eptesicus fuscus)*

There are records of big brown bats from the Peace River/ Taylor area (Nagorsen and Brigham 1993) and Jasper National Park (Holroyd and Van Tighem 1983). However, this bat has not been captured in any other recent study in northeastern BC or northern Alberta. Calls have been reported in mixedwood boreal forests (Crampton and Barclay 1998; Hubbs and Schowalter 2003), the Liard River (Vonhof *et al*. 1997), and possibly at the Prophet River (Crampton *et al*. 1997). In much of its range, this species prefers human structures, but it has also been documented roosting in tree cavities and rock crevices (Nagorsen and Brigham 1993).

Hoary Bat *(Lasiurus cinereus)*

The hoary bat is another foliage-roosting bat that has been captured and recorded in mixedwood boreal forests in central and eastern Alberta (Crampton and Barclay 1998; Hubbs and Schowalter 2003), and at three sites at the Liard River (Vonhof *et al*. 1997). The hoary bat was not recorded at the Prophet River (Crampton *et al*. 1997). The species is generally found in the southern half of BC (Nagorsen and Brigham 1993). The hoary bat roosts in the branches of coniferous and deciduous trees and shrubs (Nagorsen and Brigham 1993).

2.0 METHODS

Surveys were completed in the Boreal White and Black Spruce moist warm (BWBSmw1) subzone in the Peace River corridor between Hudson's Hope and the Alberta border. Surveys were timed to coincide with the presence of lactating females and maternity colonies. Mist-netting and acoustic sampling occurred simultaneously during three sampling periods: August 2005, July 2006, and August 2006. Radio-tracking occurred from July to August in 2006.

Netting sites that were successful in 2005 were re-visited in 2006 to increase the probability of successful captures (Figure 1). High-activity sites were visited multiple times, but were rarely netted on consecutive days. Acoustic monitoring sites were selected in the field based on accessibility and the presence of suitable habitat features.

Sample sites were stratified into six habitat types: mature aspen forest, balsam poplar floodplain forest, river edge (rapidly moving, deep water with a wide channel), slow-moving creek (occasionally with pool areas), wetland (stagnant or very slow-moving water with emergent vegetation), and forest edge habitat (the transitional area between a forest and an open area such as a clearcut, old road, or cleared field). These broad habitat types represent the major foraging and roosting habitat types that are available in the project area. Coniferous forests were not sampled due to their scarcity on the north side of the river, which is the side most accessible by road. Ground Inspection Forms (GIFs) were completed at all terrestrial sampling sites and roost locations.

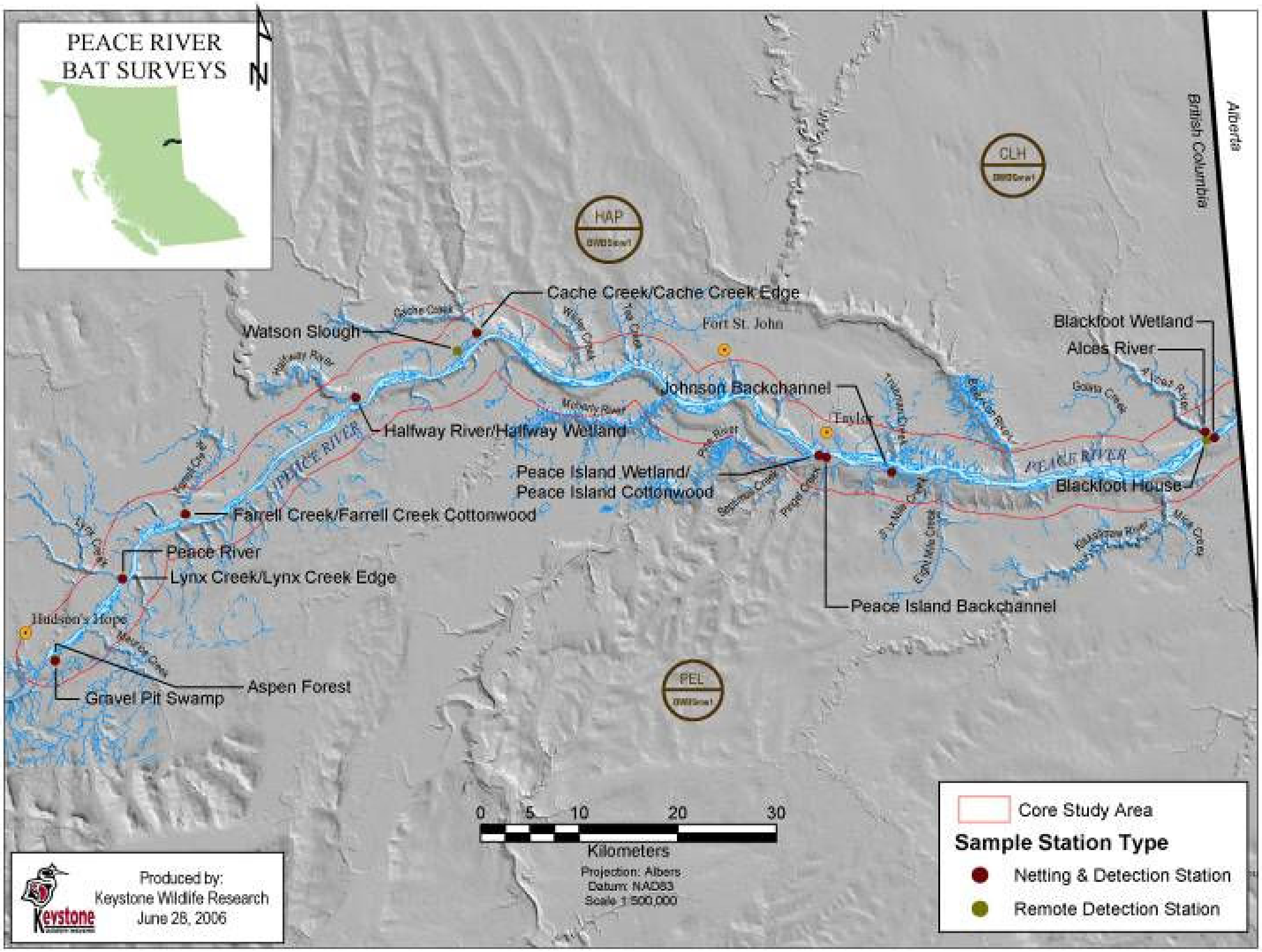

Figure 1. Sampling sites for the 2005-2006 Peace River Bat Inventory Project.

2.1 Species Inventory

Capture

Mist-nets were used for sampling, as outlined in ***Inventory Methods for Bats*** (RIC 1998a). Three to seven nets, measuring 2 m high by 6, 9 or 18 m wide, were used at each site. Mist nets were set up across slow-moving creeks, ponds, wetlands, forest gaps, and forest trails. A net-night is a standard measure of effort and is defined as one 2x6 m net-equivalent set up for 1 night (RIC 1998a); thus the 18 m net resulted in 3 net-nights of effort for each night it was used. Nets were opened at dusk (20:30 – 22:30), and monitored approximately every 10 minutes for 2-4 hours, depending on the amount of bat activity.

Captured bats were removed promptly and most were kept in cloth bags for at least a 1/2 hour, handled for identification purposes only, and then released on-site. Since bats were not held for the requisite hour to allow food to clear their digestive tract, the recorded weights may be higher than average weights reported in other studies. Lactating and late-stage pregnant females were processed and released immediately after capture to avoid jeopardizing their condition or dependent young. Weight, sex, age, reproductive condition, forearm length (mm), and presence/absence of a prominent keel on the calcar were recorded for each bat captured. Foot and ear length (mm) were also recorded for some bats, to aid in species identification. The identification key in Nagorsen and Brigham (1993) was used to confirm species. Reproductive condition was determined for males by the presence of enlarged testes, and for females, by visual examination and gentle palpation of the abdomen and nipples (Racey 1988). Age was determined based on the degree of ossification of the finger joints (RIC 1998a). Bats were released on-site by allowing them to fly off the hand.

Acoustic Detection

Bat detectors were used for acoustic sampling, as outlined in RIC (1998a). Bat activity was recorded at each netting site with a narrow-band bat detector (QMC Mini-3 Bat, Ultra Sound Advice, UK). The detector was tuned to 20, 30, and 40 kilohertz (kHz), for 5-minute listening intervals throughout the netting session. Acoustic sampling was used to verify bat activity, quantify activity levels, and to document the presence of species or species groups that were not captured. The frequency of the call was used to differentiate between bat species and species groups. Calls detected at 40 kHz were recorded as *Myotis* species (little brown, Californian, long-legged, long-eared and northern), calls at 30 kHz were big bats (silver-haired, big brown, eastern red and hoary bat) and calls at 20 kHz were hoary bats (RIC 1998a). Since differentiating between the calls of the silver-haired bat and big brown bat is difficult and the results can be inconsistent, these species were not distinguished (Betts 1998). The assumptions of this methodology include:

- Frequency of call detection reflects bat activity
- Calls can be accurately separated into species/species group using the criteria above.

A remote detector (Anabat, Titley Electronics, Australia) was also set up each night in stands that were not suitable for netting. Calls were recorded after dusk on 45 or 90 minute cassette tapes. The calls were transcribed from the recording at a later date.

2.2 Relative Activity and Foraging Rate

The numbers of passes and feeding buzzes were recorded at each frequency (20, 30 or 40 kHz) for each species /species group in 5-minute intervals (RIC 1998). A pass was defined as an uninterrupted series of echolocation calls as a bat travelled past a microphone and a buzz was the buzzy sound of accelerating calls as a bat homed in on its insect prey.

The activity rate was determined for each site as the average number of calls (passes and buzzes), per minute. Foraging rate was also determined as the average number of feeding buzzes per minute. Data from sites that were sampled multiple times were pooled to calculate the activity and foraging rate for that site.

2.3 Roost Identification and Description

Telemetry was used to locate day-roosts used by bats in the Peace River Corridor. Transmitters were attached to individuals that met criteria (RIC 1998a) for species, gender, reproductive condition, and the 5% rule, which suggests that transmitters should not exceed 5% of the animal's body mass (Nagorsen and Brigham 1993). The minimum weight of radio-tagged bats was 7.4 g. based on the weight of the transmitters (0.37 g). Suitable, non-lactating bats were held for at least 1 hour to ensure that their empty weight exceeded the 5% rule. Lactating females were not held before transmitter attachment, as long as their initial weights were judged great enough for transmitter attachment while complying with the 5% rule. Female bats in late stages of pregnancy and juveniles were not radio-tagged. Holohil Systems BD-2N transmitters were used. These transmitters have an expected lifespan of 8 to 15 days.

Due to the low capture rates, lactating female *Myotis* species could not be targeted for telemetry. Instead, transmitters were attached to all suitable bats in order to obtain a larger sample. Bats were tagged by clipping hair, if required, in the area below the scapulae where the transmitter was to be attached. A small amount of Skin Bond ® was applied to the clipped area and to the transmitter, and allowed to stand until it bubbled. The transmitter was then placed on the bat and held in place for three to five minutes. Bats were released on-site once the glue had set. Radio-tagged bats were located by vehicle and foot for a minimum of seven days after capture. The transmitters usually remained on the bat for 1 to 14 days but sometimes was removed earlier via chewing or grooming.

Roost trees were located on foot when feasible. If the site was inaccessible (e.g., across the Peace River), the location was triangulated from three or more locations. Habitat type at the stand level was recorded (site series and structural stage) on a RISC-standard ground inspection form (GIF), for all accessible roosts. A UTM location was obtained for the inaccessible roosts (n = 3) based on triangulation data. This location corresponded to the approximate centre of the polygon drawn from bearings. The habitat type was then determined for this location from the terrestrial ecosystem map (Keystone Wildlife Research Ltd. 2006).

Roost trees were described using the methodology for describing wildlife trees in ***Field Manual for Describing Terrestrial Ecosystems*** (BC MOE and MOF 1998, Appendix 1). The diameter at breast height, tree species, percentage bark remaining, estimated height, crown class, appearance class, crown condition class, bark retention class and decay class were recorded for each suspected roost tree.

Roost counts were completed to confirm the roost tree of a radio-tagged bat or to confirm that the radio-tag was still attached to the bat. Roost counts were not completed at roosts that could not be safely accessed at night. Counts were done by at least two observers watching the suspected roost from different viewpoints from a half-hour before dusk until dark. The receiver was used to confirm if/when the instrumented bat moved.

The "circle method" was used to delineate available habitat at the stand scale for each roost site (Joly *et al.* 2003). The average commuting distance (between roosting and foraging (=capture) sites) was determined for the radio-tracked bats in the study area. This distance was used as a proxy for home range size and was assumed to represent the area within which habitats were available to each bat. ArcMap GIS was used to create circles with a set radius around each roost centre-point (either a single roost, the midpoint of two roosts, or the centre of a roost area). The area of each available habitat (ecosystem unit and structural stage) was then calculated for each 'home range'. Ecosystems with little to no potential to provide roosting structures (river, open water, road, gravel bar, cultivated field and non-forested units) were excluded from the analysis (Appendix 3).

Forested ecosystem units were grouped by structural stage (age class) based on their ability to provide suitable roosting structures. Structural stages 3 and 4 include shrub-dominated and pole-sapling forested sites, less than 40 years old (RIC 1998b). These age classes are unlikely to provide suitable roosting microsites and were grouped. Structural stages 5, 6, and 7 include young, mature and old forests (>40 yrs old) and are more likely to support trees with scars and features commonly associated with heart rot. The selection ratios were calculated for each available habitat type as per Manley *et al.* (2002), after excluding anthropogenic sites (Rural) and data from one rural roost.

3.0 RESULTS AND DISCUSSION

Mist-netting and acoustic sampling occurred during three sampling periods: August 22 to 29, 2005, July 10 to 17, 2006, and July 28 to Aug 4, 2006. Overall, 22 nights of netting were completed, 8 in 2005 and 14 in 2006. Activity data was collected for 32 sites, 16 in 2005 and 16 in 2006.

3.1 Capture Rates

Thirty-five bats were captured in 179.5 net-nights of effort or 212 netting hours, completed over 22 evenings at 10 sites (Table 2). This effort resulted in an overall capture rate of 0.19 bats per net-night (0.16 bats per net-hour). Inclement weather conditions (low temperatures, precipitation and strong wind) were experienced on six evenings, accounting for 42 net-nights. Bats were still captured on four of the six evenings, accounting for six of the captured bats. Excluding these data increased the overall capture rate to 0.21 bats per night, or 0.18 bats per net-hour.

Table 2. Summary of sampling effort and capture rates for each sampling sites and stratum in the Peace River Corridor from 2005-2006.

Sample Period	Sample Station	Stratum	Number of nights sampled	Number of bats captured	Net hours	Net nights	Bats per Net night
Aug 22 -29, 2005	Blackfoot	Wetland	1	0	9	5.5	0.00
	Cache Creek	Slow-Moving Creek	1	4	17.5	9	0.44
	Farrell Creek	Slow-Moving Creek	1	1	16.25	9	0.11
	Gravel Pit*	Wetland	1	1	10	7.5	0.13
	Halfway River*	River	1	0	9.32	7.5	0.00
	Lynx Creek	Slow-Moving Creek	1	1	16	9	0.11
	Peace Island Channel	Backchannel	1	0	4.5	6	0.00
	Peace Island Wetland	Wetland	1	1	9.75	5.5	0.18
	Sample Period Total		**8**	**8**	**92.32**	**59**	**0.14**
Jul 10-17, 2006	Alces River	Slow-Moving Creek	4	4	19.64	17.5	0.23
	Cache Creek	Slow-Moving Creek	2	6	26.15	20.5	0.29
	Johnson Backchannel	Wetland	1	0	13.75	11.5	0.00
	Peace Island Wetland*	Wetland	2	4	18.12	16.5	0.24
	Sample Period Total		**7**	**14**	**77.66**	**66**	**0.21**
Jul 8 - Aug 4, 2006	Cache Creek*	Slow-Moving Creek	3	6	18.35	20.5	0.29
	Farrell Creek*	Slow-Moving Creek	2	5	12.08	13.5	0.37
	Lynx Creek	Slow-Moving Creek	2	2	12.01	20.5	0.10
	Sample Period Total		**7**	**13**	**42.44**	**54.5**	**0.24**
Total			**22**	**35**	**212.42**	**179.5**	**0.19**
Total (excluding net nights with poor conditions)			**16**	**29**	**165.25**	**137.5**	**0.21**

* indicates sample stations with inclement weather conditions

3.2 Species Presence

Over the two years of sampling, thirty-five bats of six species were captured, including little brown myotis (*Myotis lucifugus*), long-legged myotis (*M. volans*), northern myotis (*M. septentrionalis*), big brown bat (*Eptesicus fuscus*), silver-haired bat (*Lasionycteris noctivagans*) and hoary bat (*Lasiurus cinereus*). Detailed capture information and photos of each species are included in Appendix 2.

In 2005, 8 bats of three species were captured, including 5 little browns, 1 northern myotis and 2 long-legged myotis (Table 3). In 2006, 27 bats of five species were captured including 15 little brown myotis, 2 big brown bats, 5 silver-haired bats, 2 hoary bats and 3 northern myotis (Table 3).

Table 3. summary of bat species captured during the three surveys periods in 2005 and 2006.

Sample Period	Species	Total captured
Aug 22 -29, 2005	Little brown myotis	5
	Northern myotis	1
	Long-legged myotis	2
	Total period 1	**8**
Jul 10-17, 2006	Big brown bat	1
	Hoary bat	1
	Silver-haired bat	4
	Little brown myotis	7
	Northern myotis	1
	Total period 2	**14**
Jul 8 - Aug 4, 2006	Big brown bat	1
	Hoary bat	1
	Silver-haired bat	1
	Little brown myotis	8
	Northern myotis	2
	Total period 3	**13**
Grand Total		**35**

All species were confirmed to be reproducing in the area, based on the capture of juveniles or of pregnant or lactating females, except the big brown bat, of which only two adult males were captured (Figures 2 and 3).

Bat captures revealed a surprisingly diverse bat fauna, in spite of the low capture success. Of particular interest was the capture of a lactating female northern myotis on July 13, 2006, confirming the presence of a reproductive population of this provincially-listed species. The identification of the northern myotis was determined based on physical characteristics (definite brown colour of the ears, nose and flight membranes) and the expected distribution of the species. The morphologically similar long-eared myotis has nearly black skin and is believed to be a more southern species (Nagorsen and Brigham 1993). The presence of a reproductive population of long-legged myotis was also confirmed in the Peace River Corridor, based on the capture of a volant juvenile on August 24, 2005. This is the first record of long-legged myotis in this area. Also of note was the confirmation of populations of big brown bat, reproductive hoary bat, and reproductive silver-haired bat.

The species most commonly captured in each sample period and overall was little brown myotis, with 57% of the bats captured belonging to this species. This may be due to the species' relative abundance, but also likely reflects its generalist habits and its relative ease of capture (Nagorsen and Brigham 1993).

Neither the Californian myotis nor the long-eared myotis were captured, although these species were documented from the Liard River in northern BC. The presence of these species in the Liard River area might be explained by the presence of hot springs, which makes the climate more tolerable for these southern species. Eastern red bats were also neither captured nor detected. The closest recorded location for this species is in the Fort McMurray area of northeastern Alberta (Stefan 2004). Although possible calls of eastern red bats were heard on detectors at one site (Cache Creek) in 2005, five nights of mist-netting and concurrent detector sampling at this site in 2006 did not provide any further evidence of this species' presence. The presence of the Californian myotis, long-eared myotis and eastern red bat would represent significant range expansion; thus, their lack of detection is not surprising.

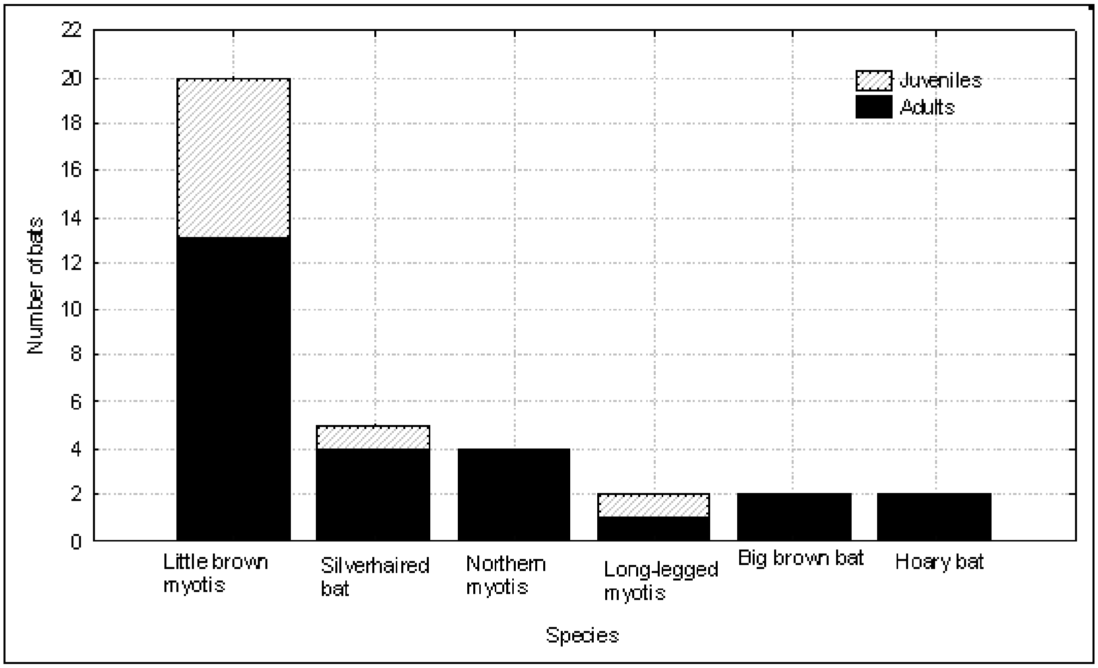

Figure 2. Numbers of adult and juvenile bats captured, by species, in 22 nights of netting.

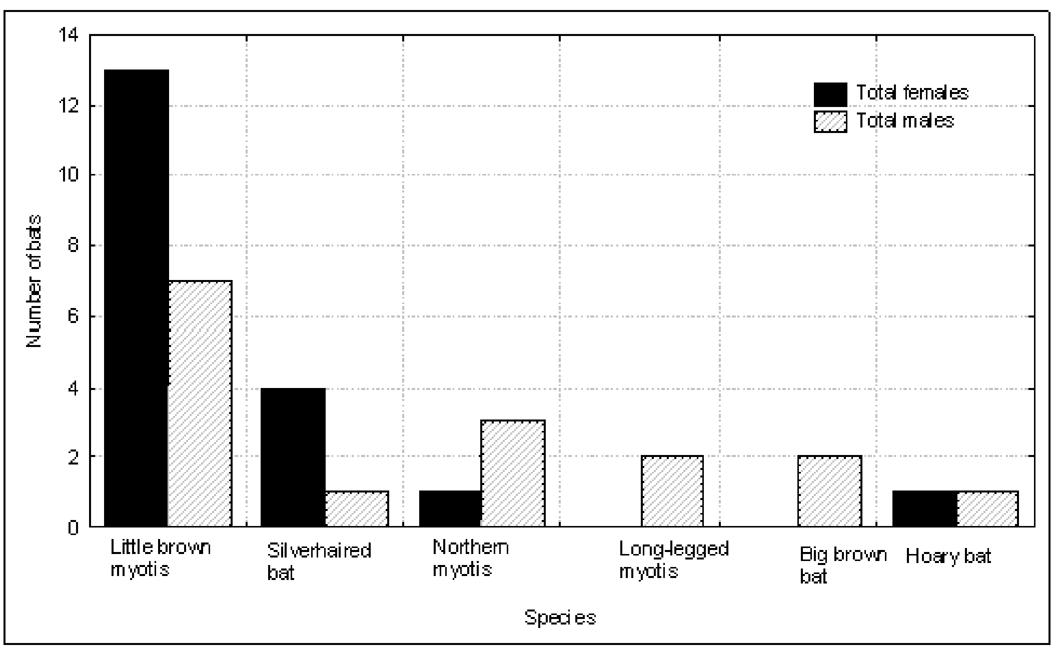

Figure 3. Numbers of female and male bats captured, by species, in 22 nights of netting.

Pregnant females were detected on July 13, 16, and Aug 26, lactating females were detected on July 11, 13 and 28 and post-lactating females were detected on Jul 17, 31, Aug 4 and 31 (Appendix 2). In Canada, bat pregnancy is expected to occur shortly after females leave the hibernacula in the spring, with offspring born in June and July (Nagorsen and Brigham 1993). The presence of pregnant and post-lactating females from early July to late August indicates that females are reproductively active over a wide time period and is contrary to the expectation that the reproductive period would be compressed at northern latitudes, based on the shorter summer. This suggests that bats in the Peace may have a more variable schedule of parturition than in other areas.

3.3 Activity Rates

Twenty-two sites were sampled over 32 nights in three survey periods. Bat activity data were recorded for 3547 minutes, or approximately 59 hours, in six habitat strata. The length of sampling time ranged from 38 to 225 minutes per site and was dependent on the survey conditions. Bats were detected at all sites, with overall activity levels ranging from 0.06 to 1.02 calls/minute (Table 4).

When relative activity for all species was compared across all strata, the highest activity levels were detected at balsam poplar, wetland, and slow-moving creek sites (Fig. 4). Sample sizes were small for all habitats types (balsam poplar n = 3, wetland n = 6, creek n = 7, aspen n = 1, edge n = 3, river n = 3) and standard errors were large, therefore, only limited inferences can be made about activity levels associated with each stratum.

Table 4. Summary of surveys hours and the relative activity level at each acoustic detection site.

				Activity level		
Sampling period	**Study Area Name**	**Stratum**	**survey minutes**	**passes/ min**	**buzzes/ min**	**calls/ min**
Aug 22 - 29, 2005	Aspen Forest	Aspen Forest	48.00	0.25	0.00	0.25
	Blackfoot House	Edge Habitat	48.00	0.19	0.00	0.19
	Blackfoot Wetland	Wetland	182.40	0.15	0.01	0.16
	Cache Creek	Slow Moving Creek	225.60	0.22	0.02	0.23
	Farrell Creek	Slow Moving Creek	192.00	0.16	0.01	0.17
	Farrell Creek Poplar	Poplar floodplain	81.60	0.50	0.04	0.54
	Gravel Pit Swamp	Wetland	134.40	0.06	0.00	0.06
	Halfway River	River	216.00	0.46	0.06	0.52
	Halfway Wetland	Wetland	115.20	0.78	0.15	0.93
	Lynx Creek	Slow Moving Creek	110.40	0.93	0.09	1.02
	Lynx Creek Edge	Edge Habitat	225.60	0.46	0.00	0.46
	Peace Island Backchannel	River	120.00	0.10	0.00	0.10
	Peace Island Poplar	Poplar floodplain	187.20	0.42	0.01	0.42
	Peace Island Wetland	Wetland	192.00	0.14	0.03	0.17
	Watson Slough	Wetland	57.60	0.76	0.12	0.89
Total for period 1			**2136.00**	**0.34**	**0.03**	**0.37**
Jul 10-17, 2006	Alces River	Slow Moving Creek	210.00	0.56	0.03	0.59
	Cache Creek	Slow Moving Creek	187.80	0.52	0.03	0.55
	Johnson Wetland	Wetland	153.60	0.50	0.06	0.56
	Peace Island Wetland	Wetland	149.40	0.11	0.03	0.13
Total for period 2			**700.80**	**0.44**	**0.04**	**0.48**
Jul 8 - Aug 4, 2006	Cache Creek	Slow Moving Creek	230.40	0.27	0.03	0.30
	Cache Creek Edge	Edge Habitat	62.40	0.43	0.03	0.46
	Farrell Creek	Slow Moving Creek	130.80	0.58	0.14	0.72
	Lynx Creek	Slow Moving Creek	84.60	0.06	0.00	0.06
	Lynx Creek Edge	Edge Habitat	134.40	0.22	0.02	0.25
	Peace River	River	67.20	0.25	0.00	0.25
Total for period 3			**709.80**	**0.31**	**0.04**	**0.35**
Grand Total			**3546.60**	**0.36**	**0.03**	**0.39**

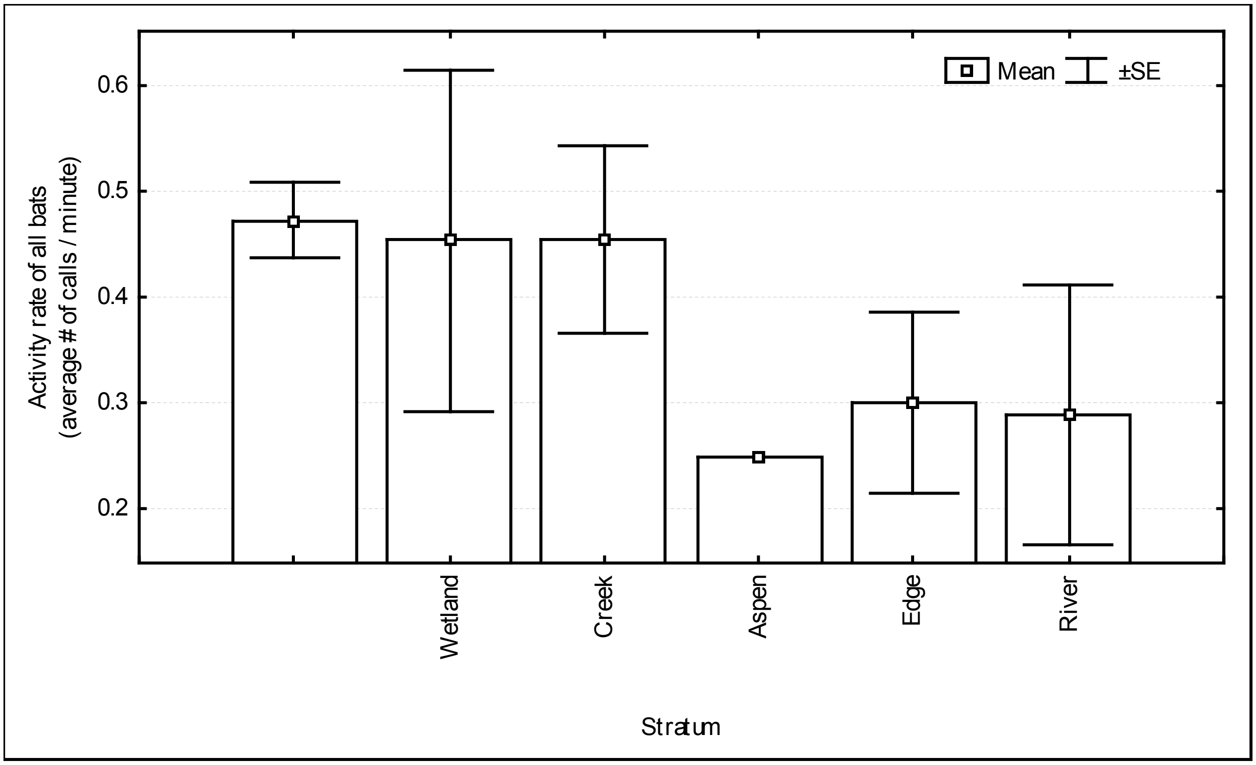

Figure 4. Activity rate (average # of calls/ minute) recorded for all bats at different habitats in the Peace Corridor.

Foraging rates were compared across strata to assist in identifying foraging habitats. The foraging rate for all bat species combined varied from 0 to 0.15 buzzes/minute between sites. Foraging activity was greatest at wetland and slow-moving creek sites (Fig. 5). Sample sizes were small for all habitats types (balsam poplar n = 3, wetland n = 6, creek n = 7, aspen n = 1, edge n = 3, river n = 3) and standard error of the mean large, so only limited inferences can be made about foraging levels associated with each stratum.

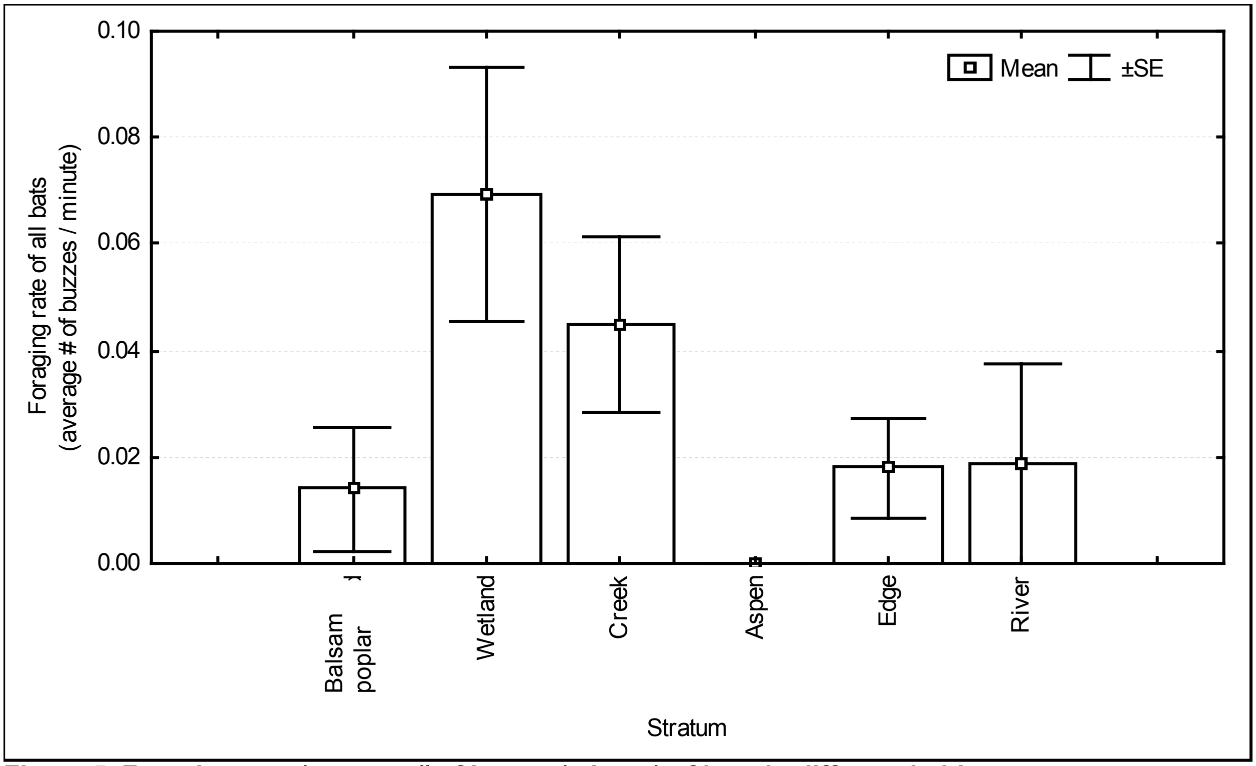

Figure 5. Foraging rate (average # of buzzes/minute) of bats in different habitat types.

Other studies have found bat activity to be greatest at riparian sites (Lunde and Harestad 1986; Thomas 1988; Grindal *et al.* 1999; Seidman and Zabel 2001), which would correspond to the balsam poplar, wetland and creek strata in this study. The activity levels likely reflect the higher insect abundance (Thomas 1988) and calm water conditions that do not interfere with echolocation (von Frenckell and Barclay 1987; Mackay and Barclay 1989). Valley bottoms also consistently provide productive bat habitat, where riparian areas are found in conjunction with warm temperatures (Grindal *et al.* 1999; Kellner 1999; Kellner and Rasheed 2002). No differences in habitat preferences have been documented between species (Barclay 1991; Saunders and Barclay 1992; Kalcounis *et al.* 1999; Patriquin and Barclay 2003).

The pattern of activity can suggest whether a site is used for roosting or foraging. An initial post-dusk burst of activity suggests roosting activity, while activity throughout the sampling period suggests foraging or commuting. The high activity rate recorded in balsam poplar and aspen forests compared to the relatively low rate of foraging in these strata, indicates that these forests are used primarily for roosting. Similar patterns of activity have been reported in other forested habitats (Crampton and Barclay 1998).

Bats in this study also travelled and foraged along forest and river edges, but these habitats were used to a lesser degree. Edges of forested stands often receive significant activity, probably due to the ease of flying in a low-clutter environment, prey concentration, and ease of navigation (Limpens and Kapteyn 1991; Grindal and Brigham 1999).

Based on what is known about bat foraging preferences and the results from detector data collected during this study, a preliminary draft ratings table for bat foraging habitat was developed (Appendix 4). This table identifies ecosystem units from the draft TEM map (Keystone Wildlife Research Ltd. 2006) that are likely to be suitable for bats. The four-class rating scheme is consistent with that outlined in ***British Columbia Wildlife Habitat Ratings***

Standards (RIC 1999). All bat species were rated as one species group since species-specific habitat preferences cannot be represented at this scale. Based on what is known about bat habitat preferences, the most suitable foraging habitats are assumed to be wetlands and the least suitable sites are young, dry, pine-dominated forests. Polygon ratings should be increased where the polygon is adjacent to prime feeding habitat (wetlands, creeks).

3.4 Roost Use and Roosting Habitat Selection

Radio-tags were attached to 12 adult bats (Photo 1), 2 of which could not be relocated. Of the 10 bats that could be tracked, 6 were reproductively active females, 1 was a non-reproductive female, and 3 were males (Table 5). The non-reproductive female was grouped with the males for all stratified roost analyses, to differentiate potential maternity colonies from other day roosts.

Table 5. Summary of bats radio-tagged in July and August 2006 in the Peace River Corridor.

Species	Name	Sex	Reproductive condition[1]	# of days monitored	Minimum # of roosts used	Roost area (ha)
Little brown myotis	Liza	F	Pregnant	17	1 *	
Silver-haired bat	Frosty	F	Pregnant	None		
Northern myotis	Bunny	F	Lactating	17	1 *	
Silver-haired bat	Cloudy	F	Lactating	17	4 *	1.1
Hoary bat	Hera	F	Lactating	13	1	
Little brown myotis	Norma	F	Post-lactating	10	4 *	0.5
Little brown myotis	Farrah	F	Post-lactating	14	3 *	12.4
Little brown myotis	Fawcett	F	Reproductive[1]	7	2 *	
Hoary bat	Cache	M	Non-reproductive[2]	None		
Little brown myotis	Willy	M	Non-reproductive[2]	12	3 *	0.1
Little brown myotis	LynxBoy	M	Non-reproductive[2]	15	1 *	
Big brown bat	Al	M	Non-reproductive[2]	14	3 *	3.3

[1] Apparently reproductively capable, not pregnant/gravid, [2] Apparently reproductively capable, not currently in a state of potency
* confirmed by walking up to roost structure

Photo 1. Radiotransmitter attached to a silver-haired bat.

Bats were radio-tracked for 7 to 17 days (mean = 13.5 days) from July 10 through to Aug 14, 2006. Due to the number of bats and their distribution in the study area, nightly roost-watches could not be completed to confirm that the transmitter was still attached to the bat. However, four bats continued to switch roosts within two days of the end of monitoring, and one transmitter was retrieved when it dropped onto the ground on day 14 of monitoring. In total, bats were visually confirmed or a roost count was completed at four trees and one abandoned house that was used as a maternity colony.

All bats were captured in the Peace River Corridor and the identified roosts were all within one km of the Peace River (Figure 6, 7, 8 and 9). The average commuting distance, inferred from the distance between foraging (=capture) and roosting sites, was 730 m. Each bat used between one to four roosts and roost-switching and re-use was common for the six bats that used more than one roost. Alternate roosts were always close to the initial roost, and usually within the same stand. Roost-roost distances ranged from 16 to 830 m (mean 290 m, s.d. 245 m). Roost areas, calculated using a minimum convex polygon for bats with three or more roosts, ranged from 0.1 to 12.4 hectares (Table 6).

Table 6. Size of roost areas and commuting distances for bats with 3 or more roosts.

Bat Name	Bat Species	Roost Area (ha)	Average Commuting Distance (roost to foraging site) (m)
Farrah	Little brown myotis	12.4	688
Cloudy	Silver-haired bat	1.1	1416
Norma	Little brown myotis	0.5	130
Willy	Little brown myotis	0.1	50
Al	Big brown bat	3.3	395

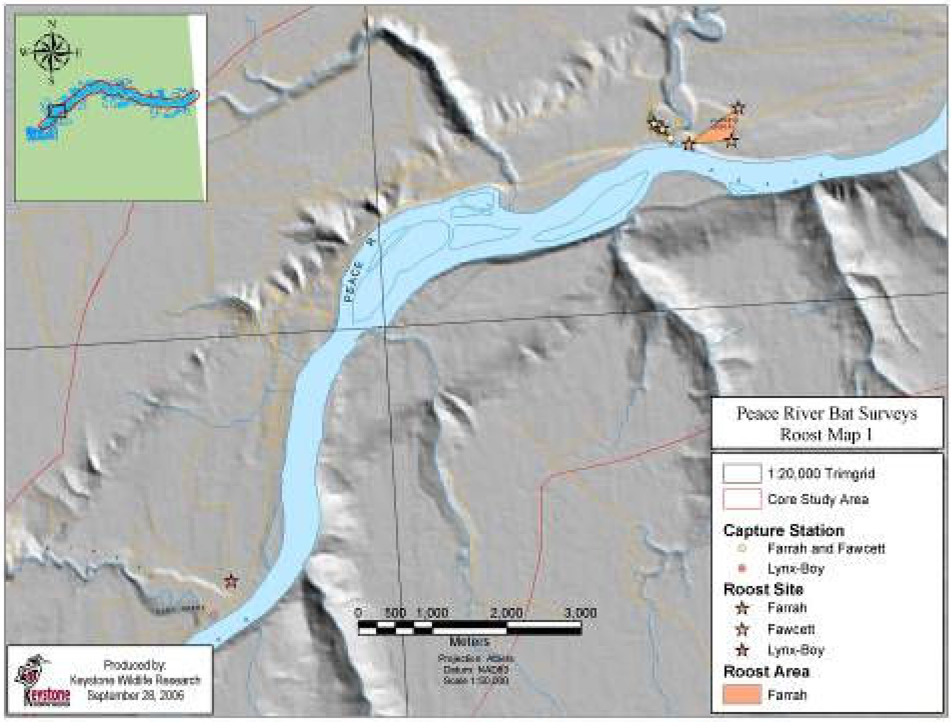

Figure 6. Roosts used by radio-tagged little brown myotis *(*Farrah, Fawcett and Lynx-Boy*).*

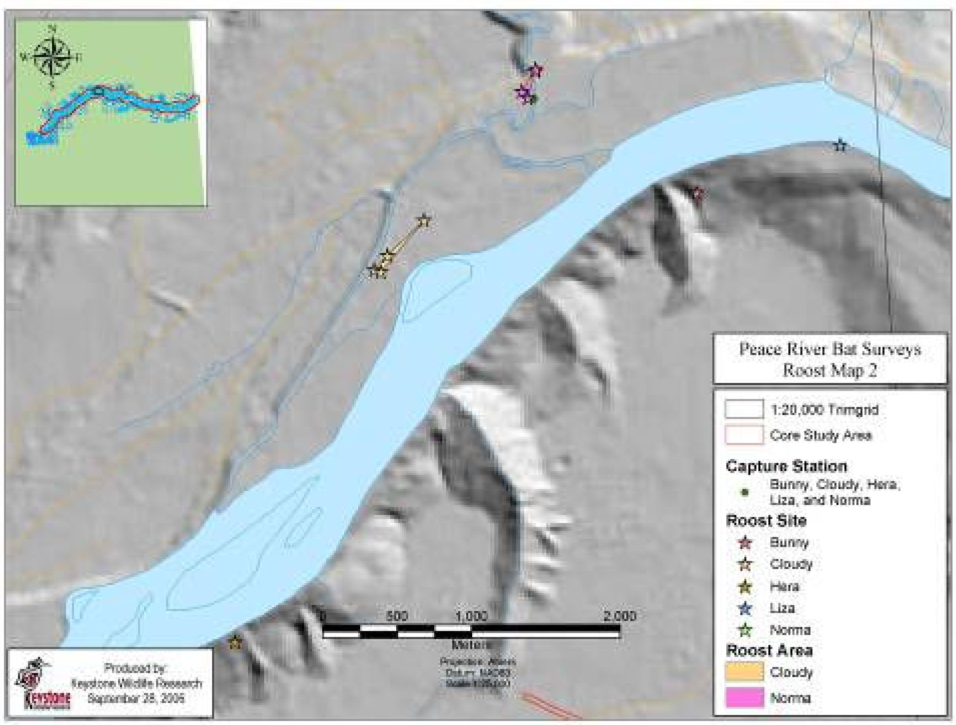

Figure 7. Roosts used by radio-tagged northern myotis (Bunny), silver-haired bat (Cloudy), hoary bat (Hera) and little brown myotis *(*Liza, Norma).

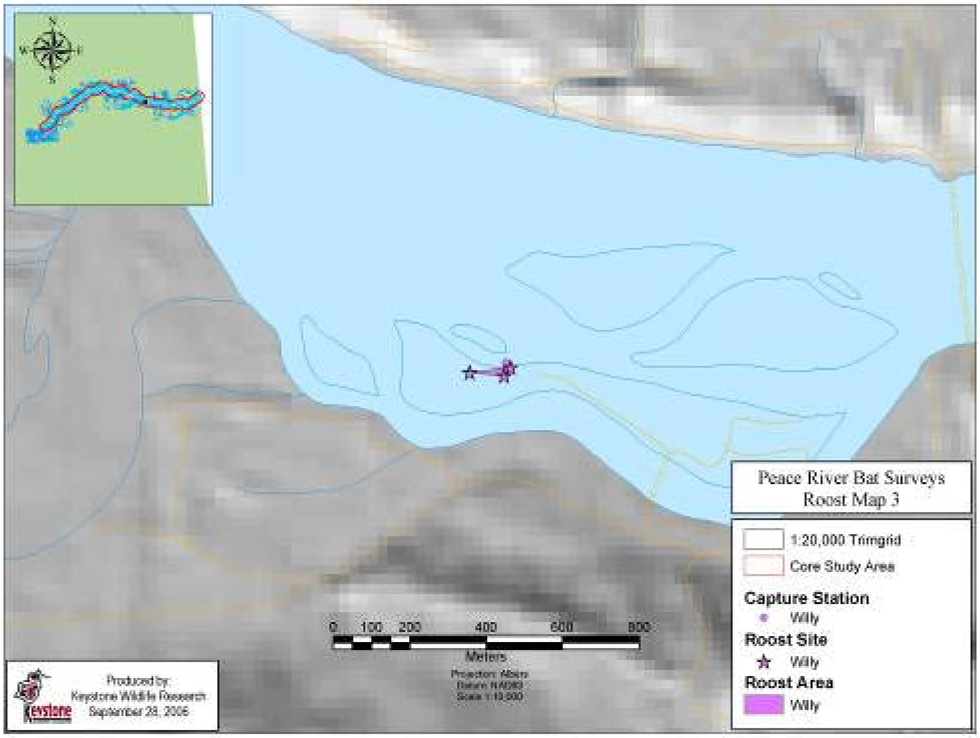

Figure 8. Roosts used by radio-tagged male little brown myotis *(*Willy).

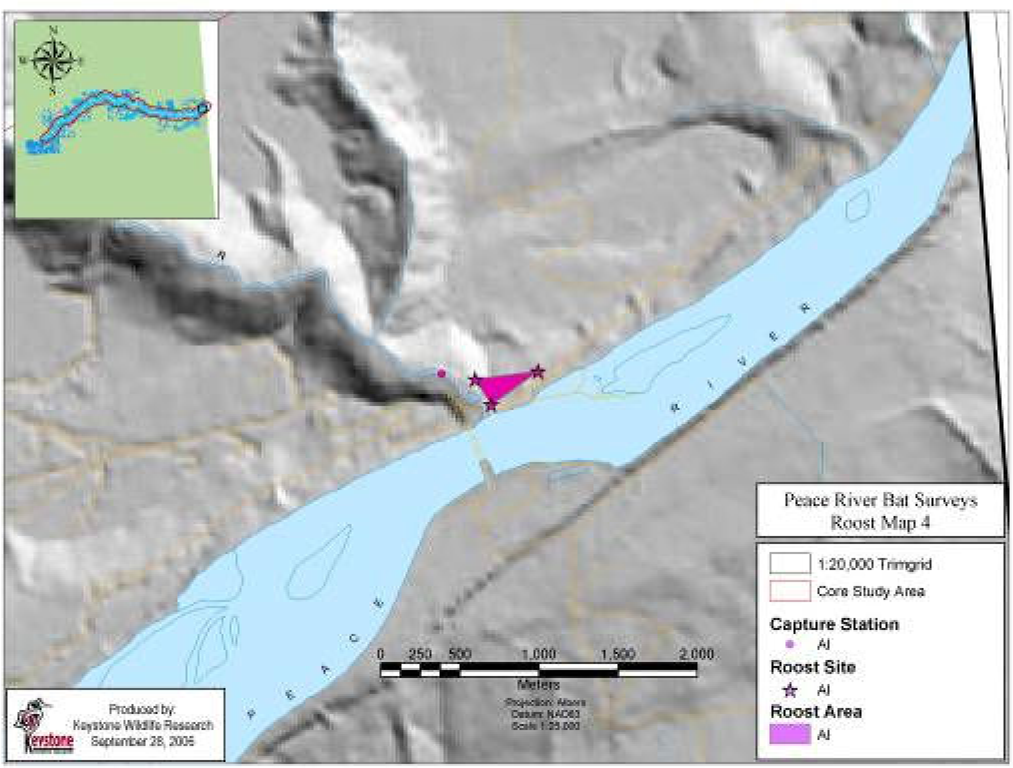

Figure 9. Roosts used by male big brown bat (Al)*.*

Roost Structures

The roost structure used by the lactating female hoary bat could not be confirmed, and has been excluded from the analyses of roost structures. Twenty-two roost structures were identified for the remaining nine radio-tagged bats. Roosts were found in 14 balsam poplar (Act; 64%), 5 trembling aspen (At; 23%), 2 steep cutbanks (9%), and 1 tin-roofed garage (4%). The proportion of structure types used by reproductive females and by other bats (males and a non-reproductive female) are shown in Figure 10.

Unlike landscape-level selection, roost selection by bats is well-documented at the scale of structure and microsite. In general, bats are known to select roost trees that are relatively old, large, in mid-stages of decay, and in more open areas compared to random trees and sites. These results have been found to apply to many species across many habitats, including boreal forests (Crampton and Barclay 1998; Kellner 1999; Vonhof and Wilkinson 2000; Psyllakis 2001).

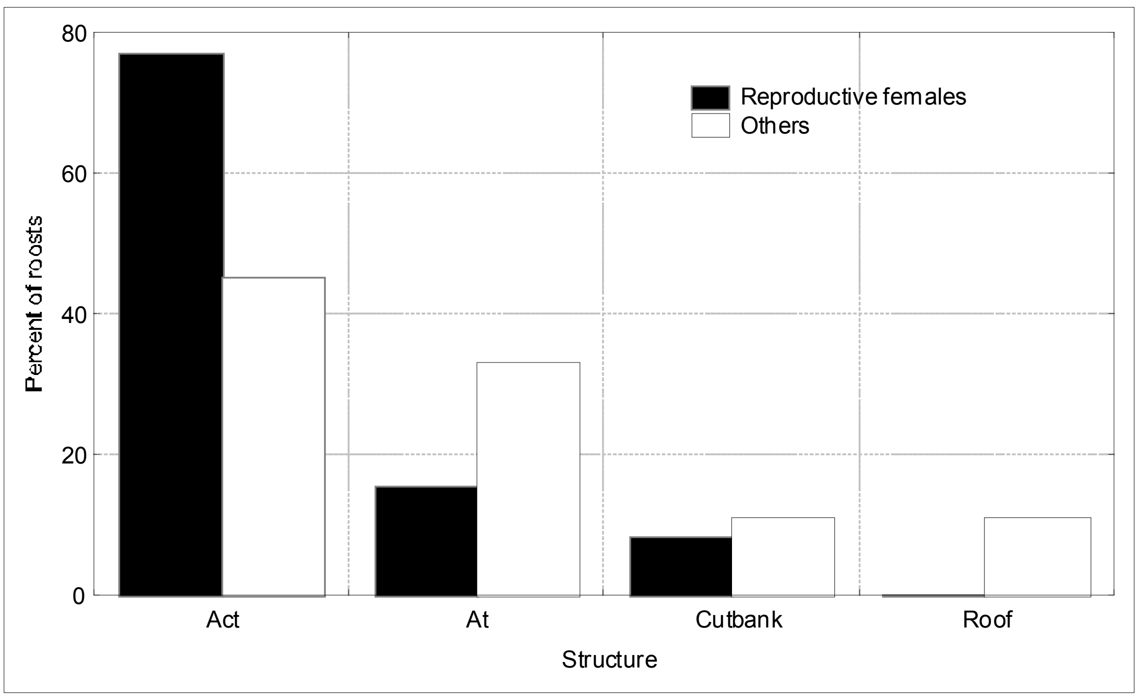

Figure 10. Roost structures used by 5 reproductive female bats (13 roosts) and 4 other bats (9 roosts).

Little brown myotis (n = 6) roosted primarily in large balsam poplar trees and the silver-haired bat (n=1) used balsam poplars exclusively. The use of balsam poplars likely reflects the abundant roost features offered by mature balsam poplars, including large exfoliating bark flakes and cavities from dropped limbs. It likely also reflects the open nature of mature balsam poplar stands and the proximity to foraging areas such as wetlands and sloughs. Research in aspen-, spruce-, or pine-dominated forests or in mixedwood forests has found that bats (including little brown myotis, northern myotis, long-legged myotis, and silver-haired bat) roosted primarily in balsam poplar and aspen trees (Vonhof *et al.* 1997; Crampton and Barclay 1998; Kalcounis and Brigham 1998; Vonhof and Wilkinson 2000; Psyllakis 2001). The literature and this study suggest that this tree species may be valuable to a range of bat species, particularly as habitat for reproductive females.

Use of aspen, with appropriate microhabitat features, was also observed for several species (big brown bat and little brown myotis). This is consistent with known habitat use by bats in areas without floodplains. Within the Peace corridor, aspen-dominated stands were often denser, resulting in less sun exposure and poorer access for roosting, and they did not appear to provide the numbers of microsites for roosting compared to balsam poplar stands. Nevertheless, aspen forests, particularly older stands or those with damaged trees and heart rot, can provide bat roost habitat.

The lactating female hoary bat was the only bat documented using a conifer-dominated stand. The use of this spruce-dominated forest patch was determined through triangulation to the habitat polygon and was not confirmed on the ground since it was on the inaccessible south side of the river. The use of spruce stands is consistent with other observations of hoary bat roosting habitat and reflects the biology of this foliage-roosting species (Nagorsen and Brigham 1993; Willis and Brigham 2005). The value of old coniferous stands in the Peace area as roosting habitat for most bat species is uncertain, but deciduous stands likely have more value based on their prominence in the study area and the propensity of balsam poplars to develop cavities and loose bark. Bats in the Liard area and in northern Alberta were only documented roosting in deciduous trees, caves, and old houses (Vonhof *et al.* 1997; Wilkinson *et al.* 1995; Crampton and Barclay 1998). Work in the Sub-Boreal Spruce zone near Prince George has found non-maternity roosts for *Myotis* species in lodgepole pine trees of decay class 4 and 5 (Psyllakis 2001), and roosts in conifers are well-documented in more southern areas (e.g., Barclay and Brigham 1995; Kellner 1999; Kellner and Rasheed 2002).

Cutbanks were used by 2 of the 10 radio-tagged bats. One cutbank was used once by a male big brown bat and a lactating northern myotis used another exclusively. The low capture success and low body weight of captured northern myotis precluded tagging any other bats of this listed species. Other work on the northern myotis in western Canada has identified day roosts in trees (aspen or balsam poplar) (Vonhof *et al.* 1997; Vonhof and Wilkinson 2000; Psyllakis 2001) and a cabin (Wilkinson *et al.* 1995).

Eight roost trees used by 3 female, reproductively active little brown myotis were located (Figure 11). Six of these roosts were in large (avg. dbh = 53.5 cm) balsam poplars and two were in trembling aspen (avg dbh = 31.6 cm). The lactating silver-haired bat used 4 balsam poplar snags with an average diameter of 69.8 cm (Figure 11). The lactating northern myotis roosted in a cutbank, high on the south shore of the Peace River. The cutbank face offered numerous potential roost sites such as Bank Swallow (*Riparia riparia*) cavities and erosion features. The forest composition of the habitat polygon (located through triangulation) that contained at least one roosting site for the lactating hoary bat indicates use of conifers, although this was not confirmed.

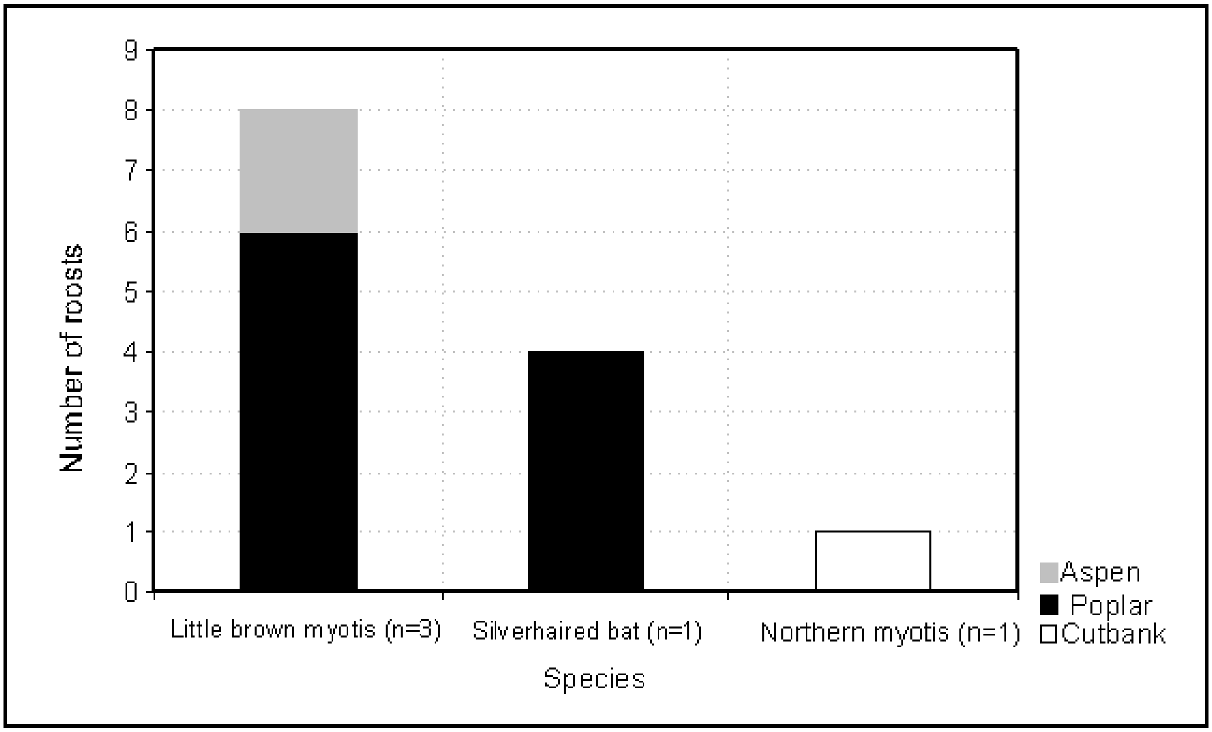

Figure 11. Roost structures used by reproductive female bats.

Six roost structures used by non-reproductive little brown myotis were also located (2 males and 1 female, Figure 12). Five of these were in trees (4 large balsam poplar, 1 trembling aspen) and 1 was in a tin-roofed shed. A single male big brown bat used 2 trembling aspen roosts and 1 steep cutbank.

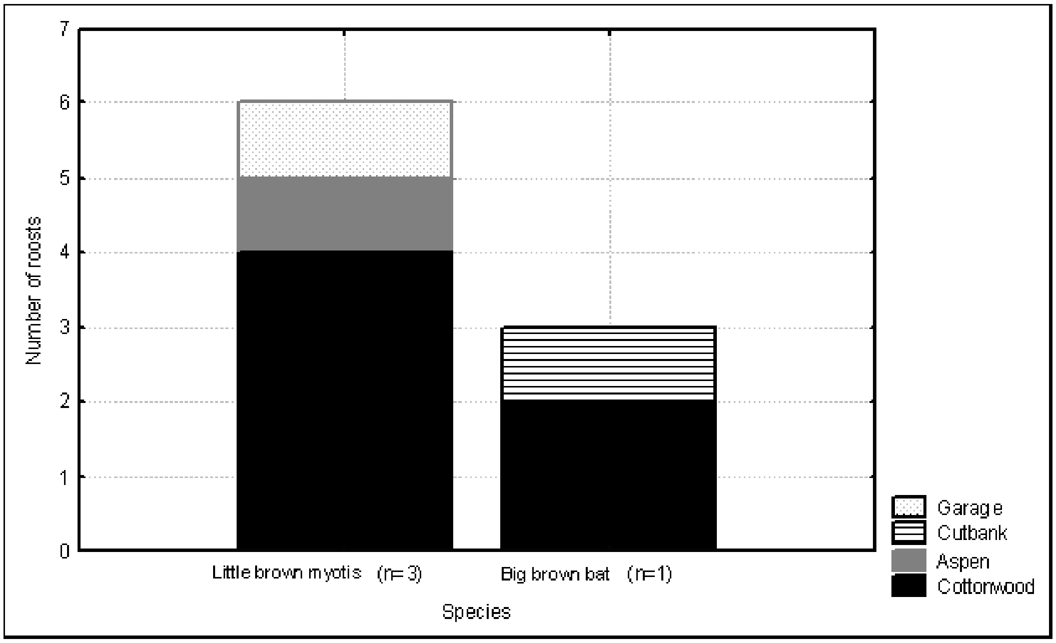

Figure 12. Roost structures used by male and non-reproducing female bats.

Bats that roosted in trees generally used large-diameter trees or snags (Table 7), in appearance classes 2 (injured or dying) through 7 (standing stub) (Figure 13). Roost trees offered specific microsites such as small to large pieces of exfoliating bark, cracks in a bole, healing scars where branches had dropped, and obvious cavity entrances into trees with heart rot.

Table 7. Quantitative characteristics of trees used as roosts by bats.

Characteristic	Average	Range	# of trees
Diameter at breast height (cm)	55.8	23 - 133	23
Estimated height (m)	14.1	3.5 - 25	20
Bark remaining (%)	73.4	0 - 100	22

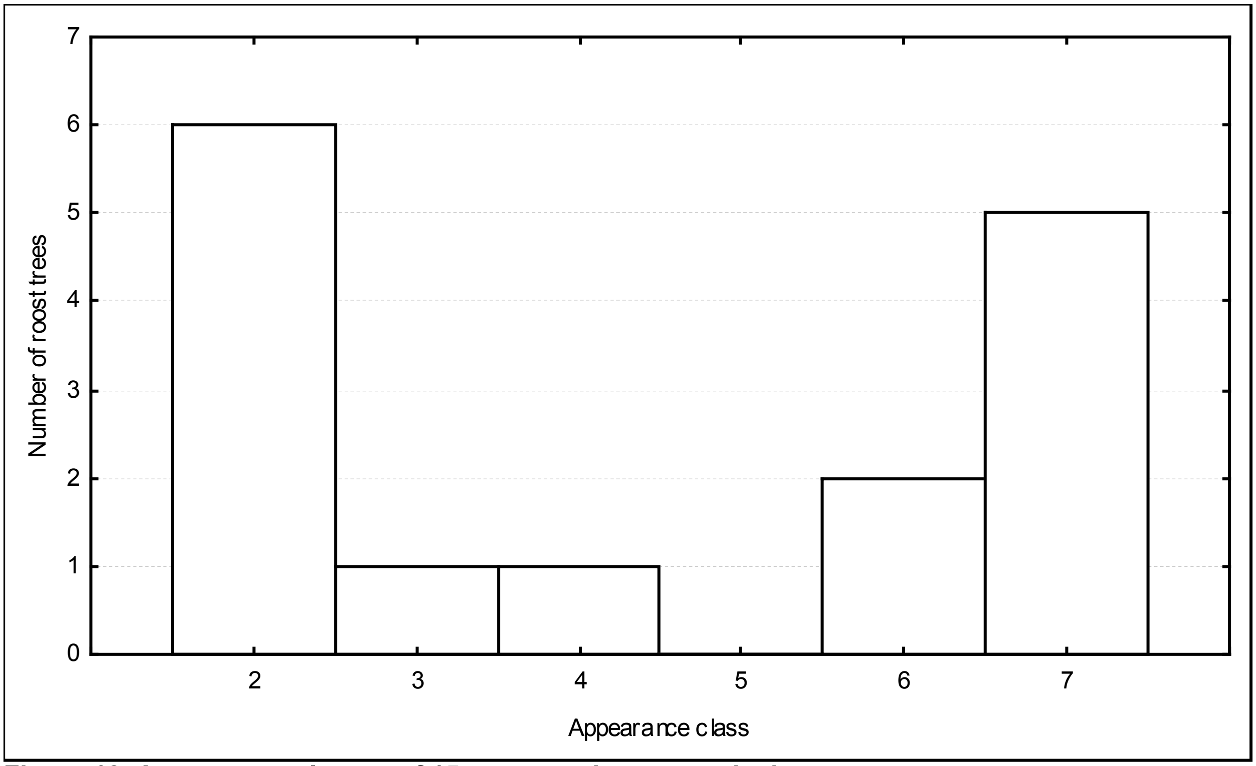

Figure 13. Appearance classes of 15 trees used as roosts by bats.
Classes are from DEIF (Appendix 1).

Roost Habitat Type

Although roost selection is generally thought to be driven by thermal benefits, and protection from the elements and predators for all species, there are interspecific differences in roost use. Bats species are also known to be adaptable in roost selection and local populations can be found using different roosts types throughout their range. Therefore, any conclusions about roosting habitat must consider the species involved and the regional habitat available. Habitat types referenced in this section are described in Appendix 3.

Little quantitative work has been done on landscape-level selection of habitat types, which in the case of bats may reflect a combination of factors such as availability of roost structures and their spatial location relative to foraging sites. Arguably, the best evidence for the value of a habitat type is simply the frequency of use regardless of availability (Garshelis 2000).

Thirteen of the 23 roosts were located in Balsam poplar-Horsetail habitat (SHac), indicating a relatively heavy use of this habitat type (Table 8). Within the Balsam poplar-Horsetail habitat, both structural stage groupings 3 - 4 (shrub to pole-sapling) and 5 - 6 (young to mature) were used more than expected (Figures 14 and 15). However, bats found roosting in structural stage grouping 3 – 4 were found in remnant balsam poplar snags. These features are likely the result of disturbance (fire) and are not typical of these structural stages, which are dominated by shrubs and small, densely spaced trees.

Cutbanks were used more than expected. Aspen –Rose habitats (AMap) in structural stage 5 - 6 were used approximately in proportion to availability, while other habitat types (AMap structural stage 3 - 4 and Spruce-Wildrye (SW) structural stage 5 - 6) were used less than available. Use of rural habitats was due entirely to a single bat roosting in a shed for the entire sample period.

Table 8. Summary of ecosystem units* containing day roosts used by radio-tagged bats.

Ecosystem unit name	Code	Structural stage	Number of roosts
Balsam poplar – Horsetail	SHac	4[1]	1
		6	2
Balsam poplar - Horsetail floodplain, active floodplain, drier than typical	Fm02x	6	1
Balsam poplar - Horsetail floodplain, active floodplain	Fm02	5	1
		6	3
		3b[1]	5
Balsam poplar forest total			**13 (57%)**
Aspen – Dogwood	AMap-y	5	2
Aspen - Rose – Saskatoon, warm aspect	AMap-w	4	1
Aspen - Rose - Showy Aster	AMap	4	1
		5	2
Aspen forest total			**6 (26%)**
Cutbank	CB	1	2
Cutbank total			**2 (9%)**
Spruce - Fuzzy-spiked wildrye, cool aspect	SW-k	6	1
Spruce forest total			**1 (4%)**
Rural	RW		1
Rural total			**1 (4%)**
All total			**23**

[1]Structural stages 3b and 4 were only used when veteran snags were present.
*see Appendix 3 for explanation of ecosystem unit names.

The use of habitats was also examined in relation to their availability in the present landscape. This was completed to investigate the relative preference for different habitat types. This analysis is based on a relatively small data set and the results should be considered with caution, however, it is presented to provide some insight into the habitat associations for bat species in the Peace River study area.

Assessment of use versus availability can be carried out in many ways, and how "available" habitat is quantified can affect the results of an analysis (Garshelis 2000; Manley *et al.* 2002). Available habitat was defined as a 730 m fixed-radius circle around the roosting area (centre point). This represented the approximate home range of the radio-tagged bats and corresponds to the average commuting distance between roost and capture sites. At this scale, bats strongly preferred valley-bottom balsam poplar habitats and cutbanks (Figure 14 and 15). The preference for balsam poplar habitats in the Peace Corridor likely reflects an abundance of preferred roost structures (large balsam poplar trees and snags).

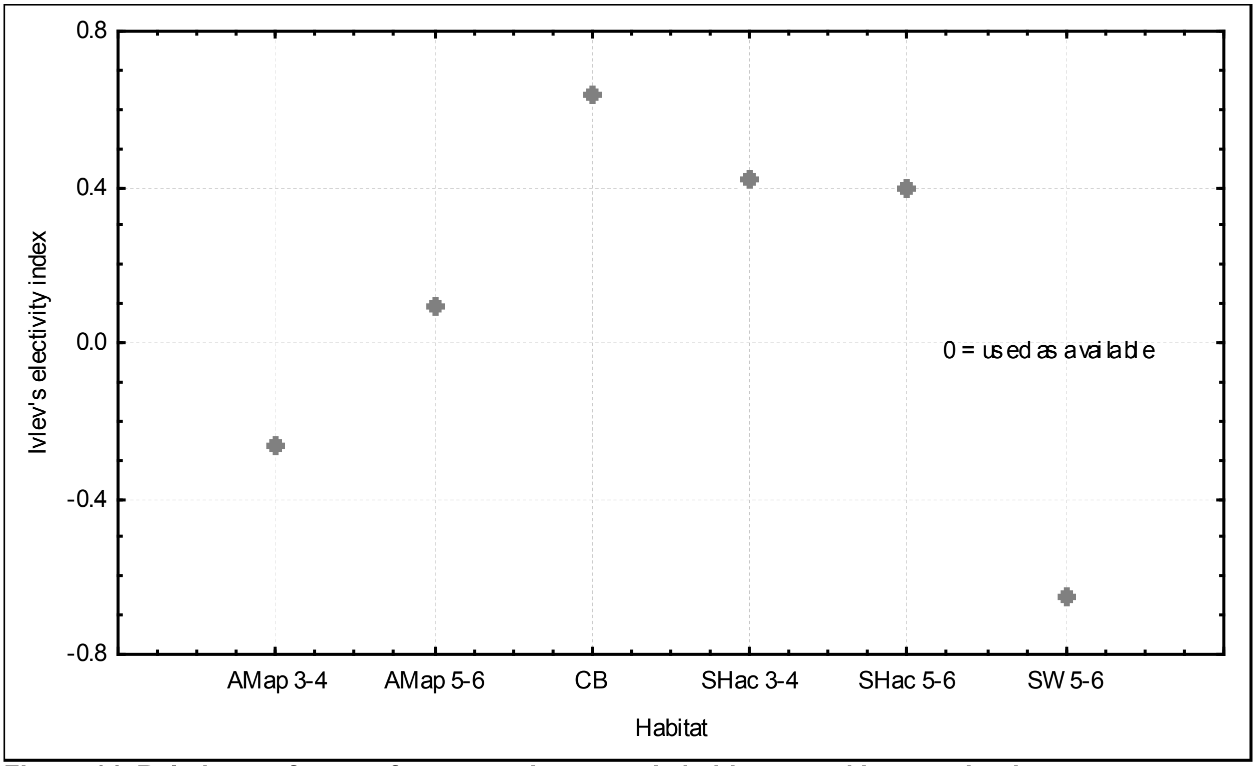

Figure 14. Relative preference for non-anthropogenic habitats used by roosting bats.
Ivlev's index ranges from –1 (not preferred) to 0 (used as available) to +1 (strongly preferred). All available but unused habitats had an Ivlev's index of –1, and are not included in the graph.

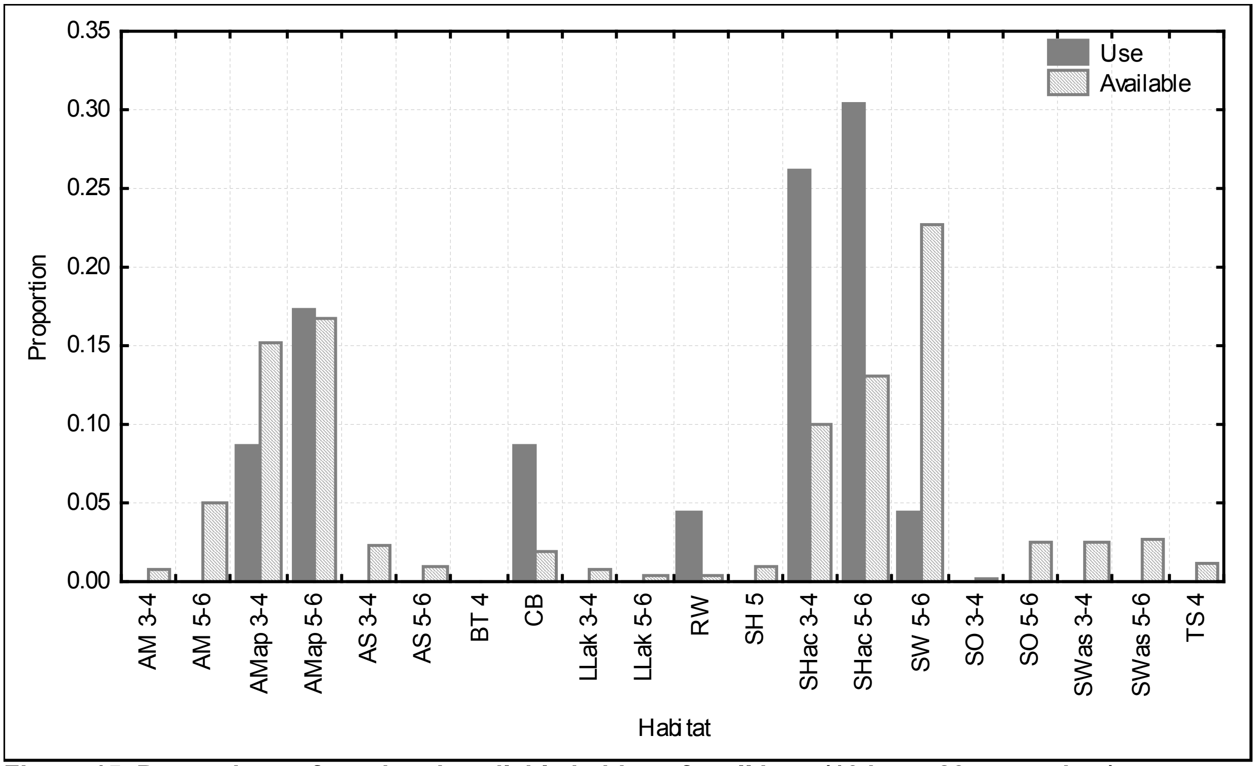

Figure 15. Proportions of used and available habitats for all bats (10 bats, 23 roost sites).
See Appendix 3 for definitions of habitat codes.

The use of habitats was also examined in relation to their availability for each species (Figure 16-20). This analysis is based on a relatively small data set and the results should be considered with caution, however it is presented to provide some insight into the habitat associations for bat species in the Peace River study area.

Some differences were observed between species, but due to the low numbers of radio-tagged bats, a statistical comparison of use/availability across species was not completed.

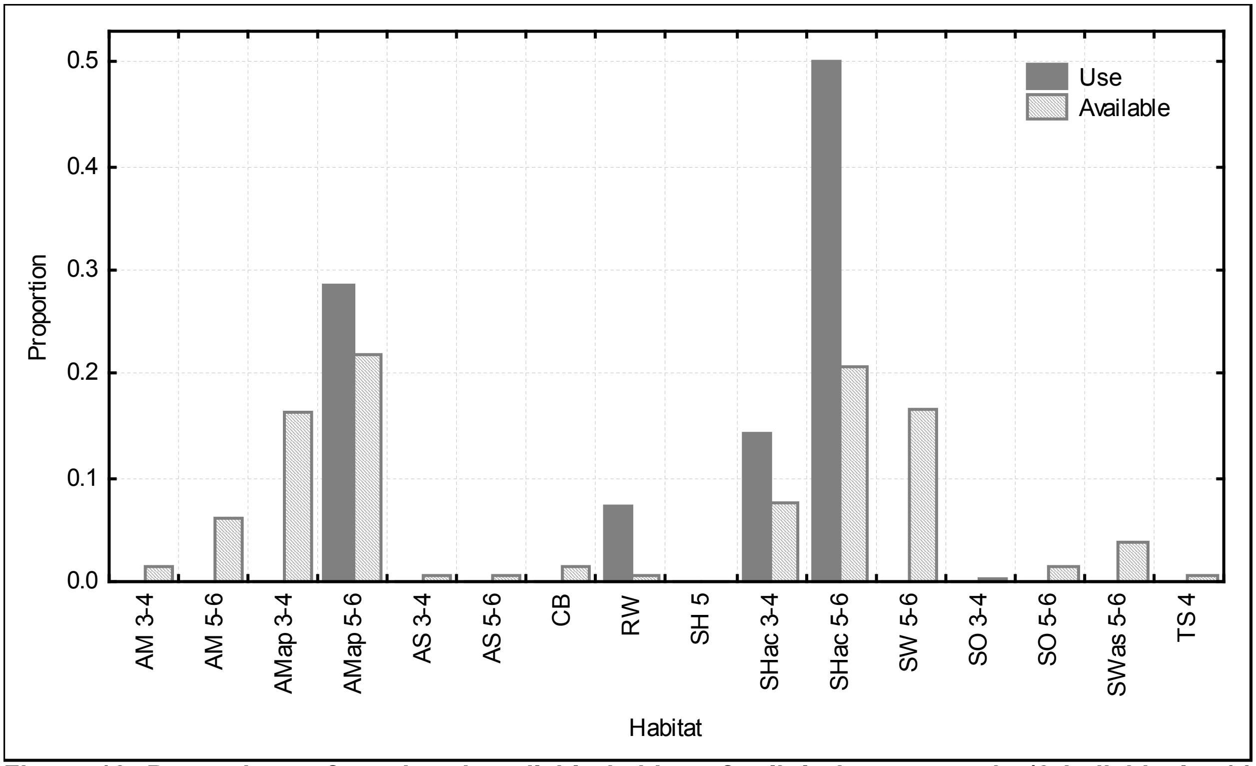

Figure 16. Proportions of used and available habitats for little brown myotis (6 individuals, 14 roost sites).
See Appendix 3 for definitions of habitat codes.

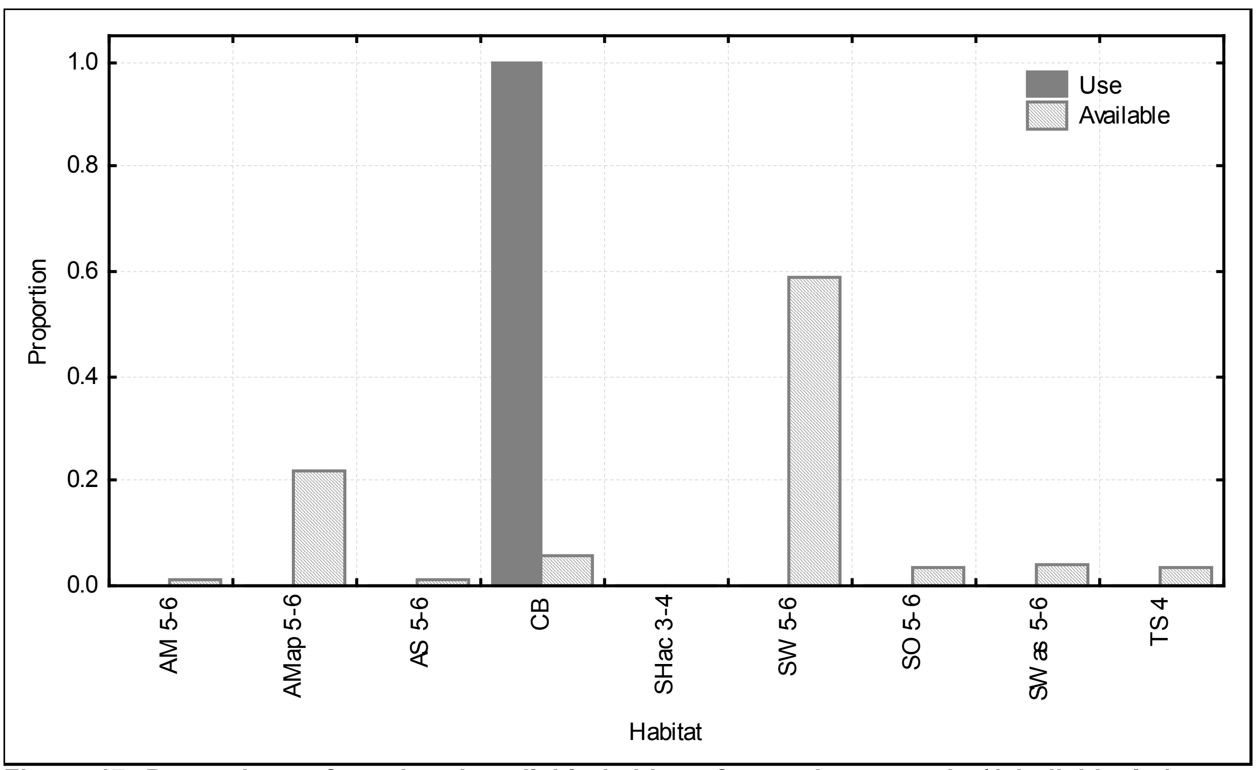

Figure 17. Proportions of used and available habitats for northern myotis (1 individual, 1 roost site).
See Appendix 3 for definitions of habitat codes.

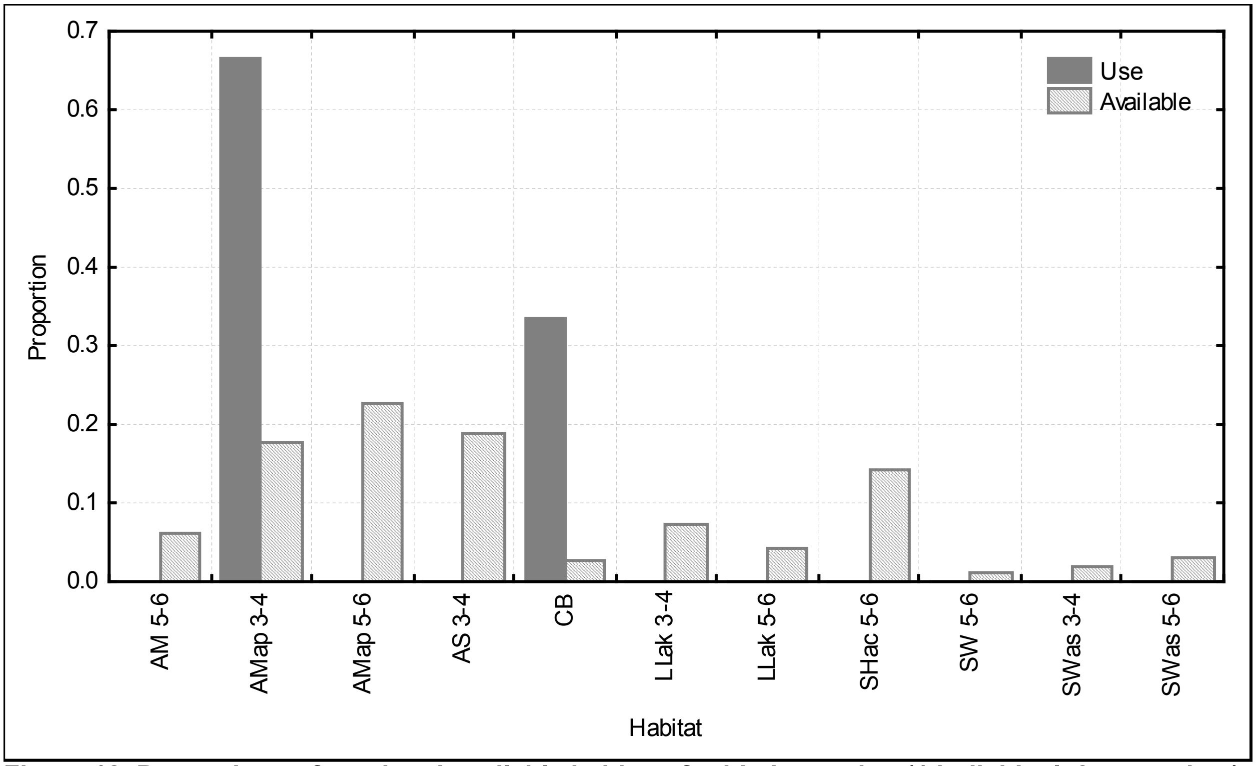

Figure 18. Proportions of used and available habitats for big brown bat (1 individual, 3 roost sites). See Appendix 3 for definitions of habitat codes.

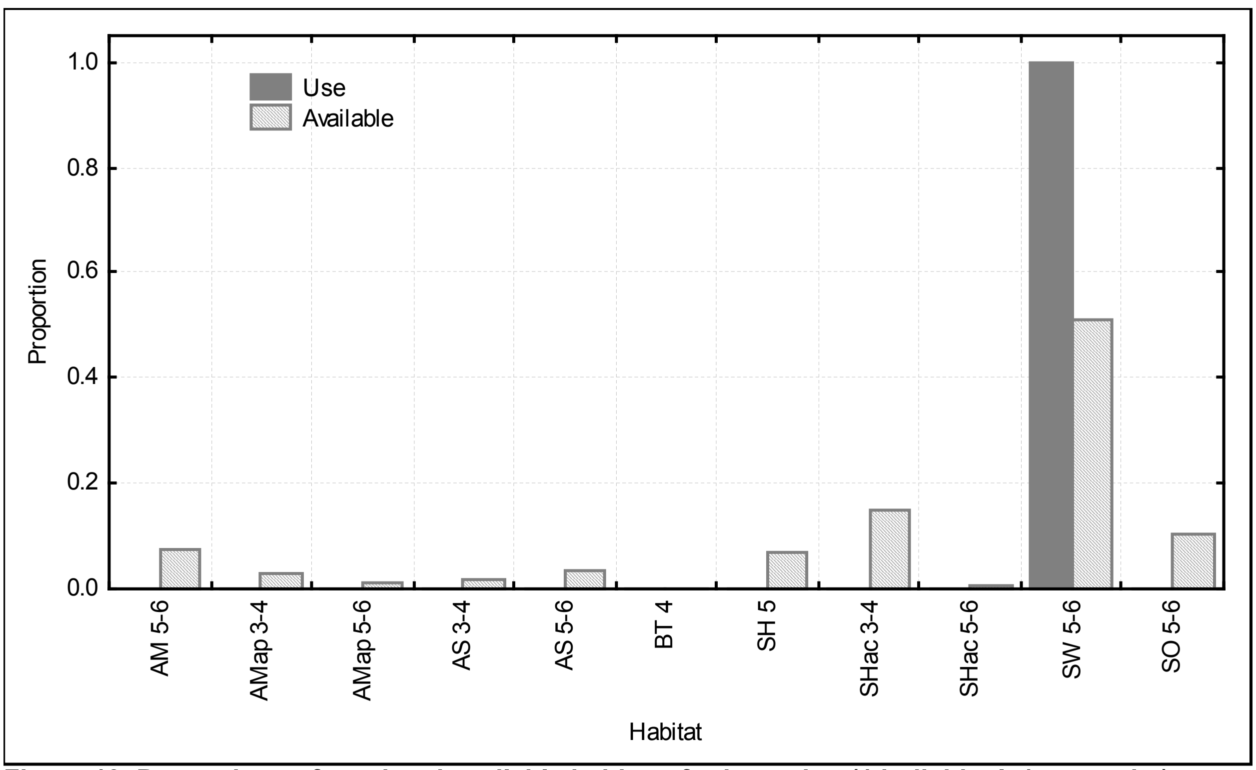

Figure 19. Proportions of used and available habitats for hoary bat (1 individual, 1 roost site). See Appendix 3 for definitions of habitat codes.

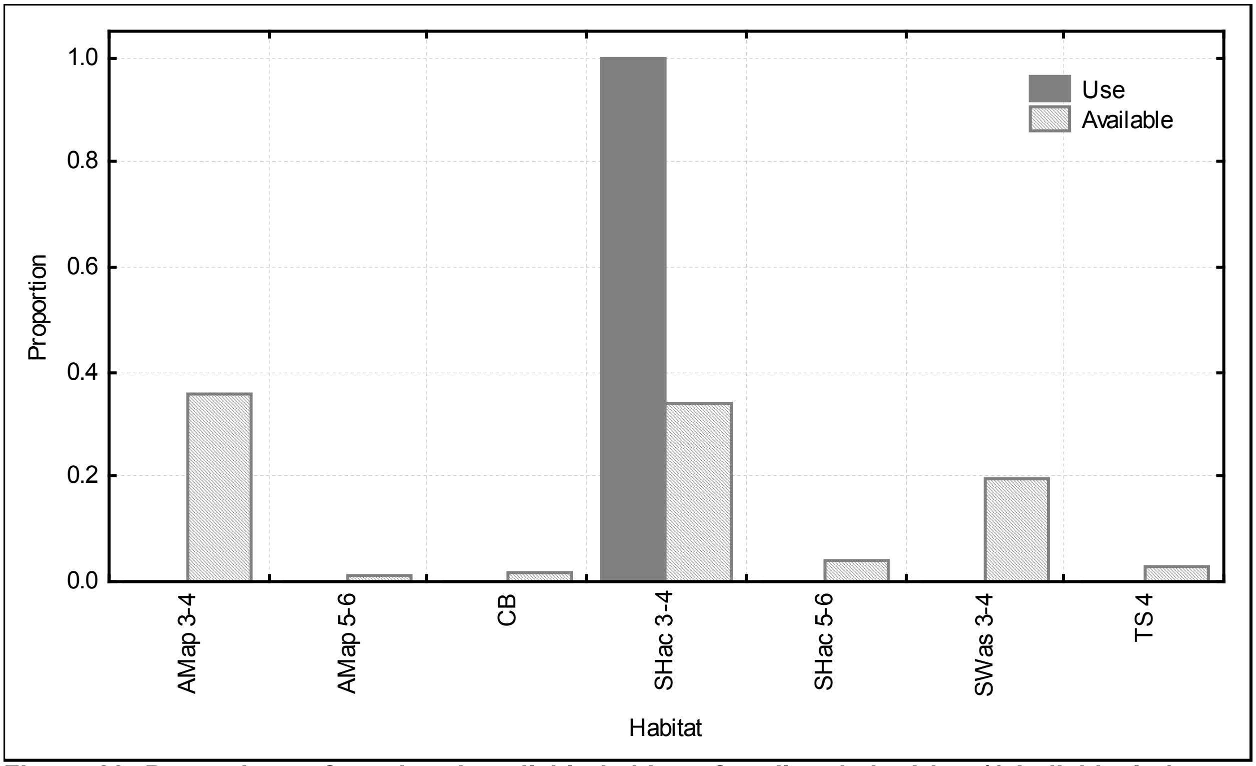

Figure 20. Proportions of used and available habitats for silver-haired bat (1 individual, 4 roost sites).
See Appendix 3 for definitions of habitat codes.

Based on the results and observations from this study, and information on bat roosting requirements from other studies in northern BC and Alberta, a preliminary draft habitat suitability ratings table for bat roosting habitat was developed (Appendix 4). This table identifies ecosystem units from the draft TEM map (Keystone Wildlife Research Ltd. 2007) that are likely to be suitable for bat species. The rating scheme is consistent with the four-class rating scheme outlined in the RIC (1999) wildlife habitat ratings standards. All bat species were rated as one species group since species-specific habitat preferences can not be represented at this scale. The most suitable roosting habitats are assumed to be old balsam poplar floodplains and the least suitable sites are young forests. Polygon ratings should be increased when emergent (protruding) and/or remnant balsam poplar snags are present.

Data Limitations

The data reported here are based upon small sample sizes (temporally, number of individuals radio-tracked and number of roosts located) due the logistical difficulties of bat capture and radio-telemetry, as well as technological limitations. Some data were pooled across species (i.e. the detector data), which may obscure differences in habitat use between species. In addition, activity data may not accurately reflect the use of particular habitats as the numbers of individuals recorded cannot be determined (Miller *et al.* 2003). The inferential ability of this study is limited by the factors described above as it may not accurately represent biology of all bat populations in the study area.

4.0 RECOMMENDATIONS

The primary objectives of this study were to determine species presence and to identify roosting habitat in the Peace River Corridor, from Hudson's Hope to the Alberta border. Sampling effort was concentrated in suspected high-use areas that were suitable for netting to maximize the number of bats captured. Consequently, little information was obtained on the use of some habitat types, particularly coniferous forests and dry ecosystem units. The relative use data that was collected for the six broad habitat types (mature aspen forest, balsam poplar floodplain forest, river edge, slow-moving creek, wetland, and forest edge habitat) can be loosely extrapolated to the TEM ecosystem units but additional surveys are required to confirm suitability and verify the draft habitat ratings.

Additional studies are recommended to measure relative activity of bats in the TEM units. This can be completed by detector surveys to determine relative activity. The study area should include multiple detector sites in habitats in the TEM-mapped area. Mist netting and radio-tagging of bats should also be incorporated to continue to investigate species presence and roost selection in the Peace River Corridor.

Information obtained will be used to verify the assumed habitat associations between bats and the TEM ecosystem units. The preliminary draft habitat suitability ratings can then be updated and a habitat suitability map can be created. This map will represent the predicted distribution of bat species in the study area.

Future surveys can also provide additional information on the Blue-listed northern myotis. Because of the low capture rate for this species, projects focussing solely on northern myotis are not feasible, however more information can be obtained as a component of a larger project. Any suitable adults captured should be radio-tagged to obtain additional information on roosting habitat for this species in the study area.

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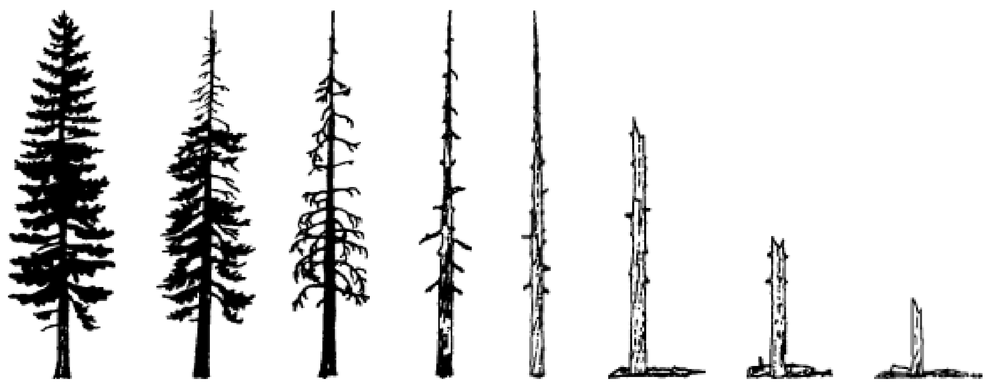
Appendix 1. Roost tree description parameters used in the field.
(From BC MoE and MoF 1998, Describing Ecosystems in the Field)

Crown Class Indicate the position of the tree in relation to other trees in the surrounding area	**D Dominant**	Trees with crown extending above the general level of the layer; somewhat taller than the codominant trees, and have well developed crowns, which may be somewhat crowded on the sides.
	C Codominant	Trees with crowns forming the general level of the crown canopy; crown is generally smaller than those of the dominant trees and usually more crowded on the sides.
	I Intermediate	Trees with crowns below, but extending into the general level of the crown canopy; crowns usually small and quite crowded on the sides.
	S Suppressed	Trees with crowns entirely below the general level of the crown canopy.
Appearance Choose the illustration that best represents the appearance of the tree, using the shape of the tree stem as the dominant characteristic.	 **1 2 3 4 5 6 7 8**	
Crown condition rate the condition of the crown in relation to a normal live crown. Note: lower crown loss due to self-pruning is not counted as foliage or branch loss.	**1**	All foliage, twigs, and branches present
	2	Some or all foliage lost; possibly some twigs lost; all branches usually present; possible broken top
	3	No foliage present; up to 50% of twigs lost; most branches present; possible broken top
	4	No foliage or twigs present; up to 50% of branches lost; top usually broken
	5	Most branches gone; some sound branch stubs remain; top broken
	6	No branches present; some sound and rotting branch stubs, top broken
Bark retention Indicate the proportion of bark remaining on each tree	**1**	All bark present
	2	Bark lost on damaged areas only (< 5% lost)
	3	Most bark present; bare patches; some bark may be loose (5–25% lost)
	4	Bare sections; firm and loose bark remains (26–50% lost)
	5	Most bark gone; firm and loose bark remains (51–75% lost)
	6	Trace of bark remains (76–99% lost)
	7	No bark (100% lost)
Wood condition Classify the texture (soundness) of the wood	**1**	No decay
	2	Probable limited internal decay and/or deformities
	3	Wood essentially hard; limited decay
	4	Wood mostly hard, but decay spreading; soft wood present
	5	Balance of hard and soft wood; spongy sections
	6	More soft and spongy wood than hard wood
	7	No more hard wood; all soft or spongy; powdery sections
	8	Hollow shell; outer wood mostly hard or firm

Appendix 2. Capture location, date, species, sex, reproductive condition, and morphological measurements for bats captured in the Peace River Corridor, 2005 – 2006.

Site	Date	Species1	Sex	Reproductive Condition[2]	Age Class[3]	Weight[4] (g)	Forearm length (mm)	Keel present	Foot (mm)
Peace Island Wetland	23-Aug-05	MYVO	M	AB	A	7.0	38.0	Y	8.0
Cache Creek	25-Aug-05	MYLU	F	PL	A	8.5	39.5	N	9.0
Cache Creek	25-Aug-05	MYLU	F	NO	J	8.0	37.5	N	9.8
Cache Creek	25-Aug-05	MYSE	M	AB	A	6.3	39.0	N	9.0
Cache Creek	25-Aug-05	MYVO	M	NO	J	7.0	37.5	Y	6.0
Farrell Creek	26-Aug-05	MYLU	F	PR	A	13.0	38.0	N	9.0
Lynx Creek	28-Aug-05	MYLU	M	AB	A	10.5	38.5	N	big
Gravel Pit Swamp	29-Aug-05	MYLU	M	AB	A	9.5	39.0	N	9.0
Peace Island Wetland	11-Jul-06	MYLU	M	AB	A	8.4	38.5	N	big
Peace Island Wetland	11-Jul-06	MYLU	F	NO	J	8.1	38.2	N	
Peace Island Wetland	11-Jul-06	MYLU	F	LA	A	9.2	38.3	N	
Cache Creek	13-Jul-06	LACI	F	LA	A	32.0	55.8	N	
Cache Creek	13-Jul-06	LANO	F	PR	A	14.8	40.2	N	
Cache Creek	13-Jul-06	LANO	F	PR	A	14.8	44.8	N	
Cache Creek	13-Jul-06	MYLU	F	PR	A	9.5	40.3	N	big
Cache Creek	13-Jul-06	MYSE	F	LA	A	7.6	38.8	N	
Cache Creek	13-Jul-06	MYLU	F	PR	A	8.7	36.0	N	big
Alces River	15-Jul-06	EPFU	M	AB	A	19.6	45.9	Y	
Alces River	16-Jul-06	LANO	F	PR	A	16.4	40.8	N	
Alces River	16-Jul-06	MYLU	M	NO	J	8.2	39.3	N	big
Alces River	16-Jul-06	LANO	M	NO	J	9.7	41.5	N	
Peace Island Wetland	17-Jul-06	MYLU	F	PL	A	9.4	39.3	N	8.2

Site	Date	Species1	Sex	Reproductive Condition[2]	Age Class[3]	Weight[4] (g)	Forearm length (mm)	Keel present	Foot (mm)
Cache Creek	28-Jul-06	MYLU	M	NO	J	7.7	40.1	N	big
Cache Creek	28-Jul-06	LANO	F	LA	A	16.3	41.8	N	
Cache Creek	28-Jul-06	MYLU	M	NO	J	7.5	36.2	N	big
Lynx Creek	30-Jul-06	MYLU	M	AB	A	7.7	36.4	N	
Lynx Creek	30-Jul-06	MYSE	M	AB	A	5.5	35.6	N	
Farrell Creek	31-Jul-06	MYLU	F	NO	J	7.1	36.4	N	big
Farrell Creek	31-Jul-06	MYLU	F	PL	A	8.8	37.5	N	big
Farrell Creek	31-Jul-06	MYLU	F	NO	J	6.1	36.1	N	big
Farrell Creek	31-Jul-06	MYSE	M	NO	J	5.6	36.7	N	big
Farrell Creek	3-Aug-06	MYLU	F	RE	A	8.6	40.8	N	big
Cache Creek	4-Aug-06	EPFU	M	AB	A	16.9	46.5	Y	big
Cache Creek	4-Aug-06	LACI	M	AB	A	21.4	52.4	N	
Cache Creek	4-Aug-06	MYLU	F	PL	A	8.8	38.3	N	big

[1] MYVO = *Myotis volans*, MYLU = *Little brown myotis*, MYSE = *Northern myotis, LANO* = *Lasionycteris noctivagans*, EPFU = *Eptesicus fuscus*, LACI = *Lasiurus cinereus*
[2] NO = Incapable of Reproduction, AB = Apparently reproductively capable, not currently in a state of potency, PR = Pregnant/gravid, LA = Lactating, PL = Post-Lactating, RE = Apparently reproductively capable, not pregnant/gravid,
[3] A = Adult, J = Juvenile,
[4] weights are not comparable to other studies because some bats were not held for long enough to purge their stomachs.

Photo 2. Little brown myotis.

Photo 3. Long-legged myotis.

Photo 4. Northern myotis.

Photo 5. Big brown bat.

Photo 6. Silver-haired bat.

Photo 7. Hoary bat.

Appendix 3. Definitions of habitat codes.

DRAFT - MAPPED SITE SERIES FOR THE PEACE RIVER *(site units are subject to the Regional Ecologist's approval)* (Feb 10, 2006).

Site Series	2-letter Code	Seral Assoc.	Name	KWR Name	Description	Moisture regime	Dominant Plants	Associated Plants
00	AD		At – Red-osier dogwood - Floodplain	At – Red-osier dogwood - Floodplain	Medium bench floodplain with seepage but limited flooding. Well developed shrub layer. Rich nutrient regime. Adapted from Will MacKenzie's wetland classification.	subhygric - hygric	***Populus tremuloides***, ***Cornus stolonifera***, *Rosa acicularis*, ***Equisetum arvense***, *Aralia nudicaulis*, *Poaceae spp.*	*Amelanchier alnifolia*, *Populus balsamifera*, *Rubus idaeus*, *Symphoricarpos albus*, *Aster conspicuus*, *Lathyrus ochroleucus*, *Maianthemum canadense*, *Rubus pubescens*
00	AH*		Alder – Horsetail - Floodplain	Alder – Horsetail - Floodplain	Low bench floodplain. Coarse soils. Well developed shrub and herb layer. Rich nutrient regime. Adapted from Will MacKenzie's wetland classification (Fl01)	subhygric - hygric	***Alnus incana***, *Rubus idaeus*, *Cornus stolonifera*, ***Equisetum arvense***, *Salix* ssp., *Poaceae* ssp.	*Urtica dioica*
00	AS		SwAt – Soopolallie	At - Saskatoon	Warm aspect slopes (25-100%). Deep, medium - textured soils. Poor nutrient regime. Commonly associated with the WW.	xeric - submesic	***Populus tremuloides***, *Rosa acicularis*, ***Amelanchier alnifolia***	*Symphoricarpos albus*, *Shepherdia canadensis*, *Aster conspicuous*, *Leymus innovatus*
00	BD		Ep – Red-osier dogwood	Ep – Red-osier dogwood	Moist to wet sites with coarse, unstable soils. Dominated by paper birch. Rich nutrient regime. Typically occurs on cool aspect slopes. Adapted from Lea and Lacelle (1989).	mesic - subhygric	***Betula papyrifera***, ***Cornus stolonifera***, *Rosa acicularis*, *Rubus idaeus*, *Equisetum arvense*	*Poplar balsamifera*, *Amelanchier alnifolia*, *Viburnum edule*, *Alnus viridis*, *Picea glauca*, *Ribes lacustre*, *Fragaria virginiana*, *Galium triflorum*, *Pyrola asarifolia*, *Maianthemum canadense*, *Orthilia secunda*
00	RD*		Red-osier dogwood - Floodplain	Red-osier dogwood - Floodplain	Low bench floodplain. Fine textured, poorly drained soils. Characterized by dense dogwood thickets. Rich nutrient regime. Adapted from Will MacKenzie's wetland classification.	subhygric - hygric	***Cornus stolonifera***	*Rosa acicularis*, *Rubus idaeus*, *Equisetum arvense*, *Maianthemum stellatum*, *Solidago spp.*
00	SM*		Sedge Marsh	Sedge Marsh	Wetland occurring on mineral or humic soils with thin peat veneers. Well developed herb layer with scattered shrubs. Medium to rich nutrient regime.	hydric	***Carex utriculata***	*Carex aquatilis*, *Salix spp.*, *Calamagrostis canadensis*

Site Series	2-letter Code	Seral Assoc.	Name	KWR Name	Description	Moisture regime	Dominant Plants	Associated Plants
					Unit adapted from Will MacKenzie's wetland classification (Wm01)			
00	SE*		Sedge Fen	Sedge Fen	Wetland with a deep peat substrate. Well developed herb layer with scattered shrubs. Medium nutrient regime. Unit adapted from Will MacKenzie's wetland classification (Wf01)	hydric	***Carex aquatilis***	*Carex utriculata, Salix spp., Equisetum fluviatile*
00	TS		Tamarack - sedge – Fen	Tamarack - sedge – Fen	Wetland with deep peat substrate. Hummocky. Scattered trees, herb layer dominates. Poor to medium nutrient regime. Unit adapted from Will MacKenzie's wetland classification (Wb06)	subhydric - hydric	***Larix laricina, Carex aquatilis***	*Picea mariana, Betula nana, Salix spp., Ledum groenlandicum*
00	WD*		Willow – Red-osier dogwood – Horsetail – Floodplain	Willow – Red-osier dogwood – Horsetail – Floodplain	Low bench floodplain. Fine to medium textured soils. Medium to rich nutrient regime. Unit adapted from Will MacKenzie's wetland classification (Fl03)	hygric	***Salix* ssp., *Equisetum arvense***	*Alnus incana, Cornus stolonifera*
00	WF*		Willow – Bluejoint - Floodplain	Willow – Bluejoint - Floodplain	Low bench Floodplain. Fine textured silts and sands. Medium to rich nutrient regime. Unit adapted from Will MacKenzie's wetland classification (Fl05)	Subhygric - hygric	***Salix spp., Calamagrostis canadensis***	*Alnus incana, Equisetum arvense, Populus balsamifera*
00	WB*		Willow – Bluejoint - swamp	Willow – Bluejoint – Swamp	Swamps occurring on fluvial terraces. Fine textured soils with veneers of woody peat. Rich nutrient regime. Unit adapted from Will MacKenzie's wetland classification (Ws03)	Hygric – subhydric	***Salix spp., Calamagrostis canadensis***	*Cornus stolonifera, Alnus incana, Lonicera involucrata, Carex utriculata*
00	WS*		Willow – Sedge - Swamp	Willow – Sedge - Swamp	Swamps experiencing prolonged saturation from fluvial systems. Medium to rich nutrient regime. Unit adapted from Will MacKenzie's wetland classification (Ws06)	subhygric	***Salix* ssp., *Carex utriculata***, *Equisetum arvense*	*Carex sitchensis, Alnus incana, Calamagrostis canadensis*
00	WW*		Wolf willow - Fuzzy-spiked Wildrye	Wolf willow - Fuzzy-spiked Wildrye	Steep (25-100%), warm aspect slopes. Deep, medium - textured soils. Well developed herb layer with stunted shrubs. Poor nutrient regime. Commonly associated with the AS.	xeric - submesic	*Elaeagnus comutata*, ***Leymus innovatus, Amelanchier alnifolia***	*Symphoricarpos albus, Rosa acicularis, Artemisia frigida*

Site Series	2-letter Code	Seral Assoc.	Name	KWR Name	Description	Moisture regime	Dominant Plants	Associated Plants
01	AM		SwAt - Step moss	SwAt – Rose	Gentle to moderate slope. Deep, fine-textured soil. Poor to rich nutrient regime.	Submesic - mesic	*Picea glauca, Populus tremuloides,* ***Rosa acicularis****, Leymus innovatus*	*Shepherdia canadensis, Linnaea borealis, Fragaria virginiana, Aster conspicuus, Lathyrus ochroleucus*
02	LL		Pl - Lingonberry - Velvet-leaved blueberry	Pl - Lingonberry	Gentle to moderate slope. Deep, coarse - textured soil. Poor to medium nutrient regime.	subxeric	***Pinus contorta, Picea glauca, Leymus innovatus***	*Populus tremuloides, Rosa acicularis, Amelanchier alnifolia,* ***Juniperus communis****, Shepherdia canadensis, Symphoricarpos albus,* ***Vaccinium vitis-idaea****, Aster ciliolatus*
03	SW		Sw - Wildrye - Peavine	Sw – Fuzzy-spiked Wildrye	Gentle to moderate slope. Deep, coarse - textured soils. Poor to medium nutrient regime.	submesic	*Picea glauca, Populus tremuloides, Betula papyrifera,* ***Leymus innovatus***	*Rosa acicularis,* ***Amelanchier alnifolia, Shepherdia canadensis****, Cornus stolonifera, Linnaea borealis, Aster conspicuus, Lathyrus ochroleucus*
04	BL		Sb - Lingonberry - Coltsfoot	Sb - Lingonberry - Coltsfoot	Gently sloping depressional sites. Deep, fine - textured soil. Very poor to medium nutrient regime. Uncommon in project area.	submesic - subhygric	***Pinus contorta, Ledum groenlandicum****, Rosa acicularis, Cornus canadensis, Linnaea borealis*	*Picea mariana,* ***Vaccinium caespitosum, Petasites palmatus***
05	SO		Sw - Currant - Oak fern	Sw – Cranberry	Gentle to moderate slope. Deep, medium to fine - textured soil. Typically cool aspect, moisture receiving sites. Medium to rich nutrient regime. Uncommon in project area.	mesic - subhygric	*Picea glauca, Betula papyrifera*	*Rosa acicularis,* ***Viburnum edule****, Cornus stolonifera,* ***Ribes lacustre****,* ***Linnaea borealis****, Cornus canadensis, Equisetum arvense, Galium trifidum, Mitella nuda*
06	SC		Sw - Currant – Bluebells	Sw – Dogwood	Gentle to moderate slope. Deep, medium to fine - textured soil. Typically warm aspect, moisture receiving sites. Medium to rich nutrient regime.	mesic - subhygric	*Picea glauca,* ***Cornus stolonifera****, Linnaea borealis*	***Populus balsamifera****, Rosa acicularis, Symphoricarpos albus, Viburnum edule,* ***Rubus pubescens, Aralia nudicaulis****, Cornus canadensis*

Site Series	2-letter Code	Seral Assoc.	Name	KWR Name	Description	Moisture regime	Dominant Plants	Associated Plants
07	SH		Sw - Currant – Horsetail	Sw – Horsetail	Level sites on fluvial soil with deep. Moderately coarse to fine soil. Medium to rich nutrient regime.	subhygric - hygric	*Picea glauca*, ***Populus balsamifera***, ***Equisetum arvense***	*Cornus stolonifera, Rosa acicularis, Aralia nudicaulis, Fragaria virginiana*
08	BT		Sb - Labrador tea - Sphagnum	Sb - Labrador tea - Sphagnum	Organic wetland. Level. Deep soils with peaty material at the surface. Very poor to poor nutrient regime. Uncommon in project area.	hygric - subhydric	***Picea mariana***, *Equisetum arvense*	*Cornus stolonifera*, ***Equisetum scirpoides, Salix spp***., *Larix laricina, Ledum groenlandicum, Fragaria virginiana, Mitella nuda*
01-$	AM	ap	$At - Creamy peavine (seral association)	$At – Rose – Showy aster	Gentle to moderate slope. Deep, fine - textured soil. Medium nutrient regime.	mesic	***Populus tremuloides***, ***Rosa acicularis***, *Shepherdia canadensis*	*Amelanchier alnifolia, Symphoricarpos albus, Cornus stolonifera, Aster conspicuus, Lathyrus ochroleucus, Galium boreale, Calamagrostis canadensis*
01-$	AM	ap-y	$At - Creamy peavine - moist (seral association)	$At – Dogwood	Level to gently sloping. Deep, fine - textured soil. Moisture receiving sites and gullies. Medium nutrient regime.	mesic - subhygric	***Populus tremuloides***, *Populus balsamifera*, ***Cornus stolonifera***, *Rosa acicularis*	*Amelanchier alnifolia, Symphoricarpos albus, Viburnum edule, Rubus idaeus, Salix spp., Aster conspicuous, Lathyrus ochroleucus, Rubus pubescens*
01-$	AM	ap-k	$At - Creamy peavine - cool (seral association)	$At – Rose - Soopolallie	Significant slope (25-100%). Cool aspect. Deep, fine - textured soil. Medium nutrient regime.	mesic	***Populus tremuloides, Rosa acicularis, Shepherdia canadensis***	*Picea glauca*, ***Viburnum edule***, *Cornus stolonifera, Aster conspicuus, Lathyrus ochroleucus, Cornus canadensis*
01-$	AM	ap-w	$At - Creamy peavine - warm (seral association)	$At – Rose - Saskatoon	Significant slope (25-100%). Warm aspect. Deep, fine - textured soil. Medium nutrient regime.	mesic	*Populus tremuloides*, ***Amelanchier alnifolia***, *Rosa acicularis, Poaceae spp.*	*Symphoricarpos albus, Cornus stolonifera, Aster conspicuus, Lathyrus ochroleucus, Vicia americana*

Site Series	2-letter Code	Seral Assoc.	Name	KWR Name	Description	Moisture regime	Dominant Plants	Associated Plants
02-$	LL	ak	$At - Kinnikinnick (seral association)	$AtPl – Kinnikinnick	Gentle to moderate slope. Deep coarse - textured soils. Poor nutrient regime. Typically on dry ridges and terraces. Uncommon in project area.	subxeric - submesic	*Populus tremuloides*, ***Arctostaphylos uva-ursi***	***Pinus contorta***, *Shepherdia canadensis*, *Amelanchier alnifolia*, ***Juniperus communis***, ***Spiraea betulifolia***, *Fragaria virginiana*, *Linnaea borealis*, *Cornus canadensis*
03-$	SW	as	$At - Soopolallie (seral association)	$At – Soopolallie - Fuzzy-spiked Wildrye	Gentle to moderate slope. Deep coarse - textured soils. Poor nutrient regime. Typically on warm aspects.	submesic - mesic	*Populus tremuloides*, ***Shepherdia canadensis***, ***Leymus innovatus***	*Picea glauca*, *Pinus contorta*, *Amelanchier alnifolia*, *Rosa acicularis*, ***Symphoricarpos albus***, *Spiraea betulifolia*, *Aster conspicuus*, *Fragaria virginiana*, *Linnaea borealis*, *Pyrola asarifolia*
04-$	BL	al	$At - Labrador tea (seral association)	$At - Labrador tea	Depressional sites. Deep, fine-textured soils. Poor nutrient regime.	submesic - subhygric	*Populus tremuloides*, *Rosa acicularis*	*Cornus stolonifera*, ***Ledum groenlandicum***, *Viburnum edule*, *Aster conspicuus*, *Cornus canadensis*, *Mertensia paniculata*, *Rubus pubescens*
05-$	SC	ab	$At – Black Twinberry (seral association)	$Act - Dogwood	Act stands on north aspect slopes. Deep, fine textured soils. Moisture receiving sites on mid to lower slopes. Medium to rich nutrient regime. Uncommon in project area.	mesic - subhygric	*Populus balsamifera*, *Cornus stolonifera*, *Rosa acicularis*	*Ribes lacustre*, *Salix* spp., *Symphoricarpos albus*, ***Viburnum edule,*** ***Equisetum arvense***, *Lathyrus ochroleucus*, *Maianthemum canadense*
07-$	SH	ac	$Ac – Cow parsnip (seral association)	$Act – Horsetail	Level to gently sloping lower slopes. Deep, medium to coarse-textured soil. Rich nutrient regime.	subhygric - hygric	***Populus balsamifera***, ***Cornus stolonifera***, *Rosa acicularis*, *Poaceae* ssp.	*Picea glauca*, *Rubus idaeus*, *Salix* ssp., *Symphoricarpos albus*, *Viburnum edule*, ***Equisetum arvense,*** *Petasites frigidus var. palmatus*
09	Fm02		$Ac – Cow parsnip (seral association)	$Act – Horsetail - Floodplain	Medium bench floodplain. Deep, medium to coarse textured soil. Rich nutrient regime	subhygric - hygric	***Populus balsamifera,*** ***Cornus stolonifera***, *Rubus idaeus*, *Poaceae* ssp.	*Rosa acicularis*, *Symphoricarpos albus*, ***Equisetum fluviatile***, *Maianthemum canadensis*

Site Series	2-letter Code	Seral Assoc.	Name	KWR Name	Description	Moisture regime	Dominant Plants	Associated Plants
09	Fm02-ab		$Ac – Cow parsnip (seral association)	$Act – gravel bar	Low bench floodplain. Coarse textured soils. Gravel bars with sparse to dense regenerating Act.	subxeric - mesic	***Populus balsamifera***, *Poaceae* ssp.	*Melilotus officinalis, Vicia americana*

Dominant Species occur in at least 50% of the plots with cover greater than 9%, Associated Species occur in at least 50% of the plots with cover values ranging from 1-9%, **Indicator species**
*non-forested sites with limited potential to provide roosting structures.
Please note the $06 unit has been merged with the $01 unit based on consultation with the regional ecologist
**site modifier ‘b’ is a project-defined modifier used to denote an ecosystem occurring specifically on gravel bars (C. Erwin, pers. comm.).

Appendix 4. Draft ratings table for bat roosting and foraging habitat.

Roosting Habitat

Site Series	Structural Stage	Rating	Comments
01	1-4	N*	
	5	L*	
	6	M*	
	7	M*	
05, 06, 07, 02, 03, 04, 08	1-5	N*	
	6-7	L*	
01$	1-4	N*	
	5	M*	Based on the assumption that 5 is the maximum seral stage for this site series
02$, 03$, 04$, 05$, 06$	1-4	N*	
	5-7	M*	
07$, 09	1-4	N*	
	5	M*	
	6-7	H	

*presence of emergent or remnant trees/snags can increase rating to 1 or 2

Foraging Habitat

Site Series	Structural Stage	Rating	Comments
00 SE, TS, WH	2-3	H	
07, 08, 07$, 09	1-3	L	
	4-5	M	
	6-7	M	
01, 04, 05, 06	1-3	L	
	4-5	N	
	6-7	M	
02, 03	1-3	L	
	4-5	N	
	6-7	L	Bats are known to forage extensively in dry pine forests in other area; these sites may be more valuable.