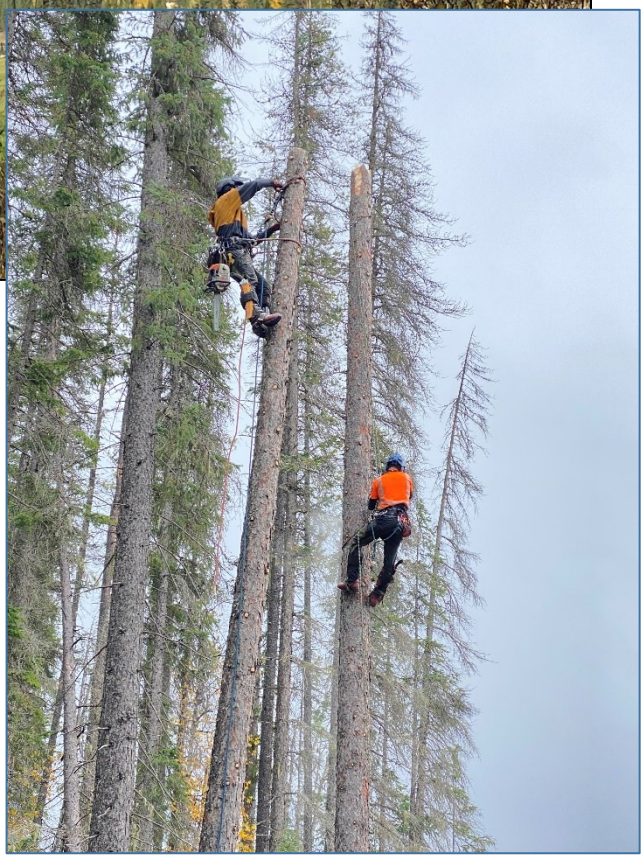
Kootenay Connect (Centre for Forestry Alternatives, Kootenay Conservation Program)



Bat Conservation in Kootenay Connect Focal Areas

Year 3 Final Report

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Project ***Kootenay Connect- BAT-YR3***

Executive Summary

The bat conservation component of Kootenay Connect consists of 3 main activities: monitoring, inventory, and roost habitat enhancement. Acoustic monitoring of bat echolocation calls tracks species diversity and relative abundance through annual sound recording using bat detectors. This sampling is an effective tool for evaluating changes to habitats over time and is part of a large-scale standardized monitoring and inventory program (North American Bat Monitoring Program, NABat) led by WCS Canada in BC. The unit of monitoring is a 10 km x 10 km grid cell monitored for at least one week during the same time period each year. In 2021, we once again acoustically recorded bats in all four of the Kootenay Connect focal regions for a total of 6 NABat grid cells: Creston Valley (1), Bonanza Biodiversity Corridor (2), Wycliffe (1), and Columbia Valley (2). In 2021, in 2 of these cells (Spillimacheen, Creston), we detected a new species, Eastern Red Bat, thought to be expanding its range westward. This species is currently under COSEWIC review along with the 2 other 'migratory tree' bats (Hoary and Silver-haired bats) that we also have detected in all 6 grid cells. Additionally, we detected Yuma Myotis in the Spillimacheen cell -the first known occurrence of this species in the Columbia Valley. In Washington, the closest location of white nose syndrome (WNS) to the Kootenays Yuma Myotis (a western-only species) is experiencing similar levels of mortality from this disease as Little Brown Myotis, and will likely decline at a similar rate as WNS spreads throughout the west.

In the roost enhancement project, we conducted our first summer of monitoring two old-growth mimic tree roosts that we created in fall 2020 in the North Columbia area near Donald. We constructed one of the pilot roosts out of an artificial flexible bark material (BrandenBark), and it was this roost pole that was used in its first summer by a maternity colony of Little Brown Myotis, a federally endangered species. Through capture inventory at this location in August 2021 we determined successful fledging of young from this roost. We also conducted a general capture inventory at multiple sampling locations across the Columbia Wetland from Brisco to Kinbasket. This helped inform site selection for additional tree roost creation in 2021: 6 BrandenBark tree roosts and 7 wildlife trees at 3 locations (Marl Creek and Burges James Gadsden Provincial parks near Donald, and Nature Trust of BC Edgewood property near Radium Hot Springs).

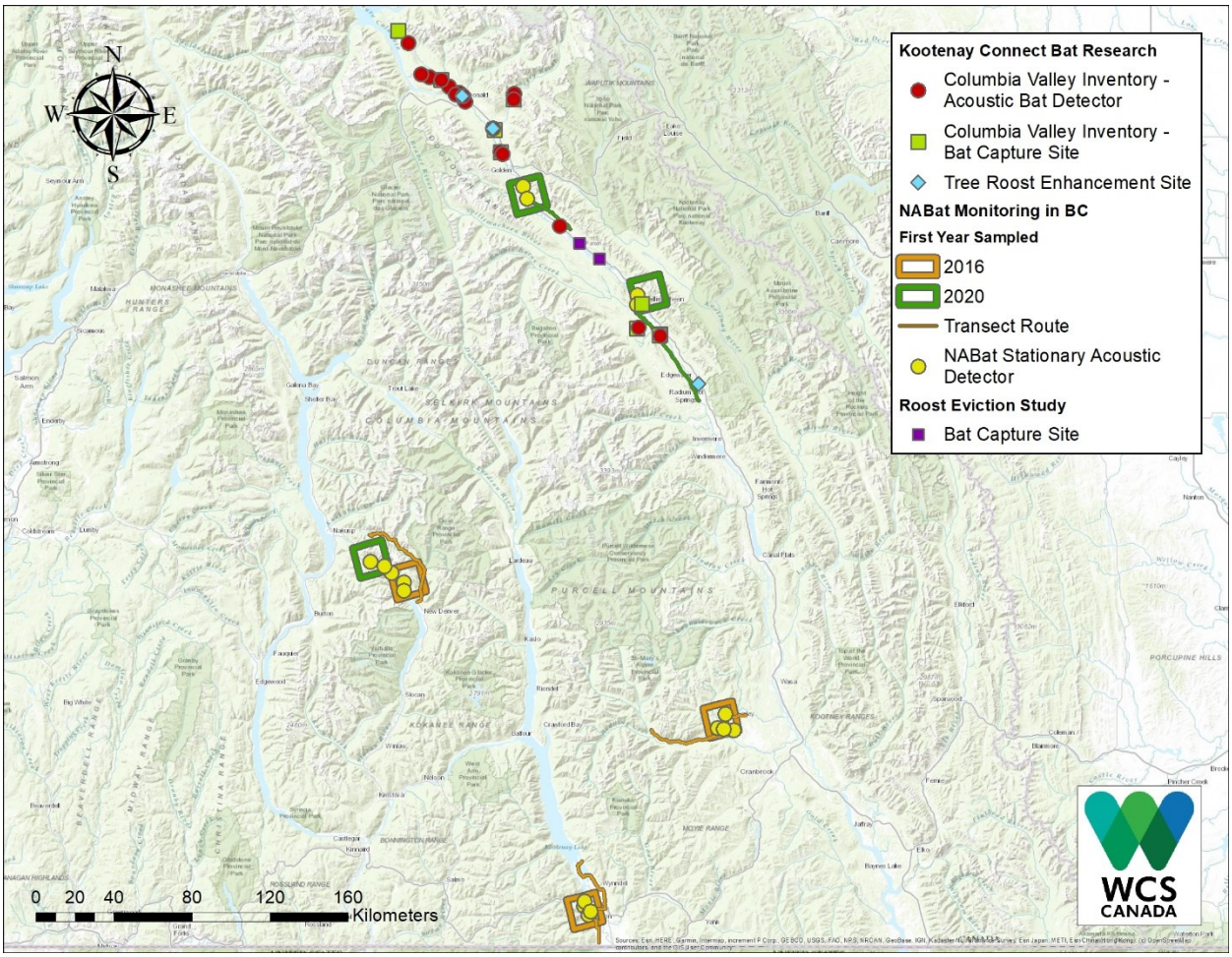

Figure 1. Kootenay Connect bat enhancement, monitoring and inventory sites. Map by J. Rae.

Background and Overview

Bats face unprecedented levels of threats. The Wildlife Conservation Society Canada's Bat Conservation program focusses on establishing baseline data for measuring impacts or efficacy of mitigation strategies; filling knowledge gaps to inform effective conservation strategies; and building resiliency into bat populations through habitat recovery and enhancement. There are important areas for multiple species at risk in the Columbia Basin, where conservation efforts are being focussed. Protecting and enhancing these areas to establish linkage corridors, promote biodiversity, and ensure suitable habitat exists for species at risk is the goal of Kootenay Connect.

The bat conservation component of Kootenay Connect consists of 3 main activities: monitoring, inventory, and roost habitat enhancement (Figure 1). We acoustically monitor bats by recording their echolocation calls using bat detectors, documenting changes in species diversity and relative abundance through annual recording and analysis. Acoustic sampling is a strategic tool for tracking the impact of habitat manipulations over time. As habitats degrade or are enhanced, and other threats continue to impact bat populations, long term monitoring of bat activity is being used to inform conservation and management across the continent -- this large-scale standardized monitoring program is called the North American Bat Monitoring Program (NABat). A large sampling grid across US and Canada is based

on 10 km x 10 km grid cells monitored, and for at least one week during the same time period each year we record bats using bat detectors in 54 cells across the province, and 15 across the Columbia Basin, 6 of which occur in Kootenay Connect focal areas: Creston Valley (1), Bonanza Biodiversity Corridor (2), Wycliffe (1), and Columbia Valley (2).

Two Endangered Myotis bat species are in BC, one of which (Little Brown Myotis) is found across the Columbia Basin, and the other (Northern Myotis) is restricted to the northern part of the Basin. The East Kootenay has had little bat inventory effort, and timber harvest in many upland areas surrounding the northern portion of the Columbia wetland/river has undoubtedly reduced the availability of tree roosts for many species. There is little guidance available for how to mitigate for lost tree roosts, but there has been some use of artificial bark in parts of US and Canada (e.g., Adams et al. 2015; Mering and Chambers 2012), and most recently an attempt in BC to try to create crevice roosts in trees using chainsaws (Todd Manning, pers. comm.). We employ these promising techniques in areas where species at risk are likely to benefit. The two endangered species of bats differ dramatically in their ecology and ecological niches. Little Brown Myotis typically forms large colonies of females (hundreds) to give birth, often in buildings or bat boxes where available, and will typically forage above standing water; but as a generalist they also forage in other habitats. Northern Myotis typically roosts and forages within the forest interior and is closely associated with old growth/mature forest. This species typically does not fly far into the open, following forest edges or within 100 m of a forest edge (Henderson and Broders 2008), and reproductive females roost alone or in small colonies in trees (<60 individuals; Foster and Kurta 1999). Unlike Little Brown Myotis, Northern Myotis hunts for insects under canopy and regularly gleans insects by picking them off of leaves or other vegetative surfaces. These different foraging styles means they must be targeted differently for capture inventories.

Although we are creating tree roosts that will benefit both species at risk, our goal was to try to locate areas in the East Kootenay's Columbia drainage where this species is found in order to focus habitat enhancement. Ideally we would like to identify patches of suitable habitat that can be connected via constructed roost trees, or patches where this species is found that could benefit from an expanded roost selection/area.

Details of Activities

Capture Inventory – With Focus on Finding Northern Myotis (3CW Bats)

We used forest cover maps for the Columbia wetland (developed by Ryan Durand) to help identify patches of mature/old-growth forest to target for inventory. We deployed acoustic detectors, but because Northern Myotis is difficult to differentiate from other bat species including Little Brown Myotis, we also needed to conduct mistnetting and harp-trapping (Figures 2 and 3). We targeted Northern Myotis with 9 nights of capture inventory.

Site selection was challenging. We ground-truthed areas of mature forest but often found they were too far apart to possibly be bridged with constructed tree roosts, largely because of the reluctance of this species to fly more than 100 m away from intact forest. In order for mistnets to be effective for a species like Northern Myotis, which is highly maneuverable, we had to find narrow trails within forests with relatively thick understory vegetation on either side of the trail (e.g., Figure 4). This type of capture site was limiting in the Upper Columbia.

In August 2021 we started our capture inventory in the area of Kinbasket Reservoir, as close to known Northern Myotis range as possible (Revelstoke/Glacier National Park region) and in the only old growth cedar patch that we could locate in the Upper Columbia. This old growth cedar patch was used

heavily by bats for roosting and although we did sample this site with one night of capture inventory, further sampling effort needs to be conducted here, and we plan to revisit it in 2022. (Due to the nature of bat behaviour, you cannot successfully repeat a mistnetting event at the same site in the same capture session given that bats have heightened awareness of nets and avoid capture.) We managed to find suitable trails to trap for this species on 8 of 9 nights. One night we mistnet sampled a bridge night roost in a highly productive foraging area near Spillimacheen, as many species of bats will visit bridges mid-night to digest or for social reasons. It was at this location that we captured a bat that had morphology similar to Northern Myotis. As the Little Brown Myotis and the Northern Myotis are difficult to differentiate in the hand in some cases (Grindal et al. 2011), we have submitted a genetic sample from this bat and await confirmation of species.

During our 9 nights of capture inventory, we captured few bats due to targeting Northern Myotis. As few other bat species typically forage along highly vegetated forest trails, overall capture numbers for our inventory were low: 52 bats (of 5 or possibly 6) species (Table 1).

To supplement data collection during our inventory, we also recorded bat activity acoustically at all capture sites to supplement capture efforts (e.g., Figure 4). In addition to the 9 nights of capture, we conducted more than 20 bat-nights of acoustic monitoring at 16 sites (Figure 1; Table 2). Although Northern Myotis is difficult to differentiate acoustically, it appeared to be missing from the bat community at most sites in our inventory. This is likely due in large part to the paucity of suitable old/mature forest habitat -- much of the forested area surrounding the wetland and Columbia River in the area we chose to inventory had been harvested with few or no accessible old growth patches remaining. Of the old growth patches we did investigate, old cottonwoods appeared to offer some roosting habitat for bats, but would be unlikely to be used by Northern Myotis due to the long distances that typically exist between these small patches of trees and the sparse nature of the patches. The nearby upland slopes did not appear to have suitable forest for this species as it was typically young and/or if there was old growth, it was spruce which is not typically rich in crevices or cavities for bats. Because of the challenge of site selection, further inventory work is needed following ground-truthing of forest structure and we are planning an expanded geographic scope in 2022.

It will be necessary to survey additional sites before drawing any conclusions about the range of this species in the Columbia Valley. The Columbia Wetlands are large and the upland drainage area has higher likelihood of finding Northern Myotis than lower areas directly adjacent to or within the wetlands. A vast amount of this has been harvested and thus it is not clear that Northern Myotis have been able to keep a stronghold in this area, assuming that at one point they were found in the Columbia Trench.

Table 1. Capture sites for Columbia Valley inventory.

Site Name	Capture Date	Scientific Name	Number of Captures	Comments
Blaeberry (Syd'sTrail)	11-Aug-21			no captures; young forest
Burges James Gadsden Prov Park	09-Aug-21	California Myotis	1	
		Little Brown Myotis	5	
		Long-legged Myotis	1	
Cleland Lake Rec. Site*	15-Aug-21	California Myotis	1	
		Long-eared Myotis	2	
		Little Brown Myotis	4	
Columbia Trail, Golden Giant Cedars Interpretive Trail	10-Aug-21	California Myotis	1	
	04-Aug-21	Long-eared Myotis	2	
		Little Brown Myotis	2	
		Long-legged Myotis	2	
Spillimacheen Swing Bridge	12-Aug-21	Little Brown Myotis	19	
		Possible Northern Myotis (or Little Brown Myotis)	1	awaiting genetic results
Susan Lake Bridge Trail	03-Aug-21	California Myotis	1	
		Long-legged Myotis	1	
Suzanne Bayley's North	14-Aug-21	Silver-haired Bat	1	
		California Myotis	1	
		Little Brown Myotis	2	
		Possible Northern Myotis (or Little Brown Myotis)	1	awaiting genetic results
Suzanne Bayley's South	13-Aug-21	California Myotis	1	
		Possible Yuma Myotis (or Little Brown Myotis)	1	awaiting genetic results
		Long-legged Myotis	2	

*flying squirrel captured

Table 2. a. Species detected through acoustic monitoring at or near capture sites or potential captures (Figure 1). Parenthesis is nights monitored. b. Species codes used in table, with federal status.

a.

Acoustic Monitoring Site	**Species Detected**
Burges James Gadsden Park (131)	EPFU, LACI, LABO, LANO, MYEV, unconfirmed MYSE, unconfirmed MYYU, possible MYCI
Spillimacheen Bridge (1)	LACI, MYLU
Suzanne Bayley Bench by River (1)	MYLU
Blue Water Bridge Rec Site (2)	LANO, MYEV
Blue Water Rec Site Columbia River (2)	EPFU, LACI, LANO, MYEV, MYLU, unconfirmed MYVO
Cleland Lake Rec Site (1)	LACI, MYCA, MYEV, MYLU
Cold Spring Tufa Site (on route to Susan Lake) (2)	unconfirmed LACI, LANO, MYCA, MYEV, possible MYSE
Columbia River Trail Golden (3)	EPFU, LACI, LANO, MYCA, MYEV, MYLU, possible MYYU
Blue Water Cutline Trail Near Quarry (2)	MYEV
Giant Cedars Interp Trail (1)	unconfirmed EPFU, LANO, MYEV, MYLU, MYVO
Help Lake Rec Site (1)	LACI, MYLU, possible LABO
Susan Lake (2)	unconfirmed EPFU, LACI, LANO, MYEV, MYLU, possible LABO
Swallow Hotel at Donald (2)	LACI, MYLU, possible MYSE
Syds Trail Blaeberry (1)	LACI, unconfirmed EPFU, unconfirmed LANO, MYEV, flying squirrel
Creekside Trail Turn to Susan Lake (3)	LANO, MYCA, MYEV, MYLU, possible MYSE

b.

SPECIES CODES:		**Federal Status, if listed**
EPFU	Big Brown Bat	
LACI	Hoary Bat	under COSEWIC review
LABO	Eastern Red Bat	under COSEWIC review
LANO	Silver-haired Bat	under COSEWIC review
MYCA	Californian Myotis	
MYCI	Western Small-footed Myotis	

SPECIES CODES:		**Federal Status, if listed**
MYEV	Long-eared Myotis	
MYLU	Little Brown Myotis	endangered
MYSE	Northern Myotis	endangered
MYTH	Fringed Myotis	
MYVO	Long-legged Myotis	
MYYU	Yuma Myotis	

In a parallel project not included in the Kootenay Connect budget, but fulfilling the goal of identifying and understanding bat species at risk in Columbia Valley, we captured bats at two additional building roosts in the Parson area (Figure 1). The objective of this project, led by BC Ministry of Environment and Climate Change, is to quantify the impact of building eviction on Little Brown Myotis health and reproduction. This federally endangered species is not well studied in BC and it the effects that eviction have on reproductive success are unknown. This fills a knowledge gap in the Schedule of Studies of the federal Recovery Strategy and so we include mention of this project here as it directly impacts the Columbia Wetland species at risk. We captured and PIT tagged 134 Little Brown Myotis. One building-roost was evicted in winter 2021-22. Both colonies will be revisited in summer 2022 to determine if the one experiencing eviction has found alternative roost sites and whether its reproductive success is lower than prior to eviction.

No Yuma Myotis were captured at either of the above-mentioned building roosts. This species is common in buildings in West Kootenay and across southern BC, with a range extending eastward to Elko. Its occurrence in East Kootenay is poorly known and it has been assumed this species is not found in the Columbia Valley north of Canal Flats. One of our captures at the Spillimacheen night roost bridge was a possible Yuma Myotis and we await genetics results – this would be the first Yuma Myotis documented in the Columbia Valley. Where WNS occurs in the west (some Washington counties), infections and mortalities of are roughly equal between Yuma and Little Brown Myotis (Abby Tobin, State WNS Coordinator, WA Department of Fish and Wildlife, unpubl. data), suggesting that Yuma Myotis, a western-only species, may also be heavily impacted by WNS, just as Little Brown Myotis.

Figure 2. (Right) Photo of mistnet in a forest fly-way. This flag-pole system allows 3 nets to be strung, one on top of the other to created what is referred to as a 'triple high' – such large 'walls' of net are effective at capturing bats because it is difficult for bats to fly around. Photo by H. Gates.

Figure 3. (Above) We deployed this harp trap along a vegetated trail on the Columbia Trail. Harp traps capture bats by forcing bats to try to fly through banks of taut fishing line (seen here as shiny vertical string within the square frame). Bats are knocked out of flight by the strings and land in a catchment bag below, where they cannot escape from because of a one-way flap of plastic. Harp traps are often used to sample areas that cannot be accessed regularly throughout the night. Unlike mistnets which are typically checked every 10 - 15 minutes, harp traps may only be checked once or twice per hour. Photo by C. Lausen.

Figure 4. An example of the type of vegetated trail that Northern Myotis would forage along as they glean insects from leaf surfaces of understory vegetation thick along the trailside. In the foreground left is a Song Meter Mini, a bat detector. This is the Columbia Trail which parallels the Columbia River slightly downriver of the city of Golden. Photo by C. Lausen.

Habitat Enhancement – Roost Creation through BrandenBark and Tree Modifications (3CW Bats)

One of the main objectives of our capture inventory was to locate sites where roost enhancement would be most beneficial to Northern Myotis – creating maternity roost habitat and/or linking patches of mature forests to facilitate access to larger or higher quality foraging and roosting habitats. In 2020 we had recorded a few acoustic signals thought to possibly be from this species in the Burges James Gadsden Park area, along the Columbia River. We thus installed two pilot tree roosts here, on private land in October 2020. These roosts consisted of a large pole dug into the ground with some form of bark mounted on the top – one roost was constructed out of large slabs of Doug Fir bark and the other of an artificial flexible bark (BrandenBark, Copperhead Consulting, KY; Figure 5 top). These are fully described in our 2020 final report by Darcie Quamme.

We continued to monitor the BrandenBark enhancement site from 2020 (Spike Farms near Golden, BC) via temperature roost loggers and guano traps in spring 2021. Guano presence revealed that the BrandenBark roost was used almost immediately in spring and throughout summer; capture at this site in August 2021 revealed it was used as a maternity roost by Little Brown Myotis in its first summer. Guano analysis will be conducted over winter 2021-22 to determine if there was evidence of other species also using this roost. The 'natural Doug-fir' bark roost designed by landowner Sigi Liebmann unfortunately was not used in the 2021, and thus in spring 2022, Darcie Quamme, Heather Gates and Cori Lausen will work with Sigi to make modifications.

During our capture inventory, using acoustics, we confirmed that the Columbia River is a significant movement corridor for many species of bats. As such, this river corridor is an ideal target for roost enhancement to facilitate bat movement within the Columbia River drainage. We therefore decided to create additional old-growth mimic roosts along the Columbia River at Burges James Gadsden Park and downriver at the river's confluence with Marl Creek. We constructed 6 roosts out of standing trees: 4 BrandenBark roosts and 6 wildlife trees (e.g., Figure 5 bottom). The latter roosts were specifically tailored to bats by creating 2 types of crevices using chainsaws (Figures 7, 8, and 9 right): slab and plunge cuts. Plunge cuts have been successfully used by bats where these have been tested in Australia. We are not aware of either one of these types of chainsaw cuts being used or tested in Canada, but they hold great potential as mitigation for bat roost habitat loss in areas where young trees remain post-harvest.

In our capture inventory, we determined that our first pilot BrandenBark pole was occupied in its first summer by reproductive female Little Brown Myotis. We also collected guano periodically throughout the summer from a mesh guano trap (Figure 5) that we installed at the base of the pole roosts. These guano pellets are being analyzed to identify species as it is possible that more than one species has used the roost during the course of the summer. Genetics results are pending.

We are monitoring effectiveness of all bark-mimic roosts and wildlife trees created in this project through use of guano traps (e.g., Figure 5 top). These traps are removed for winter to prevent damage, and will be installed at all roost tree/poles in spring 2022. Each tree roost has a metal tag so it can be located and flashing has been installed at the base of BrandenBark tree roosts to guard against beaver (Figure 10).

In October 2021, we installed four more pieces of BrandenBark (mounted on trees that were made into snags through topping and ringing; Figure 6 top-left, Figure 9 left). Two were created at Burges James Gasdsen Park and two were created near the shore of the Columbia River at Marl Creek Provincial Park. A total of 6 wildlife tree snags were created at these 2 parks, and each live tree was modified through topping and ringing and then crevices were created specific for bats -- chainsaw cuts of 2 designs (plunge and slab; plunge cut pictured at left). This work was done by Todd Manning (Figure 6 top-right) and arborists.

We also installed two pieces of BrandenBark on trees in October 2021 at Edgewater (on Nature Trust of BC conservation land). Table 4 lists all 2021 tree roost enhancements. We also installed a bat detector for winter monitoring over 2021-22 as this location may be used by bats in winter for hibernation. This BrandenBark is created near Little Brown building roosts that are likely to degrade over time as they are in the original infrastructure that was present on these conservation lands at the time of purchase. This installation will provide a more natural type of roost for this existing colony of Little Brown myotis, informing management of this endangered bat, and providing an alternative to bat boxes that are most often not occupied in their first year of deployment. We are also using this unique situation to test whether BrandenBark is likely to be selected by Little Brown Myotis over a building roost.

Figure 5. (Top) In the foreground is a BrandenBark pole roost which was successfully occupied by bats in its first summer. The pole roost in the background is constructed of large slabs of Douglas Fir bark screwed together to create cavities. The mesh screening in the wooden frame at base of each pole (above predator-guard metal flashing) collects guano which is periodically sampled and submitted for genetic analysis to identify species of bat(s) using the roost. Location: Spike Elk Farm near Donald. Photo by C. Lausen.

(Bottom) Burges James Gadsden Provincial Park. Suspended part-way up a tree (left) is a piece of BrandenBark ready to be mounted on a tree that has been stubbed and ringed to stop its growth. This will enable the tree to begin decay into a natural snag that will eventually provide nature crevices. The BrandenBark makes this tree immediately useable by bats by creating a large cavity of roosting space under what mimics a large piece of sloughing bark. The arborist seen left of centre descends a 'stub' – this tree had naturally broken off and the arborist added chainsaw cuts to create crevices for bats. Although not visible, the Columbia River and associated wetland complex lies just beyond these trees. Photo by C. Lausen.

Figure 6. (Top-left) A BrandenBark tree roost. The flexbark sheet was mounted on a tree that has been girdled with 2 rings near base. (Top-right) Habitat Restoration Specialist, Todd Manning, measures a tree during the selection process to identify suitable candidates for bat tree roost creation.

Figure 7. (Left) Arborist uses chainsaw on left tree to remove bark for a close fit of BrandenBark. The right tree has been ringed close to the bottom of the tree, which will disrupt sap flow – this will start to become a snag. To expedite the process of making this tree available to bats for roosting, 2 slab cuts have been made to create crevices (arrows). Location: Marl Creek Provincial Park. Photo by C. Lausen.

Figure 8. Arborist uses chainsaw cut to create a slab cut. The area directly below the crevice is roughened to increase the chance that a bat will notice the crevice and be able to easily land and crawl into the crevice (bats land and crawl using their claws and thus require a rough surface). Location: Burges James Gadsden Provincial Park. Photo by C. Lausen.

Figure 9. Left: BrandenBark is installed on tree at Burges James Gadsden Prov Park using a pulley to hoist it into place. Right: a snag is created and bat-specific crevices are being cut by the arborist – this chainsaw cuts is a creating a plunge crevice. Photos by C. Lausen.

Figure 10. After the tree roost structures were constructed, a metal tag was applied for monitoring purposes (left), and Cori Lausen installs metal flashing at the base of BrandenBark tree roosts to guard against beaver (right). Photos by Cori Lausen.

BrandenBark is marketed as being preferred roosting habitat for many species, not just the building-roosting bats that will use bat boxes. Little Brown Myotis is a species that regularly uses bat boxes. The fact that a nursing colony of this species took up occupancy of our pilot BrandenBark pole roost suggests there was a colony nearby our installations and they preferred the BrandenBark over whatever other roost structures they were using previously. With local interviews we determined that Little Brown Myotis have been found periodically roosting under the tin roof of a nearby hay shed, and we thus hypothesize that BrandenBark has created a more desirable roost than this shed roof, and may in fact provide a more suitable range of microclimates for raising young. Understanding use of BrandenBark by Little Brown Myotis is important for several reasons: 1. Because this species is Federally Endangered and expected to be negatively impacted by white-nose syndrome (WNS), it is important to investigate roost mitigation tools that may be instrumental in population recovery; 2. If the expectation is to create old-growth mimic roosts to target roost enhancement for bats that do not typically use bat boxes, like Northern Myotis, then it may be important to avoid erecting these roost trees in home ranges of Little Brown Myotis nursery colonies. However, what roosts are favoured by Little Brown Myotis is not fully understood. We know from research on other species, that building attic roosts provide highly suitable and preferred habitat, because they offer a wide range of microclimates to meet thermal needs of nursing females and growing pups during the reproductive season, resulting in higher reproductive success than some natural roosts (Lausen and Barclay 2006). This may also be the case for Little Brown Myotis. We therefore would like to know whether BrandenBark roosts will typically be favoured by a colony of Little Browns, or whether building roosts where bats can roost within a spacious interior, will be preferred. To try to understand this, in 2021 we installed 2 BrandenBark roosts near a known building roost of reproductive Little Brown Myotis on the Edgewater conservation property owned by The Nature Trust of British Columbia.

North American Bat Monitoring

We acoustically monitored bats in all 4 Kootenay Connect areas. In total we had detectors in 6 grid cells, and recorded more than 16,287 bat passes of 11 species (Table 3).

Table 3. Species documented in each of the 6 North American Bat Monitoring Program grids in the Kootenay Connect focal areas. Note that abundance trend analyses can be modelled from activity rates once 5 years of data have been collected. This is year 2 for Nicholson, Spillimacheen and Summit Lake grid cells. Detectors were deployed in each grid cell for the following number of days: Bonanza Marsh (14 detector-nights plus 2 nights of driving transect), Summit Lake (14 detector-nights), CVWMA (25 detector-nights), Wycliffe (20 detector-nights plus 2 nights of driving transects), Nicholson (21 detector-nights), and Spillimacheen (28 detector-nights), for a total of 124 cumulative detector-nights of acoustic monitoring in Kootenay Connect areas in 2021.

Kootenay Connect Focal Area:	Bonanza Biodiversity Corridor		CVWMA	Wycliffe	Columbia Valley	
Bat species:	Bonanza Marsh	Summit Lake	Creston	Kimberley	Nicholson	Spillimacheen
Townsend's Big-eared Bat	*		yes	yes	yes	yes
Big Brown Bat	yes	yes	yes	yes	yes	yes
Eastern Red Bat			yes - *new species in 2021*		yes - *new species in 2021*	yes - *new species in 2021*
Hoary Bat	yes	yes	yes	yes	yes	yes
Silver-haired Bat	yes	yes	yes	yes	yes	yes
Californian Myotis	yes	yes	yes	yes	yes	yes
Western small-footed Myotis			suspected (capture inventory needed)	suspected (capture inventory needed)		suspected (capture inventory needed)
Long-eared Myotis	yes	yes	yes	yes	suspected (capture inventory needed)	yes
Little Brown Myotis	yes	yes	yes	yes	yes	yes
Fringed Myotis			yes	yes		suspected (capture inventory needed)
Long-legged Myotis	yes	yes	yes	yes	suspected (capture inventory needed)	yes
Yuma Myotis	yes	yes	yes	suspected (capture inventory needed)	suspected (capture inventory needed)	yes - *new species in 2021*
TOTAL BAT RECORDINGS	595	3460	7390	1026	949	2867

*(not detected in NABat monitoring in 2021, but known from previous inventory work at this site)

Future Work

Roost Enhancement

We will install 2 pieces of BrandenBark on the existing poles near Burges James Gadsden Park in spring 2022. These will expand the number of microclimate options for the colony of Little Brown Myotis that has begun using the pilot BrandenBark pole. We will also be installing additional pieces of BrandenBark on poles and/or trees, and creating more wildlife trees in late summer or early fall 2022, expanding to include all 4 Kootenay Connect areas.

Monitoring BrandenBark and Wildlife Trees

We will install guano traps on all existing tree-roost structures for periodic guano collection throughout the summer of 2022. We will collect guano throughout the summer for genetic analysis of species.

NABat Monitoring

We will be continuing to record bats for at least one week in each of the 6 grid cells that we monitor in Kootenay Connect areas. Kootenay Connect cells are 6 of 16 NABat grid cells monitored in the Columbia Basin. We will be statistically analyzing relative abundance trend and changes in species diversity and expect to continue to find positive changes in areas where habitats have been enhanced through ours and other's recovery/enhancement efforts as part of the larger Kootenay Connect project (including wetland enhancement activities that are taking place in Creston and Bonanza areas).

Capture Inventory

In summer 2022 we will undertake ~9 more nights of capture inventory. We will expand the geographic scope of our inventory in the Columbia Valley drainage to try locate Northern Myotis. We will also try to confirm the presence of Yuma Myotis due to the high risk that WNS poses to this species and the fact that it is suspected to occur in the Columbia Wetland based on our recent acoustic monitoring.

Table 4. Tree roost enhancements.

site	base structure	bat roost feature: BrandenBark?	bat roost feature: # full slab crevices	bat roost feature: # plunge cut crevices	general notes
Spike Elk Farm	pole	yes			main cavity under BrandenBark faces south; north side is flush with no roosting cavity; second piece will be installed in spring 2022 to create cavity facing north to provide cooler summer roosting options
	pole	no			large slabs of Douglas Fir bark screwed together to create roosting cavities
Burges James Gadsden Provincial Park	tree	no	3	4	structures are at edge of wetland and canal off Columbia River
	tree	no	2	2	slabs on NE and S-SE; plunge cuts on W and SW
	tree	no	2	2	2 slabs S facing; 1 plunge S-facing; 1 plunge lower down ~8m from base SW-facing
	tree	no	3	2	slits and plunges on N-NE side of tree; one slab each E (shaded by adjacent cottonwood), W, S
	tree	yes			main opening faces east
	tree	yes			main opening faces south (extensive solar)
Marl Creek Provincial Park	tree	no	2	2	setback ~25m from Columbia River's edge; full south and west aspect - extensive solar coverage for all structures
	tree	no	3	2	
	tree	yes			
	tree	yes			
Nature Trust of BC Edgewater Property	tree	yes			near wetland and building-roost of Little Brown Myotis
	tree	yes			
	tree	no		1	only one crevice made for bats, but several bird cavity features created (as part of NTBC's bird habitat enhancement)

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