



Columbia River Project Water Use Plan

Arrow Reservoir Wildlife Management Plan

CLBWORKS-30A Arrow Lakes Reservoir Wildlife Enhancement Program

CLBWORKS-30B Arrow Lakes Reservoir Wildlife Enhancement Program – Physical Works

Reference: CLBWORKS-30A and CLBWORKS-30B

Summary of bat roost habitat enhancement installations at Revelstoke Reach and Burton Wetland

Study Period: 2019 to 2021

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May 25, 2022

Background

There are up to 10 species of bat that occur in the Revelstoke area, including the two SARA-listed species Little Brown Myotis (*Myotis lucifugus*) and Northern Myotis (*M. septentrionalis*), as well as Yuma Myotis (*M. yumanensis*), California Myotis (*M. californicus*), Long-legged Myotis (*M. volans*), Long-eared Myotis (*M. evotis*), Silver-haired Bat (*Lasionycteris noctivagans*), Big Brown Bat (*Eptesicus fuscus*), Hoary Bat (*Lasiurus cinereus*), and Townsend's Big-eared Bat (*Corynorhinus townsendii*). Most of these species have been positively confirmed through capture (Little Brown Myotis, California Myotis, Long-legged Myotis, Northern Myotis, Long-eared Myotis, and Silver-haired Bat (Fenton et al. 1983, Caceres 1998, Kellner 2014)). Hoary Bats were detected acoustically (Fenton et al 1983), and Yuma Myotis and Big Brown Bats were genetically confirmed and Townsend's visually confirmed in Revelstoke (BC Community Bat Project).

Creation of the Arrow Lakes Reservoir likely had large impacts on the availability of bat foraging and roosting habitat in the region (Utzig and Schmidt 2011), through loss of valley-bottom forests and wetlands. The drawdown zone of Upper Arrow Lake, particularly the wetland habitats at Montana and Cartier Bays and Airport Marsh, likely provides foraging habitat for most or all of the bat species. There is some roosting habitat immediately around these bays, including rocky outcrops and houses and barns; however, many species would normally use loose bark or cavities or cracks in large trees or snags. These types of features are lacking, due to the history of agriculture, forestry and reservoir creation. The Arrow Lakes Reservoir Wildlife Management Plan (CRWUPCC 2005) and Columbia River Water Use Plan Order (Province of BC 2007) supported the creation and effectiveness monitoring of physical works to mitigate this loss of habitat. For bats, installation of a variety of artificial roost structures was recommended to provide these habitat elements that are missing/rare in the drawdown zone (Hawkes and Tuttle 2016).

Artificial roost structures can effectively enhance summer roosting habitat for several species of bat. Species that are known to use bat boxes in the Revelstoke region include Little Brown Myotis, Yuma Myotis, and Big Brown Bat, and possibly the California Myotis, Long-legged Myotis, Long-eared Myotis, Silver-haired Bat and Northern Myotis. The Northern Myotis is not commonly found in bat boxes in Canada, but has been confirmed using artificial bark-type structures in the US (Adams et al 2015) and bat boxes in the southeastern US (Whitaker et al. 2006). This species is known to use multiple roosts in a small area, and change roost sites frequently (Vonhof and Wilkinson 1999). Installation of bat boxes can raise concerns about possibly influencing the bat community structure though creating roosting habitat favoured by certain bat species. However, the long history of human disturbance in the Revelstoke Reach area has likely already altered the local bat community from pre-settlement composition; enhancing habitat for existing species is likely of little impact compared to past wide-scale habitat change.

The importance of roost habitat enhancement is rapidly increasing in the face of White-nose Syndrome (WNS). WNS is a fungal disease responsible for the death of millions of bats in eastern North America. Because of the extreme population declines from WNS in eastern Canada, it has led to the emergency listing of both Northern Myotis and Little Brown Myotis as Endangered under the federal Species at Risk Act (Environment Canada 2015). WNS has continued to spread across North America, is confirmed in

Washington in the Columbia Basin (WDFW 2022), and is expected to arrive in BC soon. Increasing the availability of secure roosting habitat can help to increase the resilience of bat populations not yet affected by WNS, and help ensure that habitat is available to support recovery of surviving populations; monitoring of roosts can contribute to population monitoring pre- and post-WNS, as well as increase our understanding of roosting requirements and how to do effective habitat enhancement.

Habitat enhancement for bats in Revelstoke Reach offers an excellent opportunity for piloting the use of bat condos and artificial bark, as well as comparing these structures to more traditional artificial roost designs. Concerns about fatal or damaging temperature spikes inside of small bat boxes have led to increasing consideration of bat condos in BC. Condos and min-condos are large structures, should be more thermally-stable, and offer a wider range of microclimates. However, these structures are much more costly to build and install than regular 4-chamber maternity-style bat houses. Exploring the use of condos by bats when the condos are installed NOT in conjunction with exclusion is valuable for determining the value in pursuing condos for general habitat enhancement.

Habitat enhancement with artificial bark roosts can provide a different type of structure and roost cues than bat boxes or condos. Trial installation and monitoring of artificial bark in BC offers an opportunity to provide habitat that is potentially appealing for Northern Myotis (and Little Brown Myotis). While Little Brown Myotis commonly roosts in anthropogenic structures including condos and bat boxes, Northern Myotis in BC do not. Providing multiple roost sites within several hundred meters of each other in one area will more closely imitate natural roost areas and may increase success, as well as providing a wide range of microclimates.

This report summarizes information about location, type of structures, and dates of installation for structures installed at both Revelstoke and Burton habitat enhancement sites.

Methods

Study area

A number of potential locations were identified for habitat enhancement for bats in Revelstoke Reach and Burton flats. These locations were reviewed by BC Hydro, leading to final selection of three sites- Montana 3, Hay Fields, and Burton Wetland (Figures 1-3). Microsite selection for all sites was done by Mandy Kellner.

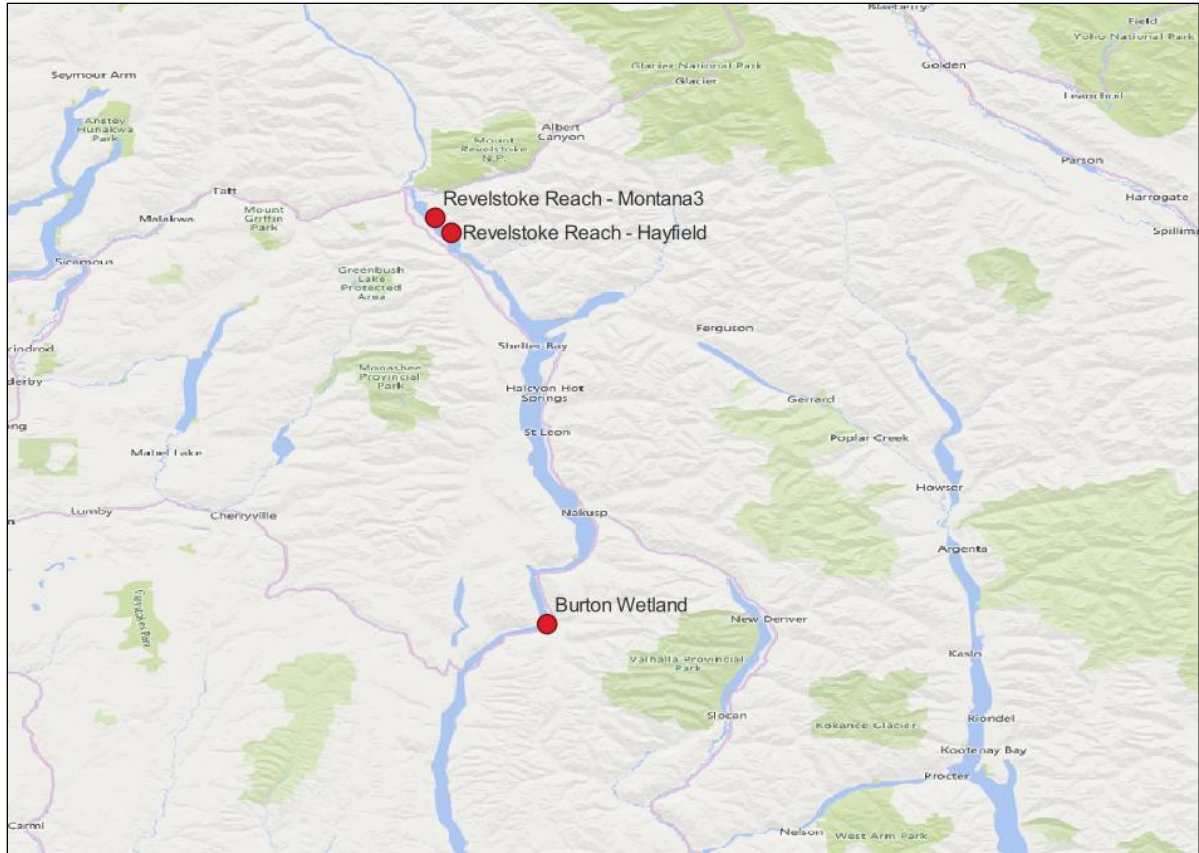


Figure 1. Overview map showing the three bat habitat enhancement sites. Two sites are in the Revelstoke Reach (Montana3 and Hayfield) and one is near Burton (Burton Wetland).

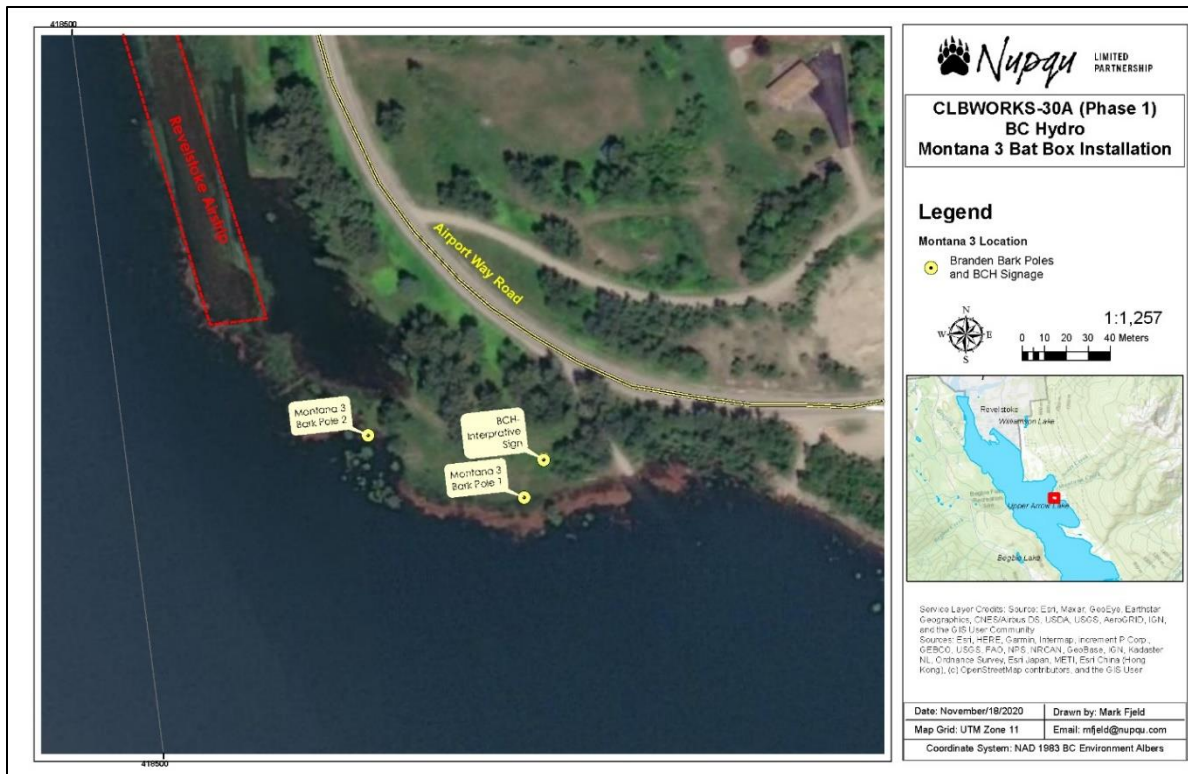


Figure 2. Detail on the location of structure installed at Montana3 in Phase 1 in 2019 (top) and at Hayfield in Phase 2 in 2020 (bottom). Maps created and provided by Nupqu.

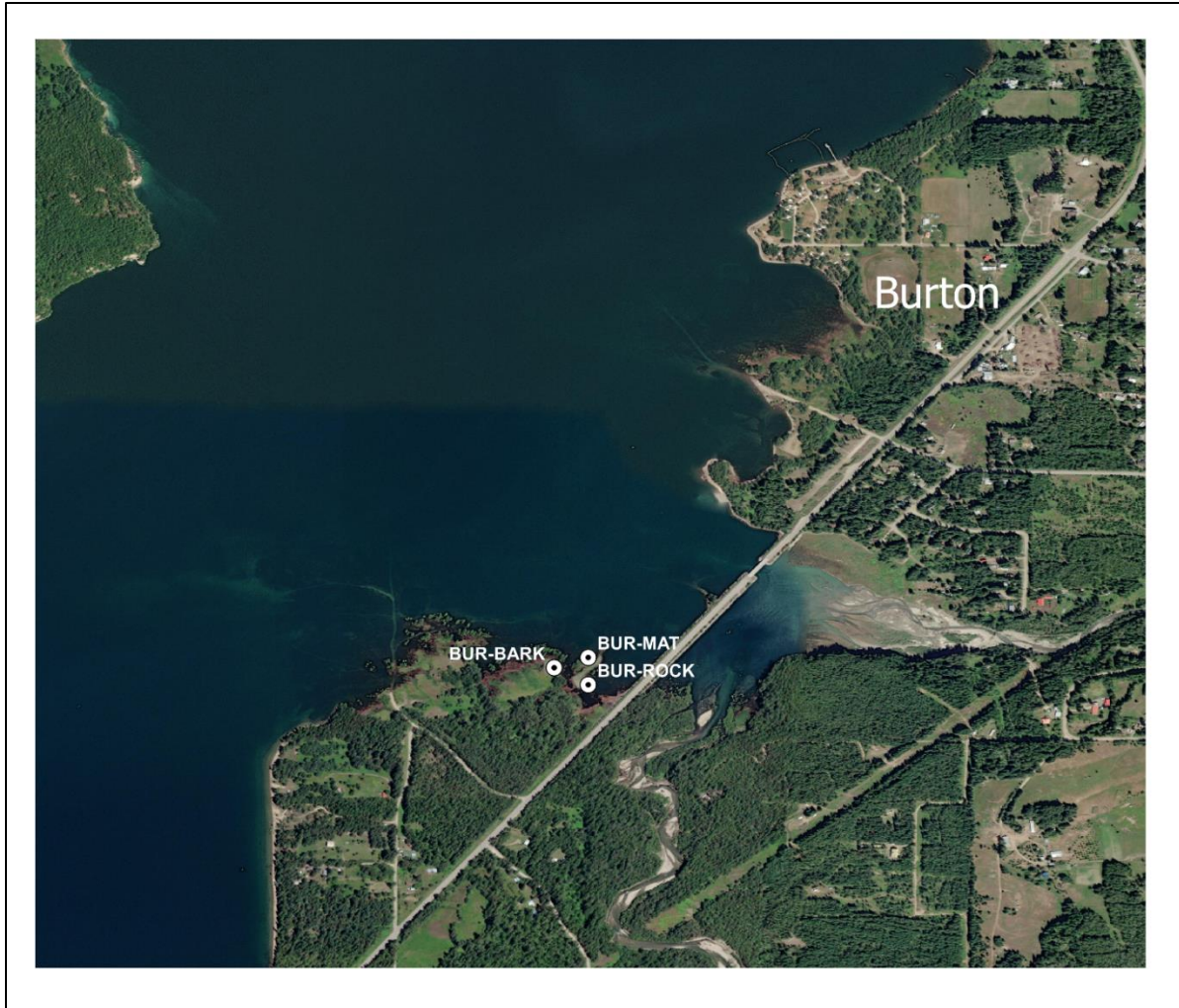


Figure 3. Detail on the location of three artificial roost structures installed at the Burton Wetland in 2021.

Artificial roost construction – plans and modifications

Four different types of structures built – 2-chamber rocket boxes (2 structures), back-back 4-chamber maternity boxes (2 structures), BrandenBark (4 structures), and a Wisconsin mini-condo (1 structure). The 2-chamber rocket boxes were built according to Bat Conservation International plans, but modified to fit over a 4'x4' wooden post, and painted black. The back-back 4-chamber maternity boxes were standard Bat Conservation International maternity boxes painted black and mounted on each side of a single 6'x6' post, with a wooden corridor joining the two rear chambers to allow bats to travel back and forth. The mini-condo was a modified version of the Wisconsin Department of Natural Resources Mini-Condo (Keeley et al 2012), stained brown. Key modifications included no large door on the side (to increase heat retention), an increased number of access points into the interior (e.g., under the bottom of the siding, through horizontal slots, and under the roof overhangs), a landing board below the base of the condo, and a snow-shedding tin roof. The BrandenBark was imported from Copperhead Environmental Consulting (<https://copperheadconsulting.com/brandenbark/>) and not modified in any way. Details on the construction and the installation requirements for each type of artificial roost

structure were outlined in the original Scope of Services for the installation of the roost structures. Details and photos from the construction of the boxes and mini-condo are also available in Fjeld 2020.

Guano catchers were built of wood and mesh, and attached to all structures to facilitate monitoring for occupancy through guano checks.

Temperature monitoring

HoboTemp MX2303 2-probe temperature loggers with BlueTooth capability were installed in each artificial roost structure. One probe was positioned in the upper reaches of the southern-facing chamber, to capture the warmest temperatures available in the structure. The other probe was positioned in the lowest portion of the northernmost chamber, to capture the coolest temperatures available. Both probes were housed inside small diameter plastic tubing with many ventilation holes drilled in it, to prevent bats from snuggling against the probe itself. The body of the temperature loggers was affixed to the pole, and all wires secured to prevent entrapment of bats.

Installation

Installation of all structures in the Revelstoke area was coordinated and completed by Nupqu. Installation of all structures at Burton was completed by Yucwmenlúcwu (Caretakers of the Land) LLP/Landmark in conjunction with the wetland creation project CLBWORKS-30B Arrow Lakes Reservoir Wildlife Enhancement Program - Physical Works. The installation was completed over several years.

Phase One included installation in July 2019 of two bark poles at Montana 3 and three structures (mini-condo, maternity boxes, and rocket box) at Airport Marsh. The structures at Airport Marsh were subsequently removed on October 17, 2019 due to the landowner anticipating needing the site for airport operations/helicopter landing (Fjeld 2020).

Phase Two involved installation of the three structures from Airport Marsh and a BrandenBark pole at the Hayfield site in November 2020. Because of concerns about cattle rubbing against the structures, a three-strand smooth-wire fence was installed around the three bat box structures (mini-condo, maternity box, and rocket box) at the Hayfield site; the BrandenBark pole was deemed solid enough to withstand cattle.

The Final Phase involved installing structures at the newly-constructed Burton Wetland near Burton in April 2021. Three structures were installed near the new wetlands, including BrandenBark, a 2-chamber rocket box, and back-back 4-chamber maternity boxes.



Figure 4. Artificial roost structures included back-back 4-chamber maternity boxes (left), with a connecting wooden ‘tube’ to allow bats to move between the two bat boxes., allowing access to a large variety of microclimates. Also installed were 2-chamber rocket boxes (right).



Figure 5. The modified mini-condo (left) was purposefully built with a number of gaps to provide multiple access points for bats while still being weatherproof, such as this side access port under a loose piece of tin roofing (right).



Figure 6. The exterior of a BrandenBark sheet (left) , and the interior (right), showing the mesh used to provide a grippy surface for bats to hang on to.



Figure 7. BrandenBark sheets were wrapped around pole tops as per the manufacturer's instructions. The top seam was caulked, and then the two Hay Field and Burton poles also had the surface covered with rubber or extra BrandenBark pieces for extra weatherproofing.

Results

The final sites and the associated enhancement structures installed at each site are listed in Table 1. Additional details on location and structure characteristics are in Appendix 2. A kmz of structure locations is available with this report.

An interpretive sign was developed by Nupqu. A single copy of the sign was installed at the Montana 3 location in 2019 (Appendix 2).

Table 1. Site names, structure type, and installation date for nine artificial roost structures for bats installed in Revelstoke Reach and Burton, 2019-2021.

Project area	Site	Structure_ID	Structure_type	Structure_Detail	Date_Installed
Revelstoke Reach	Montana3	M3-BARK 1	BrandenBark	BrandenBark on pole	July 21, 2019
Revelstoke Reach	Montana3	M3-BARK 2	BrandenBark	BrandenBark on pole	July 21, 2019
Revelstoke Reach	Hay Field	HAY-BARK	BrandenBark	BrandenBark on pole	November 4, 2020
Revelstoke Reach	Hay Field	HAY-MAT	Maternity box	Back-to-back 4-chamber maternity boxes on pole	November 4, 2020
Revelstoke Reach	Hay Field	HAY-ROCK	Rocket box	2-chamber rocket box on pole	November 4, 2020
Revelstoke Reach	Hay Field	HAY-CON	Mini-condo	Modified Wisconsin mini-condo	November 4, 2020
Burton	Burton Wetland	BUR-MAT	Maternity box	Back-to-back 4-chamber maternity boxes on pole	April 19, 2021
Burton	Burton Wetland	BUR-ROCK	Rocket box	2-chamber rocket box on pole	April 19, 2021
Burton	Burton Wetland	BUR-BARK	BrandenBark	BrandenBark on pole	April 19, 2021

Site photos

Montana3, Revelstoke Reach



Figure 8. The two BrandenBark poles at Montana3, and looking up the cedar pole at the gap between the pole and bark.

Hayfield, Revelstoke Reach



Figure 9. The three clustered artificial roosts at the Hayfield site.



Figure 10. The four Hayfield structures: mini-condo (top left), 2-chamber rocket box (top right), BrandenBark (bottom right) and back-back maternity boxes (bottom left).

Burton Wetland, Burton



Figure 9. Burton wetland bat roost structures – 2-chamber rocket box (top left), back-back 4-chamber maternity boxes (top right) and BrandenBark pole (bottom).

Discussion

Installation

The Branden Bark pieces installed through this project were the first known pieces deployed in BC. Subsequently, a large FWCP project has begun to install and monitor artificial bark at numerous sites in the North and Upper Columbia watershed (e.g., de Frietas and DeRosa 2022). The Bark is designed to look like real bark and thus provide visual cues to forest-roosting species. Installing these structures on the edge of maturing cottonwood patches connected to larger tracts of forest may provide habitat for the forest-dwelling Northern Myotis, as well as for the crevice-roosting species usually found in artificial

roost structures. Information on use by different species, and the timing of use and colony sizes, will be extremely valuable in determining the utility of this product in BC.

The BrandenBark structures are installed at varying heights, with the Montana3 poles being quite short (2.4 m to bottom of bark) and the Hayfield and Burton structures being quite high (~ 4.9 m to bottom of bark). Trees generally used by bats as maternity roosts tend to be larger and taller than surrounding trees (Barclay and Brigham 1996); however, when bats use artificial roost structures, maternal colonies may be located in boxes of widely-ranging heights (BC Community Bat Program 2022). Again, use of the various pieces of BrandenBark will provide insights into how we can use this material in future habitat enhancement efforts.

Siting

Location of artificial roost structures may greatly influence their use by different bat species, as species show variable tolerance for crossing gaps. The bat boxes and bark pole at the Burton wetland are not immediately near any tall shrubs or trees that may provide security cover for bats. This site is a new wetland creation project by BC Hydro, and habitat restoration work around the newly-developed ponds is ongoing. More substantial vegetation is expected to grow in over the next few years.

While the structures in the Revelstoke Reach are at the edge of the drawdown zone, they are also located near large tracts of older forest, including habitat where Northern Myotis has been identified acoustically (Rae and Lausen 2022).

Monitoring

Although many artificial bat roosts are installed across BC every year, monitoring of these structures is generally poor. As a result, it is difficult to determine the effectiveness of bat boxes and identify potential modifications that may improve occupancy rates and ultimately the reproductive success of bats. Monitoring of the roost structures installed at Revelstoke and Burton has great potential to contribute to our understanding of the use of artificial roosts by bats in BC, and can guide future enhancement/compensation work. A monitoring program under CLBMON-11B-5 Effectiveness Monitoring of Wildlife Enhancement Structures in Arrow Lakes Reservoir monitors the bat structures installed in Revelstoke and Burton wetland. This project will document which species use the structures, determine seasonal timing of use, and compare temperature profiles and occupancy across structures. The monitoring project is underway (Nupqu 2021), with many structures showing rapid use by a small number of bats.

Public education

One interpretive sign was installed through this project; it has unfortunately been vandalized but continues to provide information. There are quite a few local inquiries about these structures, as the areas are frequently used for recreation.

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Appendix 1. Additional information on structure locations and characteristics.


Table 3. Location information for the nine artificial roost structures for bats installed from 2019-2021 in Revelstoke Reach ad Burton.

Project area	Site	Structure_ID	Structure_type	Structure_Detail	Date_Installed	Zone	UTM_E	UTM_N	Latitude	Longitude
Revelstoke Reach	Montana3	M3-BARK 1	BrandenBark	BrandenBark on pole	July 21, 2019	11	418678	5643189	50.93459	-118.157325
Revelstoke Reach	Montana3	M3-BARK 2	BrandenBark	BrandenBark on pole	July 21, 2019	11	418611	5643226	50.93492	-118.158286
Revelstoke Reach	Hay Field	HAY-BARK	BrandenBark	BrandenBark on pole	November 4, 2020	11	421292	5639227	50.89933	-118.119277
Revelstoke Reach	Hay Field	HAY-MAT	Maternity box	Back-to-back 4-chamber maternity boxes on pole	November 4, 2020	11	421284	5638999	50.89728	-118.119341
Revelstoke Reach	Hay Field	HAY-ROCK	Rocket box	2-chamber rocket box on pole	November 4, 2020	11	421286	5638994	50.89724	-118.119312
Revelstoke Reach	Hay Field	HAY-CON	Mini-condo	Modified Wisconsin mini-condo	November 4, 2020	11	421292	5638992	50.89722	-118.119226
Burton	Burton Wetland	BUR-MAT	Maternity box	Back-to-back 4-chamber maternity boxes on pole	April 19, 2021	11	435927	5536652	49.9788	-117.894
Burton	Burton Wetland	BUR-ROCK	Rocket box	2-chamber rocket box on pole	April 19, 2021	11	435868	5536571	49.978	-117.894
Burton	Burton Wetland	BUR-BARK	BrandenBark	BrandenBark	April 19, 2021	11	435832	5536629	49.9785	-117.895

Table 4. Structure detail for the nine artificial roost structures for bats installed from 2019-2021 in Revelstoke Reach ad Burton.

Project area	Site	Structure_ID	Structure_Detail	Aspect	Colour	Ht at bottom (m)	Notes	Temperature_Detail
Revelstoke Reach	Montana3	M3-BARK 1	BrandenBark on pole	n/a	n/a	2.7	caulking used around top of bark for waterproofing	Hobotemp - 1 probe in top of south side and 1 probe in bottom of north side
Revelstoke Reach	Montana3	M3-BARK 2	BrandenBark on pole	n/a	n/a	2.7	caulking used around top of bark for waterproofing	Hobotemp - 1 probe in top of south side and 1 probe in bottom of north side
Revelstoke Reach	Hay Field	HAY-BARK	BrandenBark on pole	n/a	n/a		caulking and rubber mat cover used around top of bark for waterproofing	Hobotemp was not installed in 2020 but plan to have 1 probe in top of south side and 1 probe in bottom of north side
Revelstoke Reach	Hay Field	HAY-MAT	Back-to-back 4-chamber maternity boxes on pole	North-south	Black			Hobotemp - 1 probe in top of south-most chamber and 1 probe in bottom of north-most chamber.
Revelstoke Reach	Hay Field	HAY-ROCK	2-chamber rocket box on pole	n/a	Black			Hobotemp - 1 probe in top of south side and 1 probe in bottom of north side
Revelstoke Reach	Hay Field	HAY-CON	Modified Wisconsin mini-condo	South	Light brown stain		Roof mid-line is northeast-southwest	Hobotemp - 1 probe in top of south side and 1 probe in bottom of north side
Burton	Burton Wetland	BUR-MAT	Back-to-back 4-chamber maternity boxes on pole	North-south	Black			Hobotemp - 1 probe in top of south-most chamber and 1 probe in bottom of north-most chamber
Burton	Burton Wetland	BUR-ROCK	2-chamber rocket box on pole	n/a	Black			Hobotemp - 1 probe in top of south side and 1 probe in bottom of north side
Burton	Burton Wetland	BUR-BARK	BrandenBark	n/a	n/a	4.9	caulking and tin cover used around top of bark for waterproofing	Hobotemp - 1 probe in top of south side and 1 probe in bottom of north side

Appendix 2. Interpretation



A place to call home

Bats are amazing animals and play a vital role in our ecosystem. All bats in BC eat insects, and a single Little Brown Myotis can eat more than 600 mosquitoes in an hour. A colony of 100 Little Brown Myotis can eat 19 kg of insects over a single summer! Favourite foods include insect pests that affect people, crops, and forests.

Bats are also in trouble and need our help. A fungal disease known as white-nose syndrome has already killed millions of bats in North America.

Habitat loss, pesticide use, and evictions from roost sites in buildings further threaten already stressed bat populations.

When not out foraging, bats seek shelter in roost sites, and need secure roosts to survive. Roosts include nurseries where pups are born and reared, hibernation sites, and resting places. Some roost sites accommodate hundreds or thousands of bats.

Providing artificial roosting structures offers additional secure summer roosting habitat for local species such as Little Brown Myotis, Yuma Myotis, and Northern Myotis. These roosts might help reduce stressors on local bat populations, increase resilience to white-nose syndrome, and support recovering populations.


BC Hydro has installed several types of bat roost structures in the area to enhance bat roost availability.

These structures include artificial bark poles, multi-chambered maternity boxes, rocket boxes, and a mini-condo.


Please do not approach or disturb the structures. If bats are using the structures, they may be observed exiting during the summer around dusk in good weather.

Bat sighting instructions


If you see a bat, please leave it alone. For more information on bats, contact BC MoE or visit bcbats.ca or if you would like more information regarding the BC Hydro bat box program please contact BC Hydro at 1 800 BC Hydro.



Little Brown Myotis (*Myotis lucifugus*) Photo by Jared Hobbs.



Northern Myotis (*Myotis septentrionalis*) Photo by Jared Hobbs.



Yuma Myotis (*Myotis yumanensis*) Photo by Jared Hobbs.





Figure 10. Text of the interpretive sign installed on a post at Montana3 near the bark poles.