

# Stewardship of Wildlife and Biodiversity Values through the Installation of Maternity Bat Boxes

Can the placement (post-harvest) of Maternity Bat Boxes be an effective and standard mitigation strategy to help to offset the loss of critical breeding and roosting sites within the working forest?

Field Report prepared by

Frank Doyle, RPBio., Wildlife Dynamics Consulting,

Amanita Coosemans, RPBio., Balanced Ecological Management Company,

and

Danielle Riis

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Cedar Shake - Maternity Bat Box

## Acknowledgements

Danielle Riis ( <https://www.cedarbatboxes.com/>) worked with us in the design and creation of the nursery-style bat boxes, which she constructed with a combination of local western red and yellow cedar, and with no plastic or toxic components.

## Summary

Many bat species require tree cavities to roost and to raise their young, but unfortunately forest harvesting removes these critical features from the landscape. To help to mitigate for the loss of these cavities, a research initiative supported by Terrace Community Forest, Canadian Forest Products Ltd. (Canfor), and Skeena Sawmills Ltd., was undertaken in 2018, to determine if maternity bat boxes could help to offset for the loss of the natural cavities.

Box design was focused on using sustainable, locally-sourced cedar for longevity, and incorporating a design with no plastics or other toxic substances. The boxes are intended to be left in the regenerating forest, where they will ultimately decompose, leaving only wood and minor metal components. Box installation was also designed to be mill-safe if the host tree was later harvested.

A total of 23 boxes were placed on the harvested edges of both 40-50 year old second growth and old growth stands, and by the fourth year all boxes showed evidence of use. Bat guano was collected from all boxes for potential future genetic DNA analysis of the bat species using the boxes. Future work is now focused on the identifying the number of boxes required to effectively mitigate for the area and/or type of forest harvested (i.e., providing for a comparable number of cavity-roosting bats).



**Photo 1.** Canfor. Box on harvested edge of mature forest.

## Background

This set of stewardship interventions was undertaken to support biodiversity and wildlife restoration and mitigation in harvested landscapes, where snags and cavities used by bats as roost and breeding sites have been removed. A 2017 study (Forceman Ridge Waste Management Facility baseline and offsetting projects) in the Onion Lake flats area south of Terrace BC, showed that *seven-fold fewer* bat species were using unmodified second-growth stands than the adjacent old growth in this area.

In particular, the Little Brown Myotis is known to use bat boxes for roosting and breeding; owing to a large scale population decline from white-nose syndrome (primarily in eastern Canada), this species was recently emergency-listed under Canada's *Species At Risk Act (SARA)*. Support of this species in western provinces (where it has also declined, but from habitat loss rather than disease) is expected to help sustain the species in Canada.

Although the openings and young forest created in post-harvest landscapes do provide foraging opportunities, these areas lack the cavities and loose, sloughing bark that provides for natural roost and breeding sites.

This stewardship project provides immediate- and medium- term structural attributes that can support both breeding and solitary bats. We have made strong efforts to ensure techniques used are practical, low cost, and safe—both environmentally as they degrade over time, and for logging and milling operations. Through support of this set of projects, the **Terrace Community Forest, Skeena Sawmills Ltd., and Canadian Forest Products Ltd.** have contributed to demonstrating a successful stewardship concept to support biodiversity and Species At Risk in the working landscape.



**Photo 2.** Skeena Sawmills. Box on harvested edge of coastal old-growth forest.

## Project A: Installing & Monitoring Maternity Bat Boxes

### Overview:

The major factor currently affecting BC's bat populations is habitat loss—primarily through forestry. As many of our local bats require older forest attributes (cavities or deep, flakey bark for day-roosting, and large cavities for maternity colonies), the conversion to second-growth forests has been detrimental to populations. Particularly, attributes that can support maternal colonies are extremely limited in heavily harvested landscapes which may otherwise offer good foraging opportunities in openings, ponds, lakes, streams and wetlands, in areas which historically would have supported strong and diverse bat populations.

In addition, white-nose syndrome—which is caused by a fungal infection (*Pseudogymnoascus destructans*) during hibernation—is decimating many bat populations across North America (<https://www2.gov.bc.ca/gov/content/environment/plants-animals-ecosystems/wildlife/wildlife-health/wildlife-diseases/white-nose-syndrome>), and, although predicted to arrive here soon, it has yet to reach BC. Ensuring there is a large and healthy population of bats is seen as one of the strategies that may help prevent the loss of bat species that are vulnerable to the fungal attacks.

To counter the loss of important bat habitat attributes and to sustain healthy bat populations, several local (**Terrace Community Forest**) and regional forest harvest companies (**Canadian Forest Products Ltd** and **Skeena Sawmills Ltd**), offered their support (in 2018) to determine if the installation of nursery-style bat boxes could help to address this issue. In addition, in 2020, **LNG Canada**, also contributed to the monitoring/use objectives of this project, through the installation and monitoring of six boxes in wetland restoration habitats in Kitimat, and have added a further six boxes in 2021 (which have yet to be monitored).

### Methods:

#### Box Design:

We identified several key requirements of the box which focused Dani Riis's ultimate box design:

- sized to support maternity colonies as well as non-breeding individuals;
- unlikely to allow pests (e.g. wasps) or predators (e.g. marten) to gain entry;
- all natural & non-toxic products;
- locally available wood;
- long lasting;
- easily mounted (i.e., light and practical); and
- mill safe.

To accomplish these objectives we followed the design recommendations from ***bcbats.com*** <https://bcbats.ca/attachments/Building-Homes-for-Bats.pdf>, but made several modifications:

- Locally sourced, long-lasting cedar lumber and shingles were used, thus keeping it light enough to maneuver and mount without too much difficulty.
- We use a combination of red and yellow cedar because they are light, strong and beautiful.
- The dimensions have been modified to 18” wide by 32” long and accommodate a landing pad at the bottom of the box.
- The boxes are constructed with 4 chambers to help the bats to regulate their body temperature, with passageways added to allow the bats to travel between chambers. (Photo 3).



**Photo 3.** Box Interior showing inside scoring and between chamber pathways.



**Photo 4.** Box exterior showing ledge.

- We scored the cedar shingles and back-board instead of using plastic mesh that won't break down. This surface helps bats to hang securely, with ease.
- We placed a small, unobtrusive ledge at the bottom of the box to assist with accessing the box and catching young bats (which are sometimes known to fall) (Photo 4).
- Boxes are “all natural,” so when they do decompose they will leave little trace, and can be left on site without need to retrieve at the end of its lifespan.
- We have treated the outer cedar with linseed oil—a natural preservative for extra protection for longevity.
- The cedar is scorched on the front face of some of the boxes to improve weathering and to darken the surface to warm the chambers if placed in areas with less solar exposure.
- The boxes may be hung with aluminum spikes to prevent damage in the mill if the wood is later harvested.



**Photo 5.** Terrace Community Forest. Located in second-growth Wildlife Tree Creation Patch

### **Location**

Boxes were placed on south or southeast-facing trees (>30cm DBH) that have an open flyway to the box to allow ease of access. Boxes were placed  $\sim \geq 4\text{m}$  height and were secured using 6" aluminum nails placed central to the backboard at the top and bottom of the box. Whenever possible, a tree was selected for installation that had an irregularity, in order to minimize or eliminate any negative impact to timber value. Each location was recorded using a handheld GPS unit. In many cases, the tree used for installation was also girdled, to ensure the boxes were not overtopped by shading branches, and to support the creation of natural snags in second-growth areas to provide habitat for a variety of cavity-nesting wildlife at the predicted end of the bat-box lifetime.

### **Bat Box Use**

To avoid disturbance, the boxes were checked by the authors for evidence of use *after* the breeding period in late July - August of 2018, 2019 and 2021. The boxes were then examined closely for evidence of use (bat droppings: "guano"); guano was then collected for potential DNA analysis to identify the species of bat(s) using the boxes. Boxes at the LNG Canada site were inspected visually for guano, and/or bats emerging from the boxes at dusk, by their environmental personnel.

## Box Integrity

In addition to checking for use during the bat box surveys, the boxes were also inspected for wear and damage.

### Results:

A total of 23 maternity bat boxes were erected in two biogeoclimatic subzones in northwest British Columbia (Appendix 1, Table 1 and Map P7.).

- Ten (Box location 1-8, Table 1) were on the edge of small ~ 0.5 - 1 ha openings and block roads in 40-50 year-old second-growth western hemlock (*Tsuga heterpphylla*)-dominated stands (Terrace Community Forest);
- four were on the edge of recently harvested coastal old-growth (>20ha cutblocks) dominated by western hemlock, Sitka or Roche spruce (*Picea sitchensis*), and amabilis fir (*Abies amabilis*) (Skeena Sawmills Ltd.);
- three were on the edge of recently harvested interior old growth (>20ha cutblocks) dominated by white spruce (*Picea glauca*), subalpine fir (*Abies lasiocarpa*), lodgepole pine (*Pinus contorta*) and aspen (*Populus tremuloidies*)(Canfor Ltd.); and
- six were along the edge of recently created wetlands within the Kitimat LNG Canada facility property.

The exact location and general geographic area of each bat box is listed in Appendix 1.

**Table 1.** Habitat associated with the location of each maternity Bat Box.

Box Location #	Number of Boxes	Habitat Type	Biogeoclimatic Unit
1	1	40-55 year old Second Growth	Coastal Western Hemlock
2	1	40-55 year old Second Growth	Coastal Western Hemlock
3	1	40-55 year old Second Growth	Coastal Western Hemlock
4	1	40-55 year old Second Growth	Coastal Western Hemlock
5	1	40-55 year old Second Growth	Coastal Western Hemlock
6	2	40-55 year old Second Growth	Coastal Western Hemlock
7	2	40-55 year old Second Growth	Coastal Western Hemlock
8	1	40-55 year old Second Growth	Coastal Western Hemlock
9	1	Old Growth	Coastal Western Hemlock
10	1	Old Growth	Coastal Western Hemlock
11	2	Old Growth	Coastal Western Hemlock
12	1	Old Growth	Sub Boreal Spruce
13	1	Old Growth	Sub Boreal Spruce
14	1	Old Growth	Sub Boreal Spruce
15	6	Wetland	Coastal Western Hemlock
<b>Total</b>	<b>23</b>		

### **Bat Box Use**

During the less than four-year period across which these boxes have been installed, inspection of boxes for guano confirmed the use of all 23 boxes. In three cases (two in second growth, one in old growth), individual bats were still using the boxes in late July and emerged from the box as a ladder was placed beneath to check for evidence of use. We do not, as yet, have direct evidence of their use as maternity colonies.

### **Box Integrity**

One box had evidence of gnawing damage beneath the lower two shingles—damage possibly caused by a squirrel. In one mature - old growth stand, the tree on which the box had been placed had blown down, but the box was relatively unscathed apart from a broken ledge (Photo 6).



**Photo 6.** Tough Boxes! Tree down, box survived.

### **Conclusions**

The box design, including the modifications to the recommended BC Bat program maternity-style nursery boxes, were successful in attracting bats over the 2-4 year period that the 23 boxes were deployed: All the boxes have shown evidence of use.

Using natural wood and materials to minimize pollution and prevent potential damage at the mill (if a box tree is milled) was successful, with only minimal damage caused by a squirrel chewing on one box, and slight damage caused by the blow down of one bat box tree.

And yes, the boxes are tough!

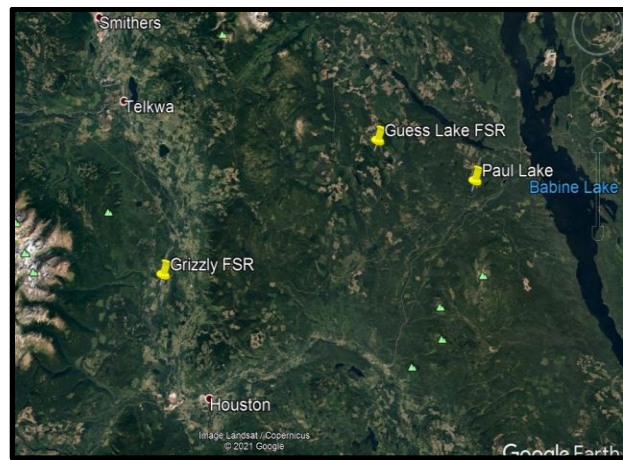
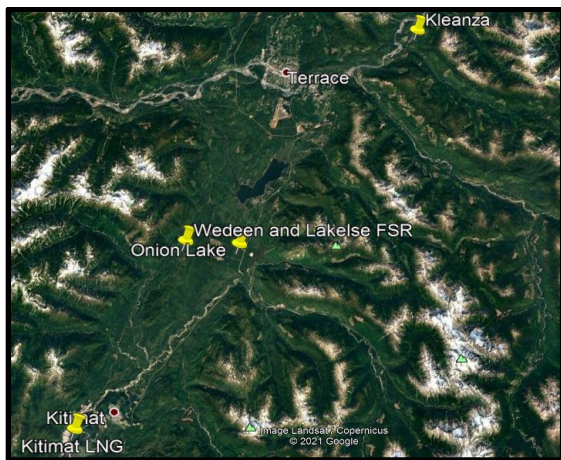


**Future Work**

- The work to date has established that the boxes are being used by bats, and together with ongoing work with the BC Bat Box Program, we will strive to continue to refine a box design that maximizes use by the bats, and provides for a healthy and long-lasting roost and maternity colony habitat.
- In addition, we will continue to refine that design and installation techniques to ensure that the boxes are cost effective, long lasting, plastic/toxin-free and mill safe in their construction and their installation.
- Genetic DNA analysis of the guano may be conducted to establish which bat species are using the boxes.
- Through continued partnerships we need to determine the optimum number of boxes required (per area), in both second growth and mature – old growth forest harvest landscapes, to mitigate effectively for the loss of bat roosts and maternity cavities.

**Appendix 1.** Table 1. Location of the individual Bat Boxes and Supporting Partners.

Box Location #	Number of Boxes	General Location	UTM			Supporting Partner
			Zone	Easting	Northing	
1	1	Lakelse FSR. 3 km. Terrace	9	526812	6014076	Terrace Community Forest
2	1	Lakelse FSR. 4 km. Terrace	9	526892	6014027	Terrace Community Forest
3	1	west of 4 km Lakelse FSR. Terrace	9	527003	6013931	Terrace Community Forest
4	1	Lakelse FSR. 6.5 km. Terrace	9	529883	6014115	Terrace Community Forest
5	1	Lakelse FSR. 5.5km. Terrace	9	529924	6014049	Terrace Community Forest
6	2	Forceman Ridge. Onion Lake. Terrace	9	529920	6013942	Terrace Community Forest
7	2	Forceman Ridge. Onion Lake. Terrace	9	523866	6020107	Balance Ecological Consulting
8	1	Kleanza. Terrace	9	538877	6052046	Balance Ecological Consulting
9	1	Widen FSR. 6.5 km. Terrace	9	522485	6015132	Skeena Sawmills Ltd.
10	1	Widen FSR. 7 km. Terrace	9	522537	6014707	Skeena Sawmills Ltd.
11	2	Widen FSR. 15 km. Terrace	9	521517	6010943	Skeena Sawmills Ltd.
12	1	Guess Lake FSR. 3 km. Fulton	9	658570	6076213	Canadian Forest Products Ltd
13	1	Paul Lake. Topley	9	675990	6071146	Canadian Forest Products Ltd
14	1	Grizzly FSR. 2 km. Houston	9	639582	6032311	Canadian Forest Products Ltd
15	6	LNG Canada. Kitimat				LNG Canada. Kitimat
<b>Total</b>	<b>23</b>					



**P7.** Maps Showing the Geographic Location of the boxes (Yellow Pins).