

Best Management Practices for Bat Boxes in British Columbia



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Summary

- Bat boxes can be valuable for bat conservation, but reasons to install boxes should be carefully considered, and attention to construction, installation, monitoring, and maintenance are essential.
 - Determine if bat boxes are necessary or appropriate prior to construction and installation.
 - Not all bat species use bat boxes. Boxes are used primarily by the two species which commonly inhabit buildings (Little Brown Myotis and Yuma Myotis).
 - Bat boxes may increase the number of roost sites available for some species but do not mitigate the loss of complex natural habitats.
 - Bat boxes may be valuable in the following situations:
 1. mitigation for exclusion from a known roost,
 2. mitigation for loss of natural roosting habitat,
 3. education, or
 4. pest control.
 - Prior to any exclusion, do exit counts to determine bat numbers and install enough bat boxes to support the excluded colony.
 - Install well-built, multi-chamber boxes, not single chamber boxes.
 - Install multiple boxes in locations with varying amounts of sun exposure, ideally three or more.
 - Follow regionally-appropriate recommendations for colour and amount of sun exposure.
 - Register your bat boxes with the BC Community Bat Program.
 - Monitor your bat boxes and report any mortality.
 - Maintain your bat boxes annually.
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Considerations for use of bat boxes

Bat boxes can provide safe, secure roost sites for several species of bats in British Columbia. They are commonly used by Little Brown Myotis, Yuma Myotis, and Big Brown Bats, and occasionally used by California Myotis, Long-legged Myotis, and Long-eared Myotis. Detailed construction and installation information is provided in [Building Homes for Bats](#) and from [Community Bat Program Regional Coordinators](#).

Bat boxes can be an essential part of managing bats and providing habitat in urban and rural areas. However, before installing a bat box, it is important to consider if a bat box is necessary or appropriate in the situation. Bat boxes are likely not necessary in undisturbed areas where natural roost sites are available (e.g. patches of old cottonwood, aspen, conifers with sloughing bark or cavities, cliffs and rock outcrops with deep cracks, barns or outbuildings). For an overview of considerations on how and when bat boxes may best be employed to contribute to bat conservation, watch the Wildlife Conservation Society Canada webinar '[Roosts for Tomorrow](#)'.

- Do not install bat boxes in undisturbed habitat (e.g. undisturbed, older forest with cavities and sloughing bark), where roosts are likely available. This will avoid concerns about potentially increasing the few bat species that use boxes to the detriment of other bat species.
- Bat boxes may be valuable in the following situations:
 1. mitigation for exclusion from a known roost,
 2. mitigation for loss of natural roosting habitat,
 3. education, or
 4. pest control.

See below for best practices specific to each of these situations.

1. Mitigation for exclusion from a known roost (e.g. building, tree, bridge)

- If possible, retain and preserve the original roost to avoid negative impacts and potentially decreased reproductive success in the colony.
 - Follow detailed guidance in [Managing Bats in Buildings](#) and examples from [Living with Bats](#).
- If exclusion is required, conduct exit counts before exclusion. Conduct a minimum of two pre-pup (June 1-21) and two post-pup (July 11 - August 5) colony counts, using the BC [Annual Bat Count protocol](#), and submit data to the [BC Community Bat Program](#) to:
 - determine the size of the colony and calculate the minimum number of bat boxes required to support the colony after exclusion, keeping in mind not all boxes will be occupied so additional boxes are needed.
 - One multi-chamber nursery box or rocket box may house 200-300 bats, while a mini-condo may house 1000 +.
 - determine if it is a maternity roost (i.e. is there a large increase in numbers between pre-pup and post-pup counts).
 - facilitate effectiveness monitoring (e.g. the proportion of colony that re-locates to bat boxes).
 - identify the main access points are for repair/renovation work during exclusion.

- Install a minimum of two (ideally 3+) four-chambered maternity boxes and/or rocket boxes. Multiple bat boxes should be installed, to provide a range of temperature options at a site and account for unoccupied boxes.
- Identify the species at the roost through acoustics or guano pellets (DNA). Contact BC Community Bat Program for guidance and analysis.
- Installation should occur at least one summer season prior to exclusion to allow time for bats to find and occupy the new boxes. Ideally, install in April or May and conduct exclusion in fall (see exclusion timing).
- If the owners of the exclusion site cannot or do not install enough bat boxes to support the colony, use a community stewardship model (e.g. install boxes within 500 m in the neighbourhood or at local parks).

Bat-friendly exclusions: If you are working with landowners to facilitate a bat-friendly exclusion in fall, encourage the landowners to help gather information about the utility of bat boxes: encourage multiple bat counts AND installation of bat boxes prior to exclusion, plus bat counts at the bat boxes in future.

2. Mitigation for loss of natural roosting habitat (e.g. old trees)

Urban and rural areas such as the Okanagan Valley have documented a 50% decrease in low-elevation roosting habitat, suggesting a role for habitat enhancement in ensuring continued presence of bat species. You can learn more about natural bat habitat in the [Bat-friendly Communities](#) guidance document. Before installing bat boxes as habitat enhancement, consider that:

- Areas with currently suitable tree roosting habitat should not be considered for bat boxes.
- Only six (6) of BC's 16 bat species use bat boxes and buildings. The majority of structures are used by only two species.
- Bat boxes are not effective mitigation for loss of complex natural habitats that provide abundant natural roosts and foraging habitat, so restore natural habitats where possible.
- Bat boxes may benefit some species by increasing the availability of safe roost options in an area that already has key elements to support those species (food and water) but lacks roosting habitat for crevice roosting bats due to human impacts.
- Bat boxes may provide temporary roost sites while forested habitats regenerate to a stage where they can provide natural roost sites. Habitat restoration benefits many species, not just bats and should be a priority over providing a few crevice roosts (e.g. bat boxes), whenever possible.

Species that use bat boxes: In BC, 89 % of bat boxes are used by only two species (Little Brown Myotis and Yuma Myotis).

3. As a focal point for public education

Public education can be another reason to consider installing a bat box. Well-situated bat boxes with interpretive materials can provide an opportunity to learn about bats and their habitat requirements, an accessible location to watch bats and increase public participation and support for bat stewardship. Before installing bat boxes for the purpose of public education, consider that:

- Multiple box sizes and designs, and varied installations, should be used to maximize usefulness of the boxes and minimize disappointment. See [Building Homes for Bats](#).
- Boxes should be installed in suitable areas to maximize both educational value and benefits to bats, rather than focusing solely on education.
- An interpretive sign should be installed. A sign design is available through the BC Community Bat Program.
- Signs last a long time. Take care to ensure contact information on the sign is also long duration.
- Ensure that a plan is in place that outlines responsibility for long term care, maintenance, and monitoring of the boxes.

4. Natural control of insect pests

Many people wish to install bat boxes to encourage bats on their property for pest control (mosquitoes, crop pests). If installing bat boxes to encourage bat presence for pest control, consider:

- Bats do eat mosquitoes and a variety of forest, agricultural, and orchard pests.
- Install bat boxes only if natural roosts are lacking but other habitat requirements are present (foraging areas, a water source within 5 km). See the [Bat-friendly Communities Guide](#) for more information on habitat essentials.
- Install a minimum of two, four-chambered, maternity boxes and/or rocket boxes. Multiple bat boxes should be installed, to provide a range of temperature options at a site and account for unoccupied boxes. If boxes are used by bats, consider adding more boxes.
- If you are installing boxes in an agricultural or orchard landscape, guano may be valuable for confirming prey items eaten by bats. Contact the [BC Community Bat Program](#) to find out more.

Construction – recommended approaches for organizations

Construction of high-quality, multi-chamber, bat boxes is time-consuming. Several approaches are recommended, based on experiences across the province.

- Use experienced woodworkers: Consider partnering with an individual, organization, or institution with construction or woodwork experience, who can build bat boxes for distribution (e.g., prison, disabled woodworker business, high-school woodworking programs, keen community volunteers with woodworking shops, rod and gun clubs).
- Volunteers or students: If volunteers are interested in building bat boxes, ensure they have the necessary carpentry skills or can acquire them (e.g. in a high-school woodworking class) to build high-quality bat boxes. Poorly constructed boxes have less likelihood of occupancy and don't last as long, so are not an optimal use of resources. As a result, most Community Bat Programs have moved away from volunteer, bat house building workshops and use experienced carpenters instead.
- Supply builders with optimal plans or [links to plans](#) online. Some boxes, such as small, single chamber boxes are not recommended. However, do install a variety of boxes if possible, including deep and shallow boxes, wide and narrow chambered boxes, etc. as this will provide varying microclimates and appeal to bats of different stages in reproduction, different sexes, and different species. All boxes need standard components including a long rough landing platform, and ways for bats to move between chambers inside the box without having to exit the box.
- Consider partnering with local hardware stores when possible, for material cost-reduction and wood-cutting options.

- Consider sourcing funds for bat house materials from local conservation funds, [TD Friends of the Environment](#) (not for private land), Fish and Wildlife Compensation Program's (FWCP) [Community Engagement grants](#), or Public Conservation Assistance Fund ([PCAF](#)).
- Bat-box building workshops: These are a LOT of work and are rarely done as we now recommend only multi-chamber bat boxes constructed by experienced carpenters. If you are doing a workshop, due to the length of time to make a multi-chamber box, do as much preparation as possible (e.g., pre-cutting and roughening all pieces) to ensure projects can be completed in the allotted time. Combine a workshop with an educational presentation and provide instructions on installation and monitoring. Example presentations are available from the BC Community Bat Program.

Bat box style and construction details (what kind of bat box and how many?)

Details on bat box construction and installation are provided in the [Building Homes for Bats](#) guide. Regional adaptations are best discussed with the [Community Bat Program Regional Coordinator](#) for your area. Key points:

- Promote multi-chamber maternity boxes (> 60 cm / 24" tall, > 50 cm / 20 " wide) or rocket boxes found in [Building Homes for Bats](#). These offer a range of temperatures to roosting bats, are most likely to be occupied, and are most likely to house maternity colonies (highest conservation impact). Costs range from ~ \$50 - \$100 per box, plus installation costs.
 - Single-chamber houses are not recommended. They are much easier to build, but may have more chance of overheating, to the detriment and perhaps death of bats inside, and will not support maternity colonies. These boxes should only be installed in shaded or north-facing areas, if used.
- Bat condos (2.5 m (8') wide and high) and mini-condos (1.2 m (4') wide and high) are larger and can be built to provide a complex set of microclimates. They are more expensive (~\$7000 minimum) and may take years to become occupied, although structures do get occupied by a small number of bats in the first season. For mitigations where bats need a home quickly, ensure the condos offer ample roosting opportunities under siding and roofing. Standard bat condo plans may require site-specific modifications to be warm enough to support maternity colonies in BC or cool enough to avoid heat stress in hot areas of BC. Contact the [BC Community Bat Program](#) for details.
- Install a temperature and humidity monitoring device, if possible, to contribute temperature data to research projects and allow for adaptive management (see Monitoring, below). If temperatures are too hot or cold, modifications can be made, including stain colour, opening vents, closing gaps, etc.
- Ensure houses are correctly built or they will not last and are less likely to be used, including:
 - secure caulking and roofing. Leaky houses will not attract bats and are a waste of resources.
 - appropriate venting (as per designs in [Building Homes for Bats](#)).
 - all interior surfaces are roughened (roughened wood provides a "foothold" and is preferred over screen; if screen is used, ensure all staples are flush to avoid damaging wings)
 - landing pad of sufficient length (10 cm (4")) and roughness below the chambers, for bats to land on then crawl into chambers
 - colour of the exterior of the box should be based on location to increase or decrease heat – see temperature maps in [Building Homes for Bats](#)

- use of odour-free, water-based stains, and only stain the OUTSIDE of the box.
- Consider your target species when constructing boxes.
 - Most species that use bat boxes (e.g. Little Brown, Yuma, and California Myotis) use 1.9 cm / ¾" crevices or spaces between bat box chambers.
 - Big Brown Bats, which are larger, may prefer larger (2.5 cm / 1") crevices and may be less likely to use a 1.9 cm spaced box.
 - Townsend's Big-eared Bats require open, barn-like structures. Use of artificial roost structures in BC by this species is poorly understood, with only one successful Townsend's artificial roost in BC (condo, not box). If you build a structure for this species, ensure plans for the structure and monitoring results are shared with the BC Community Bat Program and the Province of BC.
 - Other bat species not mentioned are less likely to use boxes made of plywood or milled wood.
- Artificial bark can be bought (e.g. Brandenbark) or constructed (e.g. cedar shakes) and may provide habitat for a variety of Myotis species, including Northern Myotis, that do not use buildings or boxes. Use in Canada is unknown but bark trialled in BC has received immediate use (species to be determined).

Distribution (who gets a bat box and how to distribute bat boxes)

- Boxes given away for free are less likely to be installed, installed correctly and monitored. This can be a large drain on limited budgets and reduce effectiveness of the program. Consider
 - A refundable deposit, returned after installation and/or three years of monitoring (proof of installation and/or occupancy count data required). If unoccupied, move the box.
 - Pricing that covers materials and installation costs.
 - Pricing that contributes funds to the bat project.
- Prioritize who will receive bat boxes (e.g., eviction is planned, landowners can commit to do annual bat counts and/or that are centrally located for volunteers to do roost counts and guano collections).
- Hand-deliver bat boxes if possible, and review installation criteria, select a site, and promote monitoring. Ideally include installation by a trained person.
- Maintain a contact list of all bat house recipient and/or workshop participants and obtain permission to share data for research purposes, and/or ensure recipients all register bat boxes on www.bcbats.ca
- Ensure that installation, maintenance, and monitoring advice is provided to all bat house recipients, regardless of how the boxes are built/sourced.

Installation

Bat boxes in full sun will get hot. Heat appeals to maternity colonies of bats in spring when heat is critical to advance gestation. There is, however, concern that boxes could get too hot and/or humid and contribute to mortality later in the season, particularly during sudden temperature fluctuations. To be effective, bat houses must be installed according to the guidelines in [Building Homes for Bats](#), with regionally-appropriate amount of direct sunlight, on a heated building/outbuilding/pole, and at least 10 feet high and away from clutter. Bat boxes can be placed on de-limbed trees, but live branches may cause shading and clutter.

- Promote installation of multiple boxes (minimum of two, ideally three or more), in positions that receive varying amounts of solar heating. Sites with multiple houses offer a range of roost temperatures and are more likely to be occupied by maternity colonies. Bats will move between boxes. To facilitate movement when pups are unable to fly, place some boxes back-to-back, with a roughened tunnel between them. Use variation in staining, solar exposure, and/or awnings to create different microclimates across the structures.
- Ensure bat boxes get installed. Many donated (free) bat houses do not get installed, or may be installed in suboptimal locations. Maximize effectiveness of bat boxes by ensuring that boxes are sited in optimal locations. Consider:
 - Site visits to assist with siting and installation by trained staff/ volunteers.
 - Financial incentives to encourage installation by homeowners (e.g., a deposit returned after installation).
 - A fee-for-service model including a site visit, bat boxes, and install.
- Provide a regional instruction sheet, including recommended colour of bat box, facts about local bats, maintenance recommendations, and your contact information (Appendix 1).
- Record details on installation and submit online – see Tracking below.
- Install houses at least one summer season before an exclusion, to allow bats time to locate the new roost site.
- Bat houses not occupied after three or more years should be relocated to a site with more or less direct sunlight.

Tracking bat houses

- Encourage bat box owners to [register their bat house online](http://www.bcbats.ca) at www.bcbats.ca
- Keep a list of all contacts who receive or build or install a house for follow up.
- Confirm if bat box owners give permission for data on their bat house (location, box characteristics, and installation information) to be shared provincially for research.
- Always collect standard information on bat house characteristics and installation details, to aid in determining bat preferences. This should include:
 - Type and size (e.g. nursery box, rocket box, Wisconsin mini-condo)
 - Number of chambers
 - Colour
 - Aspect
 - Mounting surface (pole, wall).
- During site visits, record basic characteristics of successful and unsuccessful bat houses (e.g. evidence of use, location, bat box type, mounting method, height, aspect, colour). All data should be reported online through the [Bat House Registration link](#).

Monitoring and maintenance

Providing effective artificial roosting habitat is a long-term commitment. Bat boxes should be maintained and monitored yearly (at a minimum).

- Maintenance must be carried out for boxes to be effective. Ensure box recipients know to
 - Scrape out wasp nests.
 - Scrape out any large guano accumulations.
 - Recaulk joints and repair roofs if needed.
- Monitoring approaches could include:

- A monitoring agreement signed by bat box recipient to encourage monitoring.
- Funded or volunteer monitoring team with an identified team leader.
- Recruiting dedicated volunteer groups.
- Provide an easy and clear monitoring protocol. At least one count (ideally four) during the BC Annual Bat Count is recommended, even if no bats are observed.
- Promote visual checks throughout the summer, to confirm occupancy.
- Remember that bats may occupy bat boxes intermittently and perhaps for only part of the season. These boxes are still providing important habitat!
- Use a guano catcher or place plastic sheeting or cardboard on the ground to best monitor for intermittent use. Bat guano looks like mouse droppings – dark and elongated pellets. Bat guano is easily crushed, and contains insect fragments.
- Encourage reporting of all unused boxes as well as used boxes, to improve future installation advice.
- Encourage box owners to regularly inspect the ground under the bat boxes in late June and early July, to check for dead pups or adults. Report these immediately to the [BC Community Bat Program](#).
- Consider installing a shade cloth/sheet over the bat box if bats appear too hot and are hanging around the entrance of the box.
- If mortalities are observed, install a nearby or adjoining box that is cooler, through shading, aspect, or venting. This will provide a safe escape from occasional overly-hot (e.g., > 42 °C) temperatures in the main box.
- Provide feedback to bat box owners and monitors to enforce value of monitoring and retain monitors.
- Expect to have to re-contact box owners with reminders to monitor boxes. At a minimum – March/April – reminder to install new boxes, ensure older boxes are clean and in condition. June/July – reminder to monitor for occupancy/Annual bat count, and to check for dead pups.
- Encourage monitoring of temperature and occupancy in bat boxes, to determine maximum tolerable temperature for bats and situations that create high temperatures. Contact the BC Community Bat Program for more information.

Guano collection and distribution

- Ensure appropriate respiratory protection is used when collecting guano from enclosed spaces.
- As with the handling of any animal feces, ensure gloves are used.
- Guano is an excellent fertilizer but should not be transported away from the roost site, due to the possible persistence and transport of Pd, the fungus responsible for WNS, in guano.
- Promote using guano as fertilizer ONLY in the immediate surroundings (<20 km from source).

Acknowledgements

This document was based on the recommendations developed in the Kootenay Community Bat Project report (Craig and Isaac 2018), information from Habitat Acquisition Trust (Erickson-McGee 2019) and communications with bat biologists, bat advocates, and BC Community Bat Program regional coordinators across the province. Their experiences and findings are invaluable in helping direct future mitigation and enhancement efforts.

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Appendix 1. Example of regional installation information handout (South Coast)



South Coast Bat Conservation Society
Bat research, conversation and education



Installing a Bat Box

Bat boxes are an excellent way to enhance bat habitat in your neighbourhood. Female bats may use these roosts from April to October to raise their pup; however, occupancy time varies with species (3 wk- 5 mo). Bat boxes require very little maintenance. As a caretaker of a bat box, we encourage you to join the Community Bat Programs Annual BC Bat Count. This province-wide program only requires a total of 4 hrs of observations every summer, and allows you to directly help us monitor, protect, and manage bats.

There are numerous types of bat boxes, two successful designs are the Rocket Box and 4-chambered Nursery House (aka bat house). Be cautious of marketed boxes as they may not be suitable. Visit SCBats website for designs, to purchase a kit or box, or to book a bat house building workshop.

Bat boxes should have/be:

- ☛ Three or more chambers connected internally
- ☛ All internal surfaces grooved or scoured
- ☛ Partitions with ¾ inch spacing
- ☛ Unobstructed landing strip 3" or taller
- ☛ Roof with lateral and forward overhang
- ☛ Watertight
- ☛ Hung in a location that receives a large amount of sunlight (S or SE exposure in Vancouver)
- ☛ Hung a minimum of 12 ft (4 m) above the ground, and 20 ft (6 m) from surrounding obstacles (i.e. wires, branches)
- ☛ Hung within 400 m of freshwater
- ☛ Hung on a building near the roof or mounted on posts
- ☛ Avoid chemicals, metal or hard mesh materials that can harm bats



Rocket box

For a successful bat house in the Vancouver and surrounding areas:

- ☛ Install the box before April or 1 year prior to exclusion.
- ☛ Install 2 or more to compare and assess conditions and/or designs.
- ☛ Keep cats inside at sunset and sunrise to reduce predation on bats.
- ☛ Minimize disturbance. Do not tap or bump the box and only shine a light up inside for minimal periods of less than 10 seconds to check occupancy.



4-chambered nursery house

If your bat house is not occupied after 2-3 summers check for drafts and gaps. Monitor your property for bat activity and move it to a new location based on your observations. Or try painting it a different colour. Contact SCBats of the BC Community Bat program for guidance and learn about the Annual BC Bat Count.