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BUILDING AND MANAGING Bee Hotels for Wild Bees

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Tunnel-Nesting Bees

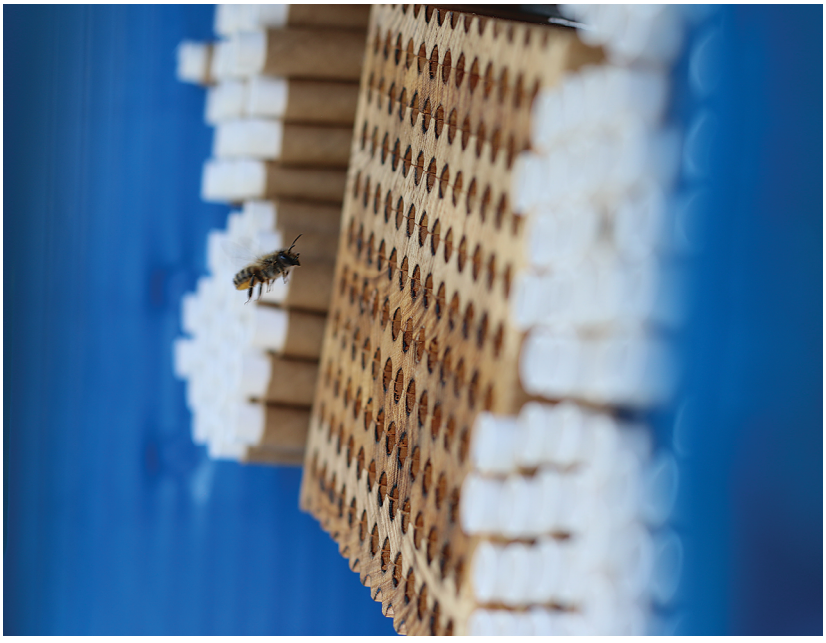
About 30 percent of the 5,000 native bee species in North America build nests in a variety of aboveground cavities or tunnels. These can be beetle holes in wood, hollow or pithy plant stems, brush piles, standing snags, or cavities in human-made structures. There are two main kinds of cavity-nesting (tunnel-nesting) bees: mason bees (*Osmia* species), which are mostly active in the spring, and leafcutter bees (*Megachile* species), which are active in the summer. Both types are found across the U.S. and can provide important pollination services for fruits and vegetables. By providing them with nesting resources, people can manage some of these species to help conserve their populations in farms and home gardens. Bee hotels are one way to provide these resources.

Jason Gibbs, University of Manitoba



Leafcutter bee, *Megachile pugnata*, building her nest in natural reeds.

Emily May, Xerces Society for Invertebrate Conservation



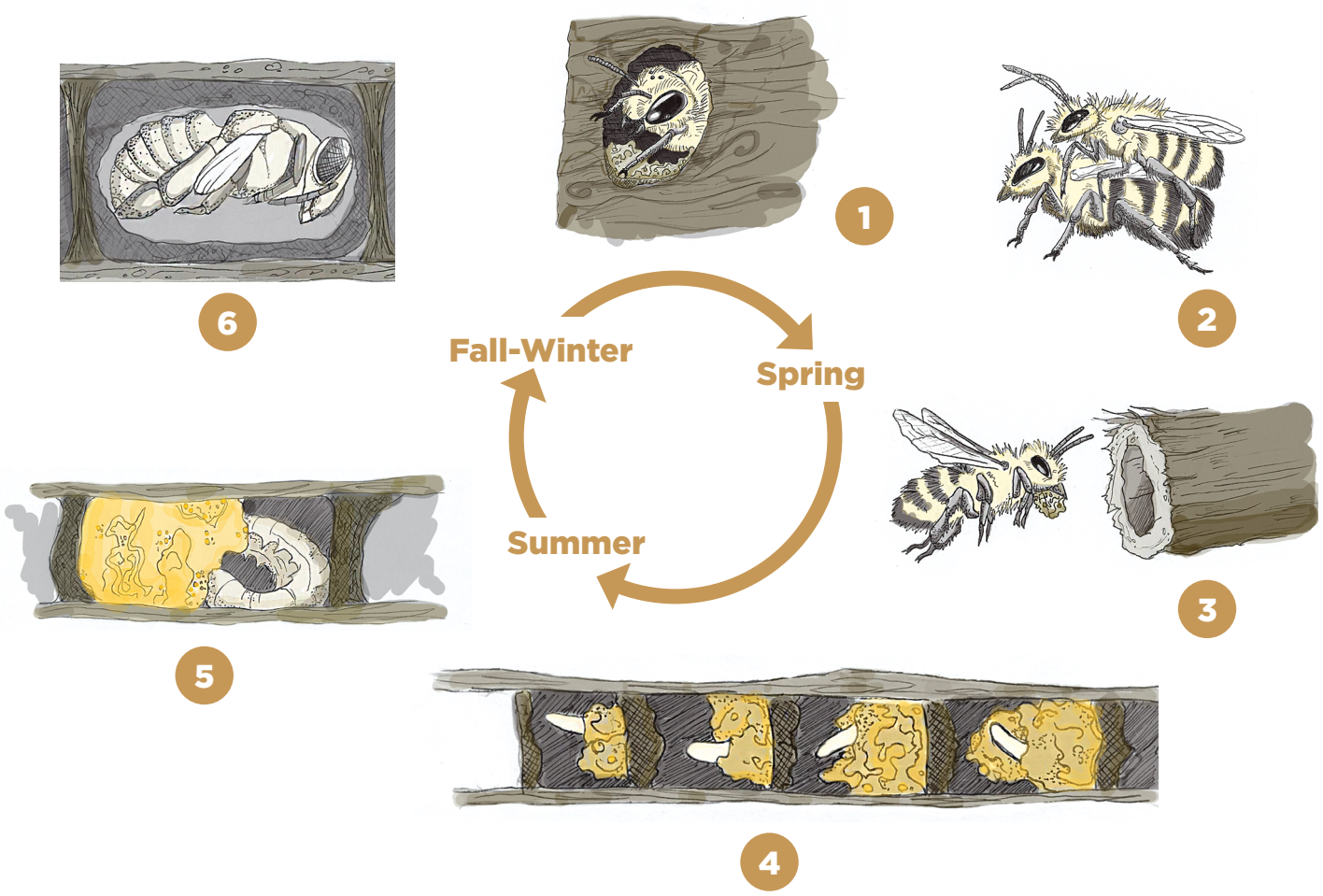
Mason bee building nests in a wood block.

Tunnel-nesting bees are solitary, meaning that each female uses an individual nest. Unlike honey bees, there is no colony with workers, there are no swarms, and they do not produce honey. Solitary bees are nonaggressive; they rarely sting unless they are grabbed or caught in clothing.

This guide provides instructions and tips for building nesting boxes, also known as bee hotels, for tunnel-nesting bees. Bee hotels can be built on any budget for farms, gardens, and parks. In addition to their role in increasing bee abundance, bee hotels can be an educational and fun way to learn about wild bees.

Sarah Scott, Michigan State University

Life Cycle of Tunnel-Nesting Bees



1) Tunnel-nesting bees emerge from nests created the previous year. Mason bees emerge in early spring. Leafcutter bees emerge in summer.

2) The bees mate in the spring (*Osmia* species) or summer (*Megachile* species).

3) The females construct their own nests by selecting a new cavity.

4) Inside the cavity, the bees divide the tunnel into brood cells one at a time starting at the back of the cavity. Each cell is provisioned with enough pollen to feed one larva. An egg is laid on each pollen mass before the cell is sealed using mud, plant resins, leaf pieces, or flower petals. For each successive cell, the female bee collects more pollen and lays an egg until the cavity is filled. The end of the tunnel is almost always "capped" with mud, plant resins, leaf pieces, or flower petals.

5) The eggs hatch into small larvae that eat the pollen provisions through the summer.

6) They pupate and overwinter as pre-pupae or as adults. A few species have two generations within one summer. They will go through this process twice per year.

Julia Brokaw, Michigan State University



Julia Brokaw, Michigan State University



Julia Brokaw, Michigan State University



Example bee hotel designs using bamboo, wood blocks, and cardboard tubes.

Steps for Building a Bee Hotel

Step 1: Design and Materials Selection

Building a bee hotel is a great opportunity to be creative in your garden, farm, or park. It can be as simple or as elaborate as you choose and can be constructed on any budget. The bees won't care how much money you spent or how fancy it looks!

The designs presented are sample ideas, but whatever design you use, be sure that your bee hotel is placed in a location that ensures its safety – where it is protected from rain and moisture, wind, and insect predators. Using a variety of nest materials and tunnel diameters will bring a diversity of bee species to your bee hotel. Or, if you are deliberately trying to enhance populations of specific bee species such as the blue orchard bee *(Osmia lignaria)*, focus your construction on using the specific nest dimensions they will use. (Read the following section on construction for specifics on dimensions.)

Step 2: Construction

Stem Bundles

Materials needed:

- Bundle of hollow tubes (for example, plant stems, bamboo, cardboard tubes, and straws)
- Paper inserts if using cardboard straws
- Tape, zip ties, string, or wire for bundling stems together
- Scissors or pruning shears for cutting stems
- Nesting structure or house for rain protection (for example, large plastic tote, constructed wooden frame, and other ideas as mentioned in the description following)

Katharina Ullmann, Xerces Society for Invertebrate Conservation



Bundle of bamboo tubes of various diameters to be used in a bee hotel.

- Wire mesh to protect from predators (optional)
- Paint to decorate (optional)

You can construct a simple nest using bundles of hollow stems such as reeds or bamboo, or cardboard tubes and straws. This design is ideal if you have no woodworking experience or equipment, because you can cut the tubes using pruning shears or scissors.

The inside space of the stems should range from 1/16 to 1/2 inches in diameter. If you use plant stems, cut each one below the node (indicated by a ridge) to create a handful of stems, each having one open and one closed end, making sure that all open ends face the same direction. Stem length can vary depending on the nest box design but should range from 5 to 8 inches. Tightly bundle the stems together with tape, zip ties, string, or wire. Avoid using rubber bands as they will dry out and break.

You can also pack cut stems or straws in a container with an open end. Be sure the open ends face out of your container. This container could be a

large plastic tote turned on its side or a constructed wooden frame that will hold nest materials. Some examples include aluminum cans, milk cartons, cinder blocks, plastic buckets, cut PVC pipes, and a number of other containers. When designing this, provide an overhang to protect the nest materials from rain.

Plants with hollow or pithy stems:

- Asters with large stems (*Symphyotrichum* spp.)
- Bamboo
- Bee balm (*Monarda fistulosa*)
- Common reed (*Phragmites*)
- Cup plant (*Silphium perfoliatum*)
- Honeysuckle (*Lonicera* spp.)
- Joe-Pye weed (*Eupatorium maculatum*)
- Raspberry, blackberry (*Rubus* spp.)
- Sumac (*Rhus* spp.)
- Sunflower (*Helianthus* spp.)
- Wild rose (*Rubus* spp.)

Wood Nest Blocks

Materials Needed:

- Untreated wood
- Drill
- Long drill bits of various diameters
- Rain protection
- Wire mesh to protect from predators (optional)
- Paint (optional)

To construct a wooden nest block, use *untreated* lumber or old tree stumps, standing snags, and logs that are at least 4 inches thick. On one side, drill a series of holes of varying diameters to attract a range of bee species. The holes should be between 3/32 and 3/8 inches in diameter and 3 to 6 inches deep. (Blue orchard bees prefer holes that are 5/16 inches wide and 6 inches long). As the hole diameter increases, the length of the tunnel should also increase. Smaller drill bits create thinner and shorter holes that can be used by small bees that nest successively in numerous small holes. You can use longer drill bits to make holes for larger bodied bee species. Separate the holes by at least 3/4 inches to ensure the integrity of the wood block. Most bees prefer a closed-end tunnel so do not drill completely through the block. If holes are drilled all the way through, attach an opaque backboard. Drill with a sharp bit and at a high speed as bees avoid rough interiors that could damage their wings.

Decorating your bee hotel with paint on the outside can help attract bees from long distances to the nesting tubes and protect the structure from rain.

Katharina Ullmann, Xerces Society for Invertebrate Conservation



Wood block drilled with holes of various diameters to attract a diversity of stem-nesting bees.

Julia Brokaw, Michigan State University



Leafcutter bee (*Megachile* sp.) sealing her nest in bamboo tube.

Step 3: Location

Nests should ideally be placed in a location facing southeast to receive direct sunlight in the morning. Elevate the nest about 4 to 5 feet above the ground and attach it to a visible landmark such as a post, building, or isolated tree. Mount the nest boxes firmly so they do not move or shake in the wind because it may disturb developing larvae. Be sure that there are flowering plants nearby that bloom in early spring and throughout the summer. Willow, maple, redbud, and wild cherry provide pollen for early emerging mason bees. Later blooming wildflowers such as purple coneflower, black-eyed Susan, and bee balm provide foraging resources for leafcutter bees. Both mason bees and leafcutter bees can fly hundreds of feet to locate suitable plants so be sure to locate the nest relatively near to floral resources to help ensure that bees will find your hotel for nesting.

In early spring (late-March to mid-April in Michigan), place nest boxes outside at your chosen location and leave them until late October. The mason bees will complete nesting by mid-June, whereas most leafcutter bees will complete nesting in July and August.

Jason Gibbs, University of Manitoba



Be sure to provide floral resources that bloom throughout the season near your bee hotel.

Pesticide Safety

Is your bee hotel location safe from pesticide risk? If you use insecticides in your lawn or garden, be sure to protect your bee hotel from drift, avoid spraying when bees are active, and do not spray flowering plants. Always follow pesticide label instructions and observe the pollinator protection information.

Step 4: Maintenance and Monitoring

Materials Needed:

- Pipe cleaners
- Bleach
- Mesh bags
- Plastic box or bin
- Ant bait or sticky spray

Maintaining and monitoring your bee hotel are the most important and significant steps in installing a bee hotel. Once you have created nesting habitat, you should make every effort to keep it clean and safe for

William Brokaw, Brokaw Photography



Long drill bits can be used to drill holes in wood blocks spaced about ¾ inches apart.

Jason Gibbs, University of Manitoba



Bufflehead mason bee (*Osmia bucephala*) foraging on false indigo (*Baptisia* sp.)

Rufus Isaacs, Michigan State University



Completed mason bee nests.

nesting bees. If the nests are never cleaned, they can harbor bee pests and diseases, putting local bees at greater harm than if no nests had been provided.

Rotating Sets of Tubes:

We recommend rotating two sets of tubes or nesting structures for the bees: one set that you put out in the spring for bees to use that year and another set that you clean after bees from the previous season have emerged. You will then have clean nesting tubes for use the following year.

Cleaning Tubes and Wood Blocks:

You should clean tubes each winter to prepare them for the following year. Use pipe cleaners to clean out previous nests, replace paper inserts, or replace with entirely new nesting material. You can also clean wood blocks using a bleach solution during winter cleaning to prevent build-up of disease. Mix a half cup of bleach per gallon of water in a well-ventilated location, cover the surfaces with the solution, rinse, and then dry. Take precautions to control any splashes. Replace natural reeds and wood block nests every 2 years as pathogens spread easily when tubes are close together.

Preventing Parasite Attacks:

Throughout the spring and summer, monitor your bee hotel to see if you have nesting bees. Tubes capped with mud or leaves indicate a nest of mason bees or leafcutter bees, respectively. If you are raising only mason bees, you can place tubes into a mesh bag in the early summer to prevent parasite attacks. Place these in a location out of the sun to limit exposure to extreme temperatures. At the end of the season, leave the tubes outside or bring them into a frost-free unheated barn, shed, or refrigerator (36-39 °F) to protect from wind, moisture, and birds.

Using Emergence Boxes:

To make sure bees do not return to their original nest, place your occupied nest or tubes in an “emergence box” in late winter or early spring. This is a box or plastic bin with a half-inch diameter exit hole cut into one side. Set up your new nesting structure nearby. The bees will emerge, exit, and use the new clean nest outside the box instead of returning to the original inside the box. When the bees finish emerging, you can clean the old nest for future use for next year.

Monitoring for Problems:

Throughout the summer, check for the following:

- Moisture getting into the nest box
- Ant infestations (They are attracted to the protein-rich pollen provisions and developing bee larvae but can be prevented using sticky spray or ant bait at the foundation of the bee hotel.)
- Paper wasp nests
- Predatory birds
- Spider webs (Their presence may indicate the nest location is too dark.)

Katharina Ullmann, Xerces Society for Invertebrate Conservation



Bee hotel in winter.

Tunnel-Nesting Bees of Michigan

Common species that you might find nesting in your bee hotel:

Mason Bees

Katherine Odanaka, Michigan State University



Blue orchard bee
(*Osmia lignaria*)

Katherine Odanaka, Michigan State University



Japanese horn-faced bee
(*Osmia cornifrons*)

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Small mason bee
(*Osmia pumila*)

Leafcutter Bees

Katherine Odanaka, Michigan State University



Unarmed leafcutter bee
(*Megachile inermis*)

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Giant resin bee
(*Megachile sculpturalis*)

Katherine Odanaka, Michigan State University



Flat-tailed leafcutter bee
(*Megachile mendica*)

Additional Tunnel-Nesting Species

In addition to those featured above, you may also find the following species in your hotel: Maine blueberry bee (*Osmia atriventris*), bufflehead mason bee (*Osmia bucephala*), pugnacious leafcutter bee (*Megachile pugnata*), alfalfa leafcutter bee (*Megachile rotundata*), small-handed leafcutter bee (*Megachile gemula*), apical leafcutter bee (*Megachile apicalis*), silver-tailed leafcutter bee (*Megachile montivaga*), and the bellflower resin bee (*Megachile campanulae*).

Other species of bees and solitary wasps may also nest in your bee hotel such as small carpenter bees (*Ceratina*), wool-carder bees (*Anthidium*), resin bees (*Heriades, Dianthidium*), grass-carrying wasps (*Isodontia*), and potter wasps (*Euodynerus, Ancistrocerus*). You may also see cleptoparasitic bees (*Coelioxys* and *Stelis*) that lay their eggs into these nests. They hatch into larve that eat the pollen provisions made by other bees. These species are uncommon and do not have a large impact on host populations.

Summary

When you use appropriate nesting materials and careful management at key times of year, bee hotels can provide an important resource for wild bees in your landscape. They can be a great way to learn more about wild bees, their biology and identification, and may also help support pollination of nearby flowers.

Jason Gibbs, University of Manitoba



Cleptoparasitic bee to leafcutter bees, *Coelioxys sodalis*, rests on the ground.

Resources

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