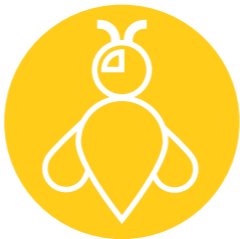


air bee n' bee

# guide to artificial habitat for cavity nesting solitary bees



written and illustrated by

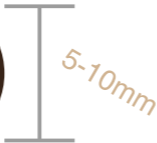
xavier mcnally



# wood block dimensions

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for best results follow these guidelines



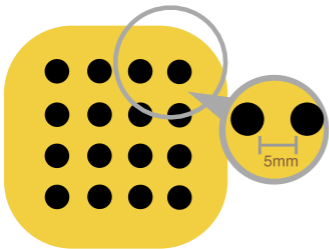
- cavities should range from 5-10mm in diameter & 15cm in depth
- when drilling you should keep the holes at least 5mm apart
- the wood must be untreated, with no added preservatives



- a range of cavity diameters will diversify nesting species



- remove any snags around cavity holes, to protect fragile wings



## tips



- position the block South facing (lots of sun)



- a height of 1.5m is optimal, and ensure it is out of direct wind



- ensure the entrance is covered to prevent water damage from rainfall, you could also tilt the block down



# wood block maintenance

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the holes are drilled and you have nesting females, what can you do to protect a healthy population?

## protect

- it is best practice to replace wood blocks at least every two years as they can degrade making them more vulnerable to the elements
- at the end of the Summer, wood blocks should be stored in a cool, dry place as moisture promotes fungal/bacterial growth
- after all adults have emerged, all cavities can be cleaned with a pipe cleaner to remove old material; the wood block should then be put in the freezer to kill bacteria



## design

- as long as the general size guidelines are followed and a population is present in your area, bees should nest in your structure; however some designs can maximise it's effectiveness

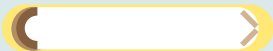
## rain guard

- keep your nest dry, water is the natural enemy of the structure
- although Mason bee cocoons are largely water resistant, they are not resistant to parasites or fungus



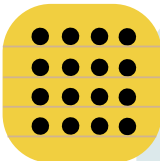
## inner tubes

- paper tubes placed inside the lining of the drilled cavities can allow more effective cleaning and observation
- the paper lining should be shorter than the depth of the cavity and coloured dark at the cavity entrance to not deter bees
- paper linings can be removed with tweezers or pliers; ensure they are pinched at the back to ease removal



## ability to disassemble

- when drilling the wood block, cutting horizontally can create the ability to disassemble the block
- at the end of the Summer you can open the nest for observation, this is also great for cleaning cavities for reuse
- easy access to the cavities allows you to harvest cocoons and then you can evaluate their health more efficiently





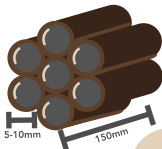
# artificial tubes

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for best results follow these guidelines

## bamboo cane

- ensure bamboo canes are drilled to allow the bees passage through the tube
- when drilling, make sure to only drill part way through as bees prefer only one cavity entrance



## cardboard tube

- cardboard tubes must be kept dry, so place them inside an outer casing
- some commercially available cardboard tubes have an inner paper lining to allow observation

## tips



- position the tubes South facing (lots of sun)



- ensure the entrance is positioned away from direct wind



- an outer casing can be used to prevent water damage

- a range of cavity diameters will diversify nesting species



## glass/plastic tube

- glass or plastic tubes are commercially available and can be effective in promoting nesting activity
- they offer the chance for easy observations of nesting and life cycles

But they can prove lethal for nesting bees as moisture promotes:

Fungal growth & disease



## fixing

- to secure the habitat, you can use:



a drain pipe bracket



small shelving brackets



tie the structure with string

- the structure must be secured tightly and not be able to move



# artificial tubes maintenance

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nesting females have shown interest in your tubes,  
how can you protect a healthy population?

## protect

- it is best practice to replace bamboo or cardboard tubes every year as they can degrade making them more vulnerable to the elements
- at the end of the Summer, artificial tubes should be stored in a cool, dry place as moisture promotes fungal/bacterial growth
- the structure needs to be fixed securely; protected from rainfall and wind as movement or moisture will deter bees



## design

- as long as the general size guidelines are followed and a population is present in your area, bees should nest in your structure; however some design choices can maximise it's effectiveness

## rain guard

- keep your nest dry, water is the natural enemy of the structure
- although Mason bee cocoons are largely water resistant, they are not resistant to parasites
- you can use a terracotta pot or plastic drain pipe



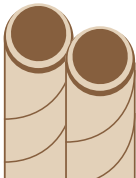
## inner tubes

- paper tubes placed inside the lining of the cavities can allow more effective cleaning and observation
- the paper lining should be shorter than the depth of the cavity and coloured dark at the cavity entrance to not deter bees
- paper linings can be removed with tweezers or pliers, ensure they are pinched at the back to ease removal



## ability to disassemble

- some commercially available cardboard tubes can be taken apart easily, allowing you to disassemble nest cavities
- at the end of the Summer you can open the nest for observation, this is also great for cleaning cavities for reuse
- easy access to the cavities allows you to harvest cocoons and then you can evaluate their health more efficiently



# what you'll see

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## Mason Bee

*Osmia* sp.

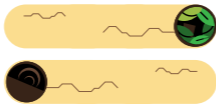
- mason bees use mud to build their nest
- look out for nest caps made from soil and mud
- Red Mason bees have distinctive red hairs across their abdomen



## Leafcutter Bee

*Megachile* sp.

- leafcutter bees use leaf cuttings to build their nest
- look out for nest caps made from leaves or petals
- leafcutter bees cut out distinctive elliptical shapes



# what's inside

- the females gather pollen and nectar for their offspring to feed on in the Spring
- inside the cavities, the females create brood cells in which they can lay an egg on top of the pollen stack
- sex of the brood is controlled, with females laid in the back and males laid by the entrance
- between 5 and 8 individual cells can be created by a single female in each cavity



larval egg

# uk cavity nesting species

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Mason



Leafcutter

## female identification



*Osmia Bicornis*  
🕒 April - June

common

- known as Red Mason Bee,  
females have two "horns"  
on their face



0.8-1.1cm



1.2-1.8cm

*Megachile Willughbiella*  
🕒 June - early Aug

common

- large species, red/yellow  
underside with black hairs  
at rear

*Osmia Cornuta*  
🕒 April - June

uncommon

- known as European Orchard bee,  
first recorded in Britain in 2017



1.0-1.2mm



1.2-1.8cm

*Megachile Centuncularis*  
🕒 June - early Sept

common

- "honeybee sized" species,  
red/yellow underside creates  
yellow halo when seen  
from above

## pollen foraging

- pollen is carried on the scopa, it is  
directed with the legs onto the  
"pollen brush"

- females reverse into  
the cavity and deposit  
the foraged material



## underside (scopa)



*Megachile Willughbiella*

red/yellow hairs  
with black hairs on rear



*Megachile Centuncularis*

red/yellow hairs



# what's inside

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## Mason bee life cycle



### Spring



- in Spring, the female gathers pollen and nectar in her brood cells

- once the pollen stack is complete, the female lays an egg on top of the material  
- the larva will hatch and feed off this material through the Summer months

### Summer



- in each brood cell, the hatched larva grows while consuming the pollen collected by its mother

### Autumn/Winter



- the larva creates silk to spin a cocoon in which to pupate

- they overwinter in the hardened cocoon, emerging the next Spring as adults

## cocoons

- you can harvest cocoons in the Winter, this allows you to check on the health of the offspring and monitor parasite activity
- cocoons can be cleaned and kept refrigerated or in a cool dry place to aid in the natural hibernation process







# what's inside

© Xavier McNally

## Leafcutter bee life cycle



### Summer



- in Summer, the female gathers pollen and nectar in her brood cells



- once the pollen stack is complete, the female lays an egg on top of the material  
- the larva will hatch and feed off this material through the Summer/Autumn months



### Autumn



- in each brood cell, the hatched larva grows while consuming the pollen collected by its mother



### Winter



- the larva creates silk to spin a cocoon in which to pupate



- they overwinter in the hardened cocoon, emerging the next Summer as adults



## cocoons

- you can harvest cocoons in the Winter, this allows you to check on the health of the offspring and monitor parasite activity

- cocoons can be cleaned and kept refrigerated or in a cool dry place to aid in the natural hibernation process





# maintenance

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if you build it, they will come!



so you've decided to create artificial habitat for solitary bees,  
a sometimes forgotten part of the journey is **maintenance**

- although letting nature take its course is important for the ecosystem, there are steps you can take to promote a healthy population of solitary bees
- from cleaning the structure every year, to using a design that reduces the impact of water, you can maximise the effectiveness of your habitat

## here are some solutions to common problems

rain



- when creating any structure ensure it is protected from the rain, especially if it will be left outside during the Winter months
- you can build a roof or secure artificial tubes inside a protective casing

wind



- over time, constant exposure to wind can break down the nest caps created to protect the contents of the cavities
- you can set artificial tubes back into a protective casing or turn the wood block away from the wind

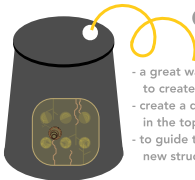
birds



- if you see evidence of birds pecking at cavity entrances then you can fix chicken wire or mesh over the structure
- the wire should deter birds but will not influence the bee's nesting behaviour

- all of these problems can compromise the brood cells inside the cavity and expose them to the elements
- once exposed this allows parasites access to the collected pollen stores and the larva themselves

## emergence



- a great way to protect the offspring and aid them in the Spring is to create an emergence box with the old nest material placed inside
- create a dark space using a bucket or black plastic tub with a small hole in the top to attract newly emerging adults to the light
- to guide them from the old material to fresh habitat, place new structures just outside the box

## remember

- Leafcutter adults will emerge later than Mason bees, so make sure your box is safe from predators and rainfall
- Mason bees will emerge in April and Leafcutter bees will emerge in June



# nest parasites

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if you build it, they will also come!

a new habitat is present and if solitary species thrive,  
then nest parasites may do too

## here are some common nest parasites

### parasitic wasps *Sapyga*

- these species are typically cleptoparasites that lay eggs in the brood cells, their larvae will then eat the pollen and the bee larva
- cleverly adapted, some of these species have long ovipositors with which to lay their eggs far into the cavity



*Sapyga Quinquempunctata*

### pollen mites *Chaetodactylus*

- pollen mites are also cleptoparasitic, in that they feed on the pollen collected in the brood cells
- they are thought to feed on the eggs, leading to dead bees in your cavities
- if you see bees emerging with lots of tiny hitchhikers on their back, then you have a pollen mite problem



*Osmia Bicornis*

### fungus *Chalkbrood*

- fungal growth within the cavities can result from exposure to moisture in the Winter months
- developing bees will die in the cavity as bacterial and fungal diseases spread, the dead bees resemble the letter C



### parasitic flies *Houdini Fly*

- this species only affects Red Mason bees (*Osmia Bicornis*), it is a small fly with red eyes
- again the larvae eat the pollen and the bee larva before making small holes in the mud walls to escape, they pupate over Winter and emerge in the Spring
- look out for small holes in the mud linings of the cavity



*Cacozenus Indigator*

## remember

- maintenance of the habitat can prevent the majority of these pests thriving, you can prevent the spread by cleaning the materials and storing nests in a cool, dry place
- you can harvest cocoons and observe whether any of these pests are present, you should remove any infected or dead cocoons immediately









**try not to disturb the nest in the Spring, maintenance and observation should be carried out in Autumn**



# references

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for more information please  
explore the references below

-  Field Guide to the Bees of Great Britain and Ireland  
By Steven Falk and amazing illustrations by Richard Lewington (2015)
-  BWARS website is full of information about ecology, identification and distribution  
(The Bees, Wasps and Ants Recording Society)
-  Steven Falk's Flickr page is a treasure trove of photos that are invaluable for identification
-  Marc Carlton's "How to Make and Manage a Bee Hotel: Instructions that Really Work" (2015)  
This can be found on the Foxleas website, along with other useful tips for pollinators.
-  "Seasonal Stewardship Practices for Mason & Leafcutter Bee Homes"  
By the Environmental Youth Alliance
-  Images and content about Mason bee brood cell development, created by Rob Fowler at the University of Sussex
-  [bumblebeeconservation.org](http://bumblebeeconservation.org)
-  Air Bee n' Bee: a citizen science study of man-made solitary bee hotels as a conservation approach - McNally (2018)

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