Advice for deploying bumble bee nest boxes (domiciles)

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Nest boxes

In areas where bumble bees are abundant, setting out nest boxes (domiciles) in the field to promote the establishment of nests by bumble bee queens is a great way to obtain colonies of bumble bees. The method has been used most successfully in Canada and New Zealand (Hobbs et al. 1960, 1962; Palmer 1968; Clifford 1973; Donovan & Wier 1978; Richards 1978; Pomeroy 1981; Barron et al. 2000).

Nest Box Design

There are many descriptions of how to build nest boxes (see Hobbs et al. 1960; Hobbs 1967; Richards 1978; Prys-Jones & Corbet 1991; Munn 1998; Kearns & Thomson 2001). A one-chambered nest box of internal box dimensions 15 cm x 15 cm x 15 cm is usually sufficient, as it accommodates a colony of up to 150 workers. Two-chambered boxes are useful if one has to shut the box for some time (e.g., when moved to another location); the larger chamber is the nest area, and the smaller chamber is a vestibule where food can be put and bees can defecate. We recommend against the 2-chamber design for normal use. It adds needless complication to box construction and size. The box can be made out of any type of material (plywood, concrete, polystyrene, plastic; Macfarlane et al. 1984), but should be constructed to allow for the escape of water vapour, as excessive humidity makes colonies susceptible to mould. Boxes made of plywood do not need to be painted if removed at the end of summer. If boxes are painted, paint should be applied only on the exterior a few months before use, as the smell may repel queens. The roof should be covered with a water-shedding material (Munn 1998), achieved most simply with a thin polypropylene sheet stapled to the roof's outside corners. A hinged lid allows access to the colony and facilitates rapid closure. A piece of wood along the top of the inside back wall prevents bees from being killed when the lid is closed, worth installing if the box is often checked with bees in it. The entrance should be in the centre of the front wall, and its diameter between 16 and 18 mm. When the entrance hole is too large, cold can easily enter and small rodents may usurp the nest box (see Barron et al. 2000).

Line the inside surfaces with a 2-cm thick layer of insulation, such as water-repellent upholsterer's cotton (Hobbs et al. 1960) or non-surgical white bleached cotton (e.g., Kendall Lakeside cotton). The bleached cotton has the advantage of allowing easy detection of nest parasites (e.g., flies, wax moths). "Cotton wool" or aquarium filter fibre

are inappropriate, as bumble bees tangle their feet in it. The cotton will be fluffed up by bumble bees once they have occupied the box. This fluffing, along with the presence of yellowish faeces, is a sure sign that the nest box has been occupied.

When, where, and how to set up nest boxes

Nest boxes should be set out in the field as soon as possible in the spring, right after snow melt, before leaves appear on the trees and early flowers (e.g. willow) start blooming, as some bee species nest very early in the season. In areas that do not get snowfall, boxes can be set out in late winter, or if well waterproofed and in trees, left out all year.

Nest boxes should be put close to sources of spring food, as queens appear to search for cavities near food-rich habitats. Meadows (Hobbs et al. 1962) and especially botanical gardens (where food is plentiful but natural nesting sites are limited) are good sites for nest boxes. As a rule of thumb, boxes perform best in habitats where bumble bees are typically common. It is also advisable to set boxes in sites where pesticides and possible vandalism are minimal. Also, presence of large ant nests within 3 m is a good cue not to install a domicile there.

All domiciles needed to be provided with a waterproof top. The best way to achieve this is with a piece of thick plastic “poly”, used in house vapour barriers, stapled to it the lid deflect moisture away from the box. The plastic should overhang the lid by about 3 cm on all sides.

Each species of bumble bee usually has preferences for nest sites (Sladen 1912; Free & Butler 1959; Hobbs et al. 1960, 1962; Richards 1978; Macfarlane et al. 1984). Nest boxes can be placed in-ground, on-ground, and on trees (Hobbs 1967). The set-up is important because it attracts different species and affects probability of occupancy. The difference is mainly observed between under- and above-ground boxes (Richards 1978). Underground boxes perform best if they are on slopes to allow for adequate drainage. A short, almost horizontal, tube (10 - 40 cm) of 20 mm outside diameter PVC pipe can then connect the box to the slope edge. The tube entrance should be cleared of obstructing vegetation, and always pointing slightly downwards (so as not to funnel rainwater into the nest). A piece of sod should cover the tube, and a second larger piece should broadly cover the box top. When set out in this way, boxes are difficult for other people to detect and interfere with. Detailed notes of box location are essential, as vegetation grows up quickly and makes the box difficult to find later in summer. An underground box can be simulated by using a surface hive with a 30 cm tube, and a piece of sod covering the tunnel entrance (the “false-underground” hives of Hobbs (1967). False-underground hives are easier to set out than underground hives and attract more queens of surface-nesting species, as well as underground species, than surface hives (Hobbs 1967). A drawback of underground hives is that they must be removed at the end of each summer to prevent deterioration from fungi and small rodents that chew the plywood. As nest entrance tubes are typically black, it is important

that they not be exposed to direct sun, as tubes so expose would be unusable on hot sunny days.

Above-ground domiciles keep drier and are easier to set up and check than underground domiciles. Furthermore, if properly waterproofed they can remain in place year-round. Remember, though, that these boxes typically attract different species from those that nest in the ground. With no need for digging, and ability to leave them out year round, above-ground boxes are easiest to use. However, care must be taken to keep above-ground boxes out of direct sun, particularly at mid-day, to prevent overheating which may melt the wax and damage the brood. In the northern hemisphere, mounting them on the N side of a thick tree trunk is optimal. Above-ground boxes are more susceptible to vandalism, mammalian predators (e.g., skunks, racoons), and occupation by ants. To protect colonies, boxes must be fastened securely to a tree, post, or stakes, at least 10-15 cm above ground to ensure they do not get flooded after heavy rains. The lid must be shut securely. Boxes are easily secured to tree with plastic strapping and a metal buckle. Ground-mounted boxes can be protected from ants with a barrier of a sticky paste like tanglefoot (but not on the box itself). To protect the colony from vertebrate predators, domiciles can be wrapped with chicken wire mesh (3-cm diameter holes), making sure to leave a gap of about 15 cm between the entrance of the domicile and the mesh.

Domiciles accumulate parasites, diseases, and mould that may be transmitted across years. To reduce these problems, boxes should be cleaned thoroughly after each season by scraping the inside surfaces of the box and replacing the nest insulant. They should be washed with a mild bleach solution to eliminate mould and parasites.

Once the first queens have finished hibernating and are looking for a nest site, boxes can be inspected every few weeks to detect occupancy. Routine inspection also permits one to detect and fix any problem incipient colonies may have, e.g., water leaks, ants. Alternatively, boxes can be examined once at the end of the season, and their contents inspected for outcome. Bumble bees leave a waxy record of their activities, which in some cases is destroyed by wax moths, but which usually preserves an accurate record of their fate.

Success of colony establishment

A UK study that used domiciles in 2 years (only) had very low occupation success (3.1%). Occupancy of domiciles is usually very low in the first year, but increases with successive years (see Frison 1926; Donovan & Wier 1978; Hobbs et al. 1962; Hobbs 1967; Macfarlane et al. 1984; Barron et al. 2000). Macfarlane et al. (1984) found an increase in occupancy from 7% the first year to 61% the fourth year. The increase in occupancy over years may be attributed, among other things, to the experience of the researcher in selecting more favourable sites, the weathering of treated timber, improved hive set-up, the return of overwintered queens to the site from which they came, and the odour left by previous occupants (Frison 1926; Donovan & Wier 1978; Pomeroy 1981; Macfarlane et al. 1984; Barron et al. 2000). In particular, nesting boxes

that have been colonized have a better success of occupancy the following year (Barron et al. 2000). The probability of occupation does not appear to be affected by previous occupation by mice or the smell of mice in the nest box (e.g., from mouse litter), the presence of pieces of honeybee comb with honey and pollen, or the compass direction a box faces (Hobbs et al. 1960; Barron et al. 2000; pers. obs.). Important factors for the establishment of queens are a dry and well-insulated nest (Donovan & Wier 1978) located near abundant spring food, in a site where bumble bees are abundant. Unfortunately, a box that is detectable by smell is good for nest-establishing queens, but might increase the likelihood of usurpation by queens of the same or different, exclusively parasitic species of bumble bee (the erstwhile *Psithyrus*).

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Tree-installed domicile. Box is secured to the tree with plastic strapping with a metal buckle.

Small domicile, outside view.

Small domicile, inside view, with dimensions. This box will accommodate all but the largest bumble bee colonies. 15 cm ruler is shown, for scale.