This hint is provided courtesy of the Australian Quarantine Inspection Service, Barbara Waterhouse and David Banks.

AN INTRODUCTION TO BEELINING

by

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Recent incursions of Asian bees (*Apis cerana*) into the northern islands of the Torres Strait and African bees (*Apis mellifera scutellata*) in Fremantle as well as the detection of Asian bees on board vessels in Australian waters has highlighted the dangers these bees and their accompanying diseases pose to the Australian apicultural industries. To combat these threats, there is a need for improved surveillance techniques at sea ports and better tracking and elimination methods, so that if swarms do manage to either move further south in the Torres Strait or to move inland from a vessel before detection, they can be eliminated. As a result, the Australian Quarantine and Inspection Service (AQIS) has in recent years been developing improved surveillance and tracking technologies. The latter were tested in the field in April 1995 at an incursion response exercise on Bribie Island, which involved senior Apiary Officers from most States and members of the Northern Australia Quarantine Strategy staff based in the Torres Strait.

In addition to the threat from the introduction of exotic bees or their diseases, there are other advantages in gaining experience in beelining. For example, it may be necessary to find and eliminate feral nests in areas which have a particularly bad history of American Foul Brood. Alternatively, Apiary Officers may be asked to destroy nests of "nuisance bees". The techniques that follow are easier to use in a rural environment, but they can be employed successfully in built-up areas, provided that it is possible to gain access to backyards along the beeline.

The objective of this paper therefore is to outline the progress which has been made by AQIS in reviving the ancient art of beelining, which is a key element in the protection of Australia's apicultural industries. The information in the following notes has been compiled from a number of sources, but mainly from books (eg "Hunting Wild Bees" by R.E. Donovan), from published and unpublished information provided by Dr Adrian Wenner of the University of California, and from personal experience gained while developing the various techniques for use in Australia. For brevity, only those techniques applicable to *Apis mellifera* have been detailed here. However, alternative methods for Asian bees have also been developed.

CONVERSION TO ARTIFICIAL BAITS

When bees have a stomach full of nectar or water they tend to return straight back to the nest. If this "beeline" is followed, returning bees will guide the follower to the nest. However, it is very difficult and time-consuming to follow bees foraging on natural nectar sources until their honey stomachs are full and they
return to the nest. Furthermore although bees can be followed from their sources of water, those sources have first to be located, and this also takes time.

The objective of the following procedure is to convert bees foraging on a natural nectar source onto an artificial bait, so that they fill up rapidly with a scented nectar and return immediately back to the nest. Once there, the scent in the syrup provides a guide to other bees which follow the initial feeders back to the syrup. Although bees use the "dance" to indicate a source of nectar to other bees, scent is also involved in locating these sources. If a bee has fed on nectar (or syrup) containing a strong scent, others will follow the scent plume set up by a flying bee returning to the source. As the scent in the artificial source tends to overpower the scents of natural nectars, more bees are "recruited", so that the number of bees feeding off the artificial bait slowly increases.

The main difficulty is to persuade bees to accept a scented artificial bait. Bees will usually simply ignore a bait which placed in close proximity to a nectar source. However, the following method for converting them onto an artificial bait has proven to be both effective and reliable.

**Equipment required:** Entomological net, bee valve, blackout, conversion pad, stand, soft drink bottle and scented syrup. (Distilled scent oils such as boronia, lavender or aniseed work well. The formula for scented syrup is 1kg granulated sugar fully dissolved in 1ltr hot water - add 20 to 30 drops of scent when cool).

**Catching bees**

First find foraging bees within reach of the net. It is usually easier to collect bees foraging on ground flora or flowering shrubs than in trees, but avoid thistles and thorny plants as the mesh of the net is easily damaged. Using the net, collect as many bees as possible in three to five minutes. Sweep net over inflorescences and fold the hoop over the pocket of the net to prevent escape. Introduce the bee valve into the net and place it over the bee, then hold it there in full sunlight until the bee enters the ventilated jar. As a general rule, the brighter the light the faster the bees come through the valve; under most circumstances this should only take a few seconds. If it is found that bees take an extended period to enter the jar, one cause could be that the funnel has not been sufficiently roughened to allow the bees to grip the sides. Alternatively, this can occur on very overcast days but can be simply rectified by shining a torch directly down into the valve entrance.

Once the bee is safely in the jar, either place the bee valve in the shade or, if none is available, cover it with the blackout. This is important as bees can get distressed if left for any extended period in full sunlight. Then return to the floral source and collect another bee. If there are a great many foragers, it is often possible to collect several bees in one sweep of the net. Alternatively, folding the net over between sweeps will retain those already caught inside the net.

This sequence should be repeated as rapidly as possible so that the trapped bees do not spend an extended period in the jar. The ideal is to catch up to **20 bees** in about **five minutes**. In many cases however, this is not possible and it is far better to catch fewer bees but keep to the maximum of five minutes, rather than hold them in captivity for a longer period for the sake of catching a few more bees. Often it requires a number of attempts to catch the required number of bees when foragers are difficult to find. Although this may increase the time taken to establish a beeline, it rarely affects the final outcome.

Once you have your bees in the jar and the five minutes is up, take them to the bait station for conversion to the artificial bait.

**Converting to artificial baits**

The bait station will have been set up some distance from the floral source on which the bees were captured.
There is no absolute rule governing the distance from the source, but experience indicates that a minimum of 10 meters is required, preferably more. If the bait station is nearer than this, bees tend to return to the floral source rather than the station.

Place a sponge pad in a honey jar lid and dampen it by pouring no more than two cap-fulls (eg soft drink bottle cap) of scented syrup evenly over the surface. It is important that the pad is not soaked, otherwise the bees will become fouled when they land; it is rare for fouled bees to return to the bait station.

Once the syrup has soaked into the pad, place it on top of the bait station platform. Unscrew the ventilated jar from the bee valve and quickly place it over the pad. It is not necessary to screw the jar into the lid. Then place the blackout over the whole assembly and wait three minutes without disturbance. At the end of this period, gently remove the blackout. Hopefully, several bees will be on the pad feeding off the scented syrup, having been attracted down the sides of the jar and onto the pad by the light holes at the bottom of the blackout. These are the bees most likely to return.

Remove the ventilated jar and allow the bees to complete their feeding. When their honey stomachs are full, the bees will fly off the pad and will usually make several loops round the bait station. As the bees get their bearings, the loops become wider until they fly off towards the nest. Occasionally, one is fortunate enough to get a rough idea of the direction of the nest on the first flight, but this is unusual.

Then comes an anxious time waiting to see if any of the bees will return to the bait station. As the wait can be extended, even when the nest is fairly close, it is better to go back to the natural forage and collect more bees, set up another pad and repeat the sequence. The sight of another blackout on the platform of the bait station does not appear to distract bees returning to the first pad. Repeat the capture, conversion sequence as many times as possible until bees are regularly returning to the station, which may be covered in as many pads as will fit on the platform.

Once bees are regularly returning to the station the beeline is established. While the initial approaches to the scented syrup may be hesitant, once "addicted", bees will go to remarkable lengths to get access to it and will tolerate a considerable amount of manipulation - as a result the syrup has been termed "junkie juice".

**SCENTING**

Occasionally, it is very difficult to collect foraging bees, even when weather conditions are good. This can occur if there are no melliferous plants in flower, or if bees are foraging in tree canopies and cannot be reached by net. In these circumstances it is necessary to attract scouts so that they may be caught and converted to the artificial bait.

One way to attract passing bees is to heat cappings in a pan over a camping stove. As the bees approach to investigate, they can be caught in the net and introduced into the bee valve in the normal way. If cappings are not available, a mixture of water, honey and beeswax works just as well. Ensure that the stove is placed away from obstructions to make it easier to use the net.

**BEELINING**

The objective of beelining is to find a nest by following bees travelling between the nest and a bait station. The technique uses the principle that bees generally take the direct route home and fly at a relatively constant speed of about 7mtr/sec or 25kph.
Equipment required: Bait station, bait pads, scented syrup, correction fluid (white, blue, yellow, green), stopwatch, calculator, note pad, compass, binoculars.

When and where to set up a bait station

When setting up the bait station, there are several factors which should be kept in mind. Firstly, the weather can be very important in beelining. Where possible, windy days should be avoided. If this is not practicable, bait stations should be set up in sheltered areas, otherwise bees have great difficulty in finding them. Furthermore, in high winds bees tend to fly closer to the ground making them more difficult to see. The initial direction bees take on windy days can also be more erratic than on calm ones.

The temperature is not so important as long it is high enough for bees to remain active. However, as scent volatilises more readily at higher temperatures, bees find it more easy to locate bait stations on warm days.

The angle of light is also important, making beelining more when the sun is overhead, although there are methods which will be mentioned later of overcoming this. Nevertheless, beelining tends to be more successful in the early morning or late evening when the angle of the sun is low and light reflected off wings make bees easier to see. Beelining on overcast days is also easier on the eyes than squinting into the sun on a sunny day.

The time of day when bees are converted to an artificial bait is not particularly important. Do not worry if conversion is made late in the evening, because once bees have made a few return trips, they will remember where to go and will return early next morning.

The location of bait stations is often determined by the local terrain, and in some circumstances the beeliner may not have much choice. However, where possible, they should be established in open areas, fully exposed to the sun and preferably without too much vegetation as a backdrop against which flying bees are difficult to see.

Finally, before going into details of the technique, a word of warning: beelining can be very frustrating at first. It requires persistence and a lot of patience. However, as with so many other activities, it becomes easier with practice - and that is the main reason for this exercise.

Taking the bearing

Once bees are returning regularly to the bait station, the first task is to determine the approximate direction from which they are coming and to which they are leaving. It is usually easier for a single beeliner to start off by facing away from the sun and observing bees departing from the pad. If working in a team however, it is usual to space the members equidistant round the station and about three metres away from it.

At newly-established bait stations, bees will generally fly in an ascending spiral after they lift off the pad. As the bee gets higher, the circuits get wider until the spiral is broken off and the bee heads for the nest. This change in direction is frequently very sudden and is often accompanied by a rapid increase in speed which can be difficult to follow with the human eye. Also, as the bee gets its bearings, the initial flight path towards the nest may be a little erratic. However, after a few weaves, the flight path settles down to a fairly constant bearing. It is wise for the beeliner to find this bearing on a magnetic compass and enter it into a notebook for future reference. This should be repeated a number of times before deciding to move on, particularly as the bees on the bait pad could come from several nests. In areas which are heavily populated by bees, it is not unusual to establish several beelines from the one bait station.

There are three basic systems of finding the location of a nest - the single station, leapfrog and triangulation methods. The single station system is more suitable for the beeliner who has to carry all their equipment with
them. It involves trapping some bees on the bait station by placing the ventilated jar over the cap and screwing it on. The secured bees are then placed in the blackout to keep them cool. The bait station is then dismantled and re-established some distance along the bearing the bees have taken towards the nest. The exact positioning of the next bait station depends on the terrain but a distance of a few hundred metres is ideal. Choose an open area which is sheltered from the wind as before. Set up the station, release the bees, and wait for some to return to the new site before establishing the new bearing the bees take towards the nest.

The leapfrog method is a modification of the single station system but uses two stations instead of one. Once the first station is established and a bearing determined, a second or forward station is set up along the beeline. However, the first station is not then dismantled but remains as a reference point in case the forward station fails for any reason. Occasionally, if bees have been retained in the ventilated jar for an extended period they will not return to the new location of the forward station. In these circumstances, it is an easy matter to return to the first station, trap another group of bees and quickly return to the new location and release them. Alternatively, if the forward station has been established on the far side of the nest (ie the nest is between the first and second stations), released bees will fail to return. The advantage of the leapfrog method is that if this occurs, it is not difficult to return to the first station, trap more bees and then set up the forward station a shorter distance than before from the first.

The third method is a little more complicated, but is particularly useful when attempting to find nests in thickly wooded areas. It involves establishing a series of bait stations round the outside of the wooded area and taking bearings from each. The bearings are then drawn on a map and the intersects searched for nest sites. The maps do not need to be particularly detailed - hand-drawn ones are adequate, provided that dimensions of the area to be searched are reasonably accurate. If a hand-held global positioning system (GPS) receiver is available, most have a facility whereby the location of the nest could be estimated using the bearings taken from each bait station. The beeliner would then only have to walk to the calculated intersect position and start searching.

When looking for nests in dense vegetation bordering water, bait stations can be set up on boats anchored a little distance offshore. Provided the procedure is carried out smoothly and quietly (the noise of an anchor chain rattling on the hull of an aluminium dinghy appears to agitate trapped bees) offshore stations can be very effective, as bees are strongly contrasted against the sky and there are no obstructions to flight, making the determination of an accurate bearing fairly simple. The procedure can be assisted if the bait station is raised on a pole or mast so that the beeliner can lie underneath and make observations.

Making it easier

Beelining can be difficult to start off with. The bees seem to appear from nowhere and their departure from the bait station is often sudden and difficult to follow with the eyes. As a general rule it is much easier to see bees in flight during the early morning or late evening due to the angle of the sun and the lower light intensity.

However there are aids which can assist beelining during the middle of the day. Probably the two main reasons why flying bees are difficult to see at that time are the lack of contrast between the bee and the backdrop against which it is viewed, and the speed at which they fly (25kph). The aim is therefore to increase the contrast between a flying bee and the background, or slow it down to make it easier to follow with the eyes.

Efforts to make bees brighter against a dark background, such as by covering them with glitter etc, have largely proved unsuccessful. If the natural dark colouration of the bee can be contrasted against the sky however, it becomes easier to see. This is achieved by lying on the ground with the feet towards the bait station and about two metres from it. The single beeliner will have to do this from several positions around the station until the direction of the beeline is established, but a team of three or more, evenly spaced, will
make the task a lot quicker.

One very ancient method of slowing a bee down and also making it easier to see is to tie a piece of kapok or cotton to a back leg while it is feeding on the pad. Although the method can be effective, it is not easy tying anything to a live, unrestrained bee. Restraining them manually distresses them, and the use of an anaesthetic such as CO$_2$ tends to leave them groggy afterwards. However, the latter can be tried as a last resort.

A more reliable method of slowing bees down and making them easier for the human eye to follow is to reduce the effectiveness of the wings. The technique involves cutting a small segment from each wing-tip with fine curved scissors. Surprisingly, when feeding off the scented syrup, bees show no reaction to having the tip cropped off the wings and it is possible to carry out the procedure on a large number of bees in a short period. The cut should never be closer to the thorax than the wing-fold, or the bee will be unable to fly; try to make the cut half way between the tip and the wing-fold. Bees with cropped wings can be identified in flight due to the increased wing-beat frequency (they sound more like mosquitoes than bees) and an unusual angle of flight in which the abdomen hangs down. Bees with cropped wings have returned to bait stations for several days in succession and do not appear to be unduly disadvantaged by the procedure other than being rather slow and cumbersome in flight.

**Estimating the distance**

Once the bait station is established and bees are returning regularly, it can be very useful to obtain an indication of the distance from the bait station to the nest. The method involves marking up to four bees on the thorax with different coloured correction fluids (usually white, blue, yellow and green) and then using a stopwatch, or a wrist-watch with a second hand, to record the time taken for a full round trip to be completed. A round trip, in this context, comprises the take-off from the pad, return to the nest, disgorge to other workers, fly back to the bait station, fill up with syrup and take-off again. The two easiest starting and ending points for a round trip are either take-off to take-off or arrival to arrival.

As the time taken to fill up will be influenced by the amount of syrup absorbed into the sponge pad, it is important to ensure that there is adequate syrup available. However, avoid pouring too much onto the pad, as bees which have become fouled by surface fluid spend a lot of time cleaning themselves before lifting off from the pad and this can significantly increase the time for a round trip.

Avoid timing the first round trip made by returning bees as this can be protracted, possibly because of "dancing" on arrival at the nest or because of the time taken to find the bait station again. More accurate estimates of distance to the nest can be made if bees are marked and then left for a while until the round trip becomes routine.

Once the marked bees have settled down to regular return trips, the distance to the nest can then be calculated using a formula developed by Adrian Wenner and his team at the University of California.

\[
\text{Distance} = (\text{Time} \times 150) - 500
\]

Where "Distance" is the distance in **metres** from the bait station to the nest and "Time" is the shortest time in **minutes**

For example, if the shortest time is 5 minutes and 13 seconds (approximately 5.25 minutes) then the distance to the nest is likely to be:
(5.25 X 150) - 500

which is equivalent to

787.5 - 500

or

287 metres

The method is not that precise, however, so the distance would be rounded out to about 300 metres.

An interpretation of "shortest time" is needed here as occasionally abnormal readings ("outliers") are recorded, presumably because bees may return to the bait station without disgorging at the nest. For example, if a series of twelve observations are taken of round-trip times with the stopwatch and the following times are recorded after rounding up or down to the nearest 0.25 of a minute:

4.50, 5.00, 4.75, 4.25, 5.25, 1.75, 5.00, 4.25, 2.50, 4.75, 4.50, 5.25

When calculating the distance, ignore the outliers - in this case the 1.75 and 2.50 readings - and take 4.25 as the shortest time.

**Locating the nest**

In order of preference for nest sites, *Apis mellifera* appears to favour trees > buildings > rock crevices. An estimation of the distance from the bait station as outlined above will give the beeliner an indication of when the nest is not far off. Occasionally if the light conditions are good (eg evening) an individual bee can be followed through binoculars straight to the nest. More often however, bees will be seen heading for a particular group of trees or buildings. *Apis mellifera* appears to prefer live trees to dead ones and nesting sites of a suitable volume are more likely to be found in large trees than small ones. When the beeliner is confident that the nest is nearby, rather than set up another bait station it is often more efficient to start scouring the largest trees or most suitable buildings within the vicinity using binoculars. The reason for this, which will be dealt with in greater detail later, is that beelining from bait stations positioned very close to the nest can be difficult.

Another indication that the nest is nearby is when bees transferred to the forward bait station using the leapfrog method persistently fail to return. For example, if bees leaving an established bait station head in a direction which appears to pass over a patch of thicket, the beeliner is likely to set up a second or forward station on the far side of the thicket. However if bees fail to return to the forward station after several releases of bees it is possible that it has been located on the far side of the nest from the established station (ie the nest is in the thicket). Bees taken from the established station, past the nest site to the forward station will lift off, get their bearings and then head off in the same direction as before but this time away from the nest. Presumably these bees eventually find their way back home, but they do not return to the forward station. It is for this reason that bearings should not be taken on the first flight away from a newly-established forward station, as both the bees and the beeliner may be equally deceived.

If bees released from a forward station persistently fail to return, there are two courses of action to take; if the opportunity arises, try both. Firstly, return to the established station and set up a forward one closer than before to the first, in front of any possible nest sites, and take another bearing. Alternatively, collect some foraging bees at the forward position, convert them to the syrup and take a new bearing. If the bees fly off on a back-bearing, it is a good indication that the beeliner has leap-frogged past the nest.
Finding nests in thick woodland presents special problems due to the lack of light and a dark backdrop, both of which make beelining difficult. In addition, even if a clearing can be found, bees often have to fly round obstructions thereby providing false bearings. In this situation, the third system of triangulation using several stations established round the outside of the wooded area is probably the most useful. Once an approximate location has been determined on the map, the best course of action is to comb the area with a line of people, equipped with binoculars, to explore likely nest sites.

**REMOVING UNWANTED NESTS**

If the exact location of a nest is known and it is accessible from the ground, the best way of eliminating it is to block the entrance at night and then pour petrol into the entrance. This is best done by setting up ladders etc in the daylight for safety reasons. Once all the bees have stopped flying after dusk, place a short piece of garden hose into the entrance and then quickly block the entrance with newspaper or sacking. Then place a funnel on the protruding end of the pipe and pour at least one litre of petrol into the nest. Block the end of the tube and leave the petrol fumes to destroy the nest. Do NOT light the fuel as this can be very dangerous and does not produce any better results in eliminating the nest.

**CONSTRUCTION NOTES**

The equipment used in beelining and remote poisoning is cheap, easy to construct and, with the exception of the net, the parts are readily obtainable from hardware stores.

1] **NET**

*Materials*

(All obtained through Australian Entomological Supplies - telephone (066) 847 188)

1 x collapsible hoop

1 x 5mm (3/16 inch) bolt and wing nut

1 x net handle

*Tools*

1 x 5mm (3/16inch) drill bit

*Construction*

Firstly, connect the two halves of the hoop together. Then thread the hoop through the fold of material supporting the mesh. Push the two ends of the hoop into the sockets at the end of the handle until the bolt holes line up. Finally secure the hoop to the handle using the bolt and wing nut. Occasionally, the holes in the handle and hoop will need to be cleared with a 5mm (3/16inch) drill bit before the bolt will go through.

2] **BEE VALVE**

*Materials*
1 x 330 ml (500gm) plastic honey jar with lid

1 x PVC threaded sleeve for 90mm (3\(\frac{1}{2}\)inch) inside diameter storm water pipe

1 x PVC end cap to fit the threaded end of the sleeve (screw cap)

1 x PVC end cap to fit the unthreaded end of the sleeve (glued cap)

3 x 5mm (3/16inch) diameter bolts, 12mm (1/2inch) long, with nuts

- 1 x plastic funnel - 90mm (3\(\frac{1}{2}\)inch) diameter wide end (minimum), 12mm (1/2inch) diameter narrow end

**Tools**

1 x 3mm (1/8inch) drill bit

1 x 20mm (3/4inch) drill bit

1 x 6mm (1/4inch) drill bit

Electric drill

Electric sander / sandpaper

Tin snips, wire cutters or similar

Silicon sealant

Marking pen

Solvent cement for PVC water pipes

**Construction**

Place the lid of the jar upside down in the centre of the open end of the plain (unthreaded) end cap (the part with the wider rim which is not to be glued into the sleeve). Drill three equidistant holes 15mm (5/8inch) in from the lid rim through both the lid and the end cap. Make sure, before drilling, that the heads of the bolts will not interfere with the jar when it is screwed onto the cap/end piece assembly. Secure the lid to the cap with the nuts and bolts (make sure they are tight as it may be difficult to adjust them later).

Next, drill a 20mm (3/4inch) hole through the centre of the lid/end cap assembly, making sure not to damage the ends of the three retaining bolts. Then glue the end of the assembly with the narrower diameter into the sleeve, so that the jar lid is on the outside of the sleeve.

Cut the large diameter of the plastic funnel down to 90mm (3\(\frac{1}{2}\)inch) with tin snips or wire cutters so that it makes a snug fit with the inside of the sleeve. One way to do this is to place the sleeve over the funnel and run the marking pen around the junction of the open end of the sleeve and the funnel. Then cut the funnel just inside the line and trim off the rough edges with an electric sander or sandpaper. Smear a little silicon sealant round the 20mm (3/4inch) hole in the assembly at one end of the sleeve and also round the inside of the open end. Push the funnel into the sleeve as far as it will go so that the tip protrudes approximately 20mm(3/4inch) through the jar lid.
While the sealant is setting, drill between 15 and 20 ventilation holes in the plastic jar with the 3mm (1/8inch) drill bit. Use the 6mm (1/4inch) drill bit to roughen the inside of the funnel, including the tip, so that bees can grip the surface (this makes a big difference to the time it takes for bees to escape through the valve, so roughen the funnel thoroughly). Finally, screw the jar onto the lid/end piece assembly, screw the threaded cap onto the other end of the sleeve and the bee valve is ready for use. It is advisable to place the valve in the sun for a while to allow the smell of the sealant to disperse before using the valve.

3] BLACKOUT

*Materials*

1 x 200 mm length of 100 mm (4inch) inside diameter PVC sewage pipe
1 x PVC plain end cap for 100 mm (4inch) diameter sewage pipe

*Tools*

1 x 3mm (1/8inch) drill bit
Electric drill
Rule
Solvent cement for PVC water pipes

*Construction:*

Firstly, glue the cap onto one end of the pipe. Then drill four holes, equidistant round the periphery of the open end of the pipe with a 3mm drill bit. Start the holes 10mm from the open end and, drilling from the outside, angle the holes inwards and towards the closed end. This is so that when the blackout is placed over the ventilated honey jar and cap, bees in the jar are attracted down towards the light, which emerges at the same level as the rim of the cap, thereby bringing them into contact with the dampened sponge.

4] CONVERSION PAD

*Materials*

Lid from a 330ml (500gm) honey jar

- Flat cellulose sponge (approx. 9mm or 3/8inch thickness) blue, yellow or green (normal household sponge, usually sold in multicoloured packs of six)

*Tools*

Scissors or shears

*Construction*

Soak the sponge in water to remove the chemicals in which it is packaged. Rinse several times, then squeeze out any residual water. Then place the jar lid on top of the sponge and cut it round the circumference of the
lid. Trim to ensure a good fit inside the lid.

5] BAIT STATION

Materials

1 x 100mm (4inch) length of 40mm x 40mm (1\(1/2\) x 1\(1/2\)inch) plain pine block

- 1 x 240mm x 240mm (9\(1/2\)inch) x 20mm (3/4inch) plain pine planking (the dimensions are not critical)

4 x 38mm (1\(1/2\)inch) 6g wood screws

1 x 25mm (1inch) thick x 1.5mtr (5ft) long dowel or broom stick

Tools

1 x 25mm (1inch) drill bit

1 x 2mm (3/32inch) drill bit

1 x 4mm (5/32inch) drill bit

Countersink

Electric drill

Construction

Drill a 25mm (1inch) diameter hole throughout most of the length of the 100mm (4inch) long pine block. Place the undrilled end in the centre of the 240mm (9\(1/2\)inch) pine planking and mark round it with a pencil. Then drill four 2mm (3/32inch) holes in the planking 10mm (3/8inch) inside each corner of the outline. Place the block over the outline again and hold it there while the drill bit is pushed through the four holes in the planking from the reverse side and into the block. These are the pilot holes for the four screws. Then enlarge the holes in the planking using a 4mm (5/32inch) drill bit, and finish off with the countersink. Place four screws through the planking and into the block and tighten them until the block is firmly attached to the planking to form a platform. Some PVA glue, introduced between the two, helps to form a strong bond.

Finally, sharpen one end of the dowelling / broom handle so that it can be hammered more easily into the ground. When standing upright, the platform can be slid over the end of the dowel to make the bait station.

Note:

As volatile solvents are used in the construction of the bee valve and blackout, it is advisable to leave them out in the sun for several days (if time permits) to remove any last traces of odour.