

# **Vanuatu Honey Bee Husbandry**



**A Training Manual**

**By Gilbert Gibson**

**developed in cooperation with the  
SPC-GIZ Climate Change Vanuatu Program**

## Contents

Honey Bee Management Practices.....	3
Handling Honey Bees .....	3
Bee Feeding.....	6
Simple queen rearing .....	8
General Bee Management Principles .....	13
Bee Management for Honey Yield & Production.....	13
Adaptation to Climate Change.....	19
Obtaining Bees .....	24
Catching a Feral Colony of Honey Bees .....	24
The Equipment of Beekeeping.....	28
The Simple Beehive.....	28
The Hive and its Parts .....	33
Frame and Comb Maintenance .....	37
The Smoker, its Manufacture and Use.....	41
The Climate Change Bee House .....	47
The Colony .....	49
Life History of the Honey Bee Colony .....	49
The Castes of the Bees .....	58
Growth of the Worker Bee .....	59
Works of the House Bee .....	65
Works of the Field Bee.....	66
Seasonality in the Honey Bee Colony .....	67
Pest and Diseases of the Honey Bee.....	68
Raw Materials Exploited by Honey Bees.....	70
The Nectar flow (The Honey flow) .....	70
Wax Rendering.....	74
Products and Services of Bee Keeping.....	76
Pollination .....	76
Distribution of Honey Bees and Diseases in Vanuatu.....	78
Test Questions for Bee Keepers.....	79

# Honey Bee Management Practices

## Handling Honey Bees

Bees communicate with smells.

At about three weeks of age house bees stand at the entrance of the colony doing guard duty.



When a sudden movement or threat is observed by the guard bees they emit an alarm smell which they fan into the hive. When the bees inside the hive smell this they become excited and fly out to help the guard bees defend the colony. People and animals standing nearby will be stung.



The beekeeper uses the smoker to cover or mask this alarm smell made by the guard bees. **The very first activity the beekeeper makes is to spray thick smoke across and into the hive entrance.** This causes the guard bees to run inside and eat lots of honey.



Honey bees with stomachs full of honey are not likely to sting. Only after the bees have been smoked for a minute does the beekeeper open the hive and then he sprays more smoke into the open hive.

The beginning beekeeper is safer to use too much smoke.



As he becomes experienced he may learn to use just a little smoke on those bees that begin to look up from between the frames. Using too much smoke will cause the bees to run down to the bottom of the frame. This makes finding the queen bee difficult because all the bees are hanging in a big thick cluster under the frame. By using just a little smoke it is easy to see all the bees quietly walking over the frame and the queen bee can be found more easily.

The beekeeper must keep adding fuel to the smoker so it is always ready for emergencies.

**The beekeeper should always move slowly.**

The beekeeper should lift his hands up over the ends of the hive and not over the middle of the hive where all the bees can see his hands. The bees will sting the beekeeper who moves quickly.





When the beekeeper is stung he must **remove the sting quickly** and then spray smoke over the sting site.

Gloves and overalls that have been stung should be washed to remove the smell of the stings, or more bees will come and sting in the same place.

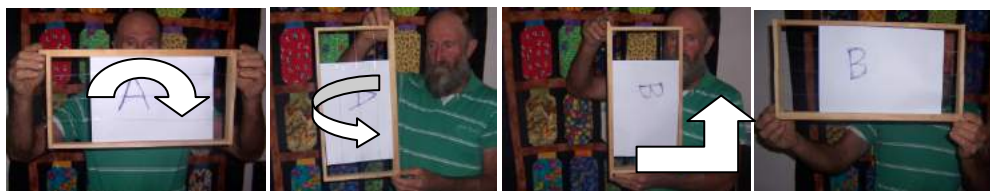
An outside or the next frame should be removed and laid against the hive at the entrance. If the queen is on this frame she may fall to the ground and it is easy for her to walk back inside the entrance.

Never hold a frame of bees away from the hive where the queen bee may fall and not find her way back into the hive.



Then each other frame can be removed and inspected and returned to it's place in the hive.

Each frame should be slowly lifted out of the box and raised above the hive to inspect the facing side. To inspect the other side of the frame, lift one side up until it is vertical and rotate the frame until the other side is facing you. Lower the side and inspect the other side. Reverse the movements and replace the frame into the box.



## Bee Feeding

### Feeding sugar

There are two reasons to feed honey bees:-

1. During the 6 to 8 weeks before the major nectar flow a small colony of bees needs feeding to build up the population of worker bees to a level where they can gather and store a large crop of honey. If this feeding is not fulfilled with natural small flows of nectar then sugar or sugar syrup should be fed. When sugar syrup is fed to encourage brood rearing during the “build up” period an equal quantity of sugar to an equal quantity of water should be used. Do not feed more than the bees will use in 2 or 3 days because by this time remaining syrup will begin to ferment.
2. Colonies of bees entering the dearth period should have plenty of stored honey otherwise 2 parts of sugar to 1 part water should be mixed to feed. This syrup is more inclined to be stored as honey than used to rear brood. During the dearth period any colony that has no honey stores needs feeding. Without feeding these colonies will become very aggressive and populations of worker bees will dwindle and may die out completely.

There are a number of feeding methods:-

1. Frames of honey can be moved from other colonies but this runs the risk of spreading AFB if this is present in the donor colony.
2. Sugar syrup can be poured into an empty drawn comb. The comb is shaken to settle the syrup into the cells then returned to the edge of the brood nest.





3. An entrance feeder uses an old jam jar or milk powder tin which has 6 small nail holes in the centre of the lid. When filled with syrup and placed upside down over the small platform that slides into the entrance it becomes very easy to refill since it is outside the hive yet the honey bees have access to the syrup only from inside the hive.
4. The same jam jar or milk powder tin can be used inside the hive with a few frames removed to allow room for it to be placed lid side down on top of the frames of the lower hive body.
5. An empty tin or margarine container placed inside the hive with grass or leaves floating on the surface is a good way to feed bees.



6. A special container to replace a frame also is a good feeder for sugar syrup.
7. A special inner lid with trays for sugar syrup and access for bees is good but must have floating leaves or pieces of wood to prevent the bees drowning.



8. The most simple of all is to pour dry sugar down between the frames where it will settle on the floor. The bees will use this but need to collect water to dissolve the sugar crystals. If sugar is placed on the top under the lid it becomes too hot and dry and the bees cannot use this hard sugar.
9. A stick of sugar cane can be chopped very fine and placed inside the hive somewhere. It should be replaced daily but will provide sugar feed valuable in times of need.

Important rules:-

8 weeks before the major nectar flow, check on your colonies and feed all that are not up to strength.

Do not let colonies of bees die of starvation during the dearth period. Check on your bee hives often.

Do not feed fermenting honey or

Do not feed more syrup to the colony than they can use in three days

Never let sugar syrup leak out of a hive. This will cause robbing

## Simple queen rearing

### The notch method for producing one or two quality queen bees

1. From your best hive of gentle bees, remove one frame containing a small number of eggs and well fed young larvae.





Put this frame and the bees on it into a nucleus box. Do not put in the queen with this frame.

2. Remove a frame of newly collected pollen with a lot of nectar or honey. Shake the bees off this frame and put it into the nucleus box beside the first frame.



3. Remove another frame of pollen and nectar and after shaking off the bees, place this frame on the other side of the first frame in the nucleus box.

4. Place an empty drawn frame into the nucleus box.

5. Find two frames with mostly young uncapped brood and look very carefully for the queen bee. If she is not on these frames, shake all the young nurse bees into the nucleus box.



6. Move the old hive back two or three metres and place the nucleus hive in it's place. Wait for two hours.

7. Lift out the frame containing the very



young larvae. Select 2 very well fed very young larvae about 4 or more centimetres apart and break down the bottom wall of each cell with a pointed knife.

8. With a marking pen or a drawing pin, mark the top bar above these notched cells.
9. After 6 to 8 days, remove this frame and inspect the 2 cells. If they look good then destroy any other queen cells and return the frame to the hive. A good queen cell will look like peanuts in a shell. Destroy any small and smooth queen cells. No other frame should have queen cells. Wait another three weeks.



Other queen cells to destroy



Two good queen cells beside four poor queen cells.

10. Lift out the frame and inspect for eggs and young brood which will indicate that you have a new queen bee.





Egg laid by the new queen bee

11. Transfer these frames and bees into a full sized hive. Shake the last of the bees still in the nucleus hive into the hive.
12. In a month the brood pattern of a very good queen will be solid and arranged in concentric circles.



A solid brood pattern arranged in concentric circles like this indicates a very good queen bee.

It will now take from 6 to 8 weeks to build this colony up to strength for the nectar flow. Remember to put another box of frames on before the first box is full.



## General Bee Management Principles

Colonies of bees existing in the wild, away from the control of human beings, will produce small surplus crops of honey above their requirements for survival. Such surplus will vary, depending on the region or locality, but will seldom exceed 25 to 30 pounds. In the same area and with the same nectar resources, colonies properly managed will produce surplus honey crops exceeding 100 pounds.

The key to these differences is management.

Proper management employs practices that harmonize with the normal behaviour of bees and brings the colony to its maximum population strength at the start of the bloom of major nectar-producing plants. Management practices are similar in basic principle wherever bees are kept and vary only as regards timing for the desired necessary nectar source of the region or locality concerned.

Regardless of the type of hives or equipment used, proper management aims at providing colonies with unrestricted room for brood rearing, ripening of nectar, and storage of honey, plus provision of adequate food requirements, both pollen and honey, for the time of year concerned. Swarming is minimized and the storing instinct encouraged when proper management is used.

Honey production, as a business enterprise is dependent upon a few species which yield honey abundantly and which are sufficiently common to enable the bees to secure honey in large quantity.

The ideal situation for the beekeeper is one where there are at least three plants which yield surplus honey in considerable quantity, and which bloom at different periods. Beside the main sources, there should be a great variety of minor plants yielding both pollen and honey throughout the season to support the bees between the main flows. In such a situation there is seldom an entire failure of the honey crop; and, in good years, the beekeeper fares well indeed.

## Bee Management for Honey Yield & Production

The benefit of keeping honey bees in a movable frame hive is that it can be managed so as to produce a very much larger crop of honey for the beekeeper.



The first requirement is a healthy young queen bee that can lay many eggs every day. Old queen bees must be replaced with new queen bees of good quality each year.



We need two big boxes for brood rearing. Any restriction on brood rearing space will limit the number of worker bees in the colony and encourage swarming.

We need a good hive that is secure against other bees and pests. This means that an entrance reducer is used when the colony is small or when robbing is likely during dearth periods. Any holes in the hive must be patched to prevent robbing.



The hive needs good ventilation and shade from the sun during the hottest hours of the day.



The hive needs to protect the bees from the wind and rain.

The hive needs plenty of room to process and store nectar and honey during the nectar flow periods.

The beekeeper needs to know when the nectar flow times occur.





This nectar flow occurred during mid April 2013 close to Port Vila

He can then use the six to eight weeks prior to the nectar flow to prepare his colonies for the flow. In this period he will strengthen weaker colonies with bees and brood from stronger colonies. Those colonies with poor queen bees will be united with other colonies. Those colonies getting too strong will be divided and a new queen given to the divide. When the flow is near and his colonies are strong with many worker bees he will check every week for swarm cells and crush them to prevent a swarm departing.



The bee hive needs to be near good nectar and pollen sources.





Water must be available.

The colony needs to be fed sugar or sugar syrup during hungry times and to build up the colony strength before the nectar flow.



Pollen must be available during the buildup time.

The buildup must take place before the first major nectar flow.

Before and during the nectar flow more than adequate room for the processing and storing of honey must be available.



Honey should be harvested as soon as it is ready.



The colony must be prepared with food stores for the dearth time.

Re-queening must take place at some time, perhaps around September when good pollen and nectar are still available and a queen of good quality can replace the aging queen.



Records must be taken of times of nectar flow and dearth. It is good to keep a diary and to use the information gathered to modify management practices.



## **Adaptation to Climate Change**

Vanuatu's situation in the humid tropics calls for durable materials in hive construction able to withstand long periods of damp warm conditions ideal for mould and fungus growth. Bee hives must be constructed from materials that are not harmful for the bees inside or to the honey crops removed for human consumption. Therefore treatment with chemicals to prolong longevity is limited or virtually impossible. Added to the foregoing circumstances is the increasing variability of weather patterns resulting in even higher temperatures and longer wetter periods of time making fungal rot an even greater problem. In response to this a number of answers are available:-





1. Selecting more durable timbers for hive construction. Many tropical hardwoods are very durable provided that only heartwood is used. Therefore the local manufacture of hive ware is encouraged using only durable heartwoods. Extreme care needs to be exercised in the accuracy of manufacture of parts to ensure interchangeability of all components.
2. Treatment of timbers to prolong durability. The dipping of hive bodies for ten minutes in smoking hot paraffin wax is commonly used in New Zealand to increase hive durability. This is presently in trial and is expected to make a big difference. It has been found that three coats of paints on radiata timber hives is of no help at all. Therefore all further hives built of radiata timber will be dipped ten minutes on paraffin wax. This is a dangerous operation and should only be carried out by competent personnel.
3. Treatment of timber to prolong durability. A chemical called wood preserver can be painted on the hive pieces before assembly to prolong the life of the hive bodies. This has not yet been trialled.
4. Design alterations to allow greater ventilation. A deep bottom board raised higher above the ground and screened on the bottom allows for easier ventilation inside the hive by the bees who must maintain an exact brood nest temperature of 35 degrees centigrade regardless of outside temperatures. This also allows more bees to be released to nectar gathering duties and the honey crop will be greater. And the processing of nectar into honey which takes place inside the hive requires air circulation which is greatly assisted in a screened bottom board hive. Of course the internal wood ware of the hive will also be dryer with added ventilation. Another benefit of the screened bottom board is that the entrance where the bees enter and exit can be reduced to 8mm wide allowing greater hive security against robbing by other colonies of honey bees.





5. Design alteration to protect from the extremes of weather. The keeping of honey bee colonies in houses has been practiced in the past and is now almost forgotten. However this has never really been practiced in the humid tropics until now. A trial bee house 9metres long by 2 metres wide housing 24 bee hives has been built and is presently showing many benefits.



- a. Rain does not reach the bee hives therefore they remain dry restricting rotting.
- b. The hot sun at middle day is not reaching the hive allowing stress free working conditions for the bees. (Heat stressed bee colonies may abscond)
- c. The hive is raised higher above the ground therefore damp from this source is reduced and rotting will not take place.
- d. The hive is raised to a more convenient working height for the beekeeper. (Back problems are common among beekeepers as supers full of honey are very heavy)



- e. Working conditions are better for the beekeeper:-
- i. Rain does not interrupt his work and he remains comfortable.
  - ii. He is protected from the hot sun which can be extremely uncomfortable when fully clothed with protective equipment, overalls, veil, gloves etc.
  - iii. Each colony can be worked individually with no interference from neighbouring bees which incite aggressive defence behaviour in the hive being worked, particularly during dearth periods in a large apiary.



- iv. Probably honey extraction could be performed inside the bee house with little interference from robbing. (This has been suggested by an experienced beekeeper but is not yet trialled)
- v. Record taking is made easy since rain does not suddenly wet not pad and paper.

- vi. Queen bee rearing operations can be carried out regardless of weather conditions. (Outside queen rearing operations are often wasted at the middle or end of the process due to bad weather)
6. Since changing weather patterns means unpredictable rain showers, the beekeeper often finds himself caught out and becomes uncomfortable with rain running down the back of his neck. Therefore his work suffers and either he is going to harvest less honey or he is more inclined to give up beekeeping altogether. Therefore a new veil has been designed around a rubber hat which allows the beekeeper to work with considerably more comfort with a dry head and neck during rain.



7. Continued wet weather causes roads to deteriorate and become impassable by motor vehicle. Even when roads are passable by vehicle the terrain is so rough that damage to comb and bees and most importantly the risk of killing or damaging the queen bee make an alternative mode of moving bees necessary. It is very simple to tie two loops of rope enough to loop under the the front runner and the other to loop under the rear runner of the bottom board, with enough rope coming up each side of the hive to slide two poles, one on each side of the hive. One or two men at the front and another one or two at the rear can lift and carry the complete beehive in a gentle fashion for great distances with no damage. Should the hive be heavy or the road long or the carriers light, two groups of carriers can relieve each other and there is no limit to distance that a hive can be moved.





Extra. Although nothing to do with climate adaptation, the hive tool commonly used by beekeepers the world over is replaced by the common Vanuatu bush knife but the point is cut off and sharpened one side like the front end of a hive tool. The bush knife is then cleaned with gasoline and metal primed then painted a bright red. This way it still operates as a bush knife for lopping saplings and cutting grass and serves well as a hive tool. The bright red colour ensures it is quickly found once lost.

## Obtaining Bees

### Catching a Feral Colony of Honey Bees

Find a wild colony of bees in an easy to get place and not too high.



Smoke this colony well before clearing around and opening the hive.



Make a large opening to remove bees and the comb.

**Important. Choose a time of year when the colony of bees have some honey stores and use lots of thick white smoke before disturbing the bees.**



Carefully lift out the brood comb and cut them to fit into the frames.



Cut the comb where the frame wire rests. Press the wires into knife cuts in the comb, then tie with string.

Hang these frames together in the box. This is the easy part.

**Brood frames must be together**



Put as many bees into the box as possible. Place the hive with the entrance as close as possible to the entrance of the old hive. All the bees and the queen bee should now walk into the new hive. This task is not easy.



**Important. The new hive must be placed in the same place as the old nesting site to capture all the bees.**

**This tree was cut down so that the new hive could be placed on the stump.**

Do not place the new hive far away from the old nesting site. The bees will not go in. If the old nesting site was up in a tree, then you must construct a platform to lift the new hive up where the old nesting site was.

You can move the hive after dark to a new location over three kilometres away.

Or you must return tomorrow to check. If the bees have clustered somewhere outside the hive, you must catch this cluster and put them in the new hive again. It will be better this time for you to move them at least three kilometres to a new location. The queen bee is likely in this cluster.

**Important. In the next two days, look often to catch them if they swarm.**



You may feed them with chopped sugar cane or sugar syrup.

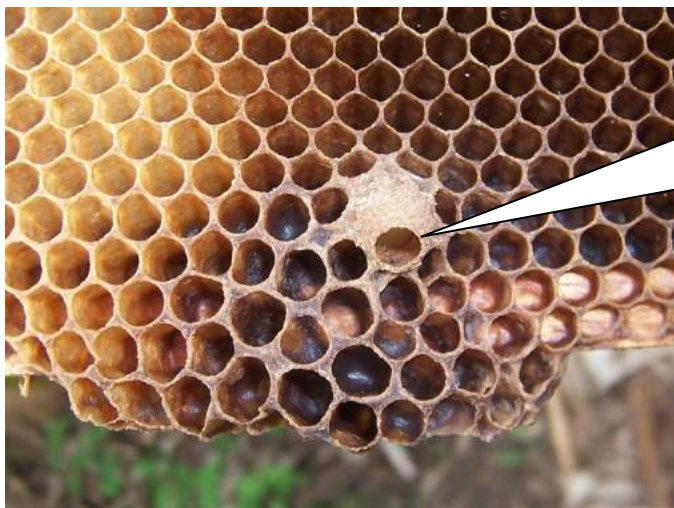
After one week you should be able to see that the queen is laying when you carefully lift out the brood frames and see the eggs laid by the queen bee.



If no eggs are present, then you may carefully look for queen cells which will indicate that the bees are making a replacement queen. Wait for three weeks for the new queen to start laying. Then look to see that she is laying.

**Important. Feed the colony of bees with sugar syrup or chopped cane to help them quickly build new wax comb.**

Handle queen cells carefully.



Queen cell with royal jelly and young queen larva.

This colony of bees has an old queen and it may be best for you to replace the old queen with a young good quality queen when the bees have settled into their new hive. This will allow you to gather more honey.



# The Equipment of Beekeeping

## The Simple Beehive

A simple bee hive needs to be:-

1. Made from materials readily available locally.
2. Made by local artisans.
3. Of low cost or no cost at all.
4. Of a design agreeable for bee acceptance.
  - a. Rain proof
  - b. Cool
  - c. Defendable
  - d. Roomy
5. Of design able to be managed by the beekeeper.
  - a. The beekeeper must be able to open and look at the bees inside.
  - b. The beekeeper must be able to harvest honey.
  - c. The beekeeper must be able to provide more room for the bees when needed.

Designs investigated so far:-

1. The European skep made from straw.



- a. We have tried this using grass but it takes a lot of time to make and the finished product was not at all satisfactory. A lot of trial to perfect construction and select right materials would need to go into this type of hive to get an appropriate modal to trial bees in. It would be entirely free.
2. Using the same shape and dimensions with ferro-cement.



- a. Looks much better than the grass skep but is too heavy.
- 3. Using the same shape and dimensions using cardboard carton reinforced with 6mm reinforcing.



- a. This is light and required minimal construction time and skill. (It was sewn to the steel rims with small string) It was stocked with bees and placed on a log and covered with a sheet of metal. Carton is available only in Port Vila and Lugainville.
- 4. A regular cardboard carton of roughly the same cubic capacity as the skep and reinforced with bamboo struts sewn in place with string.



- a. This could work. It was easy to teach someone to make. It was stocked with bees by tying combs of brood up in the top with string then filling as many bees as possible and placing it very close to the old nesting site. It also was covered with sheet iron.

5. A wooden box pile hive. This is made of pieces of 100mm to 150mm wide by 400mm long timber and has 10 top bars 395mm long and no wider than 26mm sitting in a recess inside the top of each box. Three or more boxes, one on top of the other to make up 50 or 60 litre capacity is a minimum size. A bottom board made from sheet metal cut to 425mm by 500mm with 50 mm on each side bent down to fit over two 400mm by 120mm boards and fitted with a 7mm riser makes the construction simple. A hole can be cut in the middle and screen fitted to provide extra ventilation that may be needed in periods of hot weather.

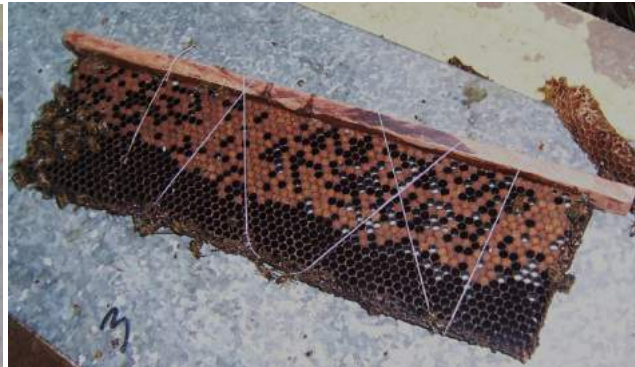


Another piece of sheet metal cut a little larger than the box will make a lid but needs a weight to keep it secure during wind. A little bees wax melted and painted onto the underside of the top bars will encourage the bees to begin building wax comb onto the top bars.





1. A swarm of bees can be introduced to the hive or,
2. A wild colony of bees can be removed from their nest and combs of brood carefully cut to fit the top bar and inside the box. These combs are tied to the top bar and placed into the box together and as many of the bees as possible, are also put into the hive. The following three photos dated 15-July 2013. Four bars with brood combs were placed in the box pile hive with the colony of bees, and then fed 50/50 sugar syrup.



Four days later the bees had attached this brood comb to the top bars.



They had also started to build comb on the nest top bar and were hanging on more top bars making wax.



One week later on the 22<sup>nd</sup> the bees were drawing out comb on three top bars with the first top bar completed as shown in the next photo. We have continued feeding sugar syrup and the string holding the original comb was cut out.



3. Or a nucleus colony of bees with a new queen can be filled into the hive.

Comb from a wild hive is tied to top bars and the colony of bees introduced to the simple hive. They are fed sugar syrup inside the hive and they quickly attach the comb to the top bars and begin constructing new comb. As they continue to build comb on the top bars which are carefully spaced at 36mm centre to centre, another box with ten top bars is placed under (not on top) the occupied box. Eventually the

nectar flow will force the filling of upper comb with honey and brood will move into lower boxes which should be added before needed. When the upper box or boxes have top bars of comb with capped honey in them, they are harvested. This can carefully be extracted in a honey extracting machine or just cut off the top bars and used as is. Once the honey is removed, the box with the cleaned top bars is re-introduced to the bottom (not the top) of the pile. It cannot be placed on top because the comb building will then begin to be constructed from the upper surface of the lower top bars and will not hang neatly from the top bars. It can be placed to the side of the brood nest where it will be drawn from the top down. If the comb remains intact after honey extraction, it can be placed in an upper box since the bees will simply fill it and not draw new comb.

As long as new boxes with empty top bars are added under the pile, the bees will continue to build comb neatly hanging from each top bar. It is necessary to monitor the construction of comb because sometimes the one comb will be narrow or narrow at the ends and deviate onto the next top bar. In such cases the discrepancy can be bent to shape with the fingers and the top bar replaced but with closer spacing. Whenever a brood inspection is carried out, each box is severed with a bush knife from the box beneath and tilted up and a knife thrust up the side wall to the top bar. This will free the comb from the side wall and allow each top bar to be removed complete with attached comb, inspected, and returned to its place in the hive. If the side of the comb is squashed about 7mm away from the wall the bees may likely leave this gap as an access way and not re-attach the comb to the wall making further inspections easier.

- a. Presently under trials
- b. Very simple construction
- c. Relatively cheap.
- d. The box pile hive has been successfully used with smaller dimensions for the Japanese honey bee.

## The Hive and its Parts

1. The bottom board. The bottom of the hive includes the entrance, the elevation of the hive above the ground and an allowance for ventilation and cooling. Normally the floor could be timber or sheet metal. An improved bottom board for greater ventilation and hive security now uses an 8 mm deep entrance and a deep screen wire floor. If this is raised 10 or 20 cm above the ground on concrete blocks or blocks of wood or a stand, the beekeeper finds the height of the hive bodies when they are being worked, much easier on his back.





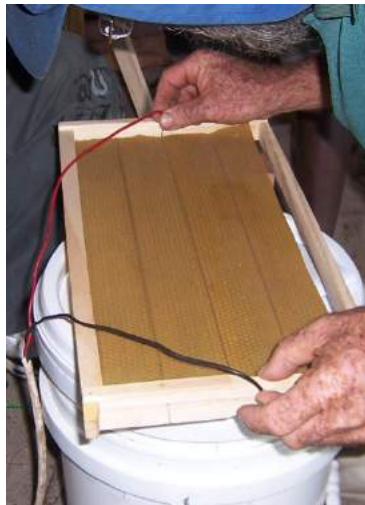
2. The brood boxes. Two brood boxes 24 cm deep accommodate the brood nest where the queen bee with the nurse bees nurse the baby bees from egg through the larval and pupal stages to emerging as adult bees 21 days after the egg was laid. Each box must fit tight with the next box and the bottom board or lower box. If there is a gap enough to allow robber bees in it will allow the death of the colony during dearth times due to starvation when other bees come to steal honey stores. If green timber is used in constructing the box it will be necessary to add 5 to 7 mm to the width of timber to allow shrinkage to the final 240mm width. This will allow the 10mm “bee space” above the frames to the bottom of the frames in the next box.



3. Inside each brood box are 10 frames which contain the comb where brood is raised and food is stored.



4. Each frame, when new was fitted with a sheet of wax foundation. The frame has three wires to hold and strengthen the wax comb.



5. One or more honey boxes or supers sit above the brood boxes. They are just the same as the brood boxes but may contain only eight frames instead of ten.



6. Over the top box is the inner lid. This is raised 6 or 7 mm to allow bee access across the top of the frames. It also allows for the movement of ventilation air across the top of the frames and up into the lid. There are some ventilation holes in the inner lid.
7. The lid covers the whole box and keeps out the rain. This normally telescopes over the inner lid and the top box and when tied down keeps everything firmly together.



8. Extras include:-
  - a. The queen excluder which is used in queen rearing and sometimes used by beekeepers to separate the brood boxes from the honey boxes thereby keeping the queen bee confined to the brood boxes only.
  - b. The entrance reducer used when the colony is small to reduce the size of the entrance when the bees need to defend their colony against robber bees. This can be a problem during the dearth period when a weak colony may starve to death because all honey stores have been robbed by stronger colonies.
  - c. A sugar syrup feeder. There are many options covered elsewhere but the feeder is needed when the colony is hungry during dearth and build up periods.





- d. A bee house is used when many bee hives are in the same place. It also helps the beekeeper when it is raining.



## Frame and Comb Maintenance

The frame is assembled from a top bar 482mm long, two end bars 230mm long and a bottom bar 450mm long. These parts are nailed with an extra nail through the end bar into the top bar to prevent the parts coming apart when the colony of bees has glued frames tightly together in a box and that first frame must be lifted from the box.

A new frame will have a sheet of wax foundation firmly attached to the wires with the top edge of the sheet securely held in the groove of the top bar. The wire must be tight before installing the sheet of wax foundation. This can be done by holding the centre of the end bar against a post and pushing with your chest and at the same time tightening the wire. Wind the end of the wire around the nail a couple of times then hammer the nail tight. Break off the end of the wire.

Securing the sheet in place is most easily accomplished by using a twelve volt car battery to momentarily heat each wire until it sinks into the wax sheet. Be careful not to heat the wire too much or it will cut the wax sheet into narrow strips.



During a nectar flow the bees will draw out the cells and complete the foundation right down to the bottom bar with perhaps only the bottom corners left open as access to the other side of the frame.

Feeding sugar syrup after a box of frames has been added will also encourage the drawing out and finishing of good quality comb in the frames.



During a poor nectar flow the comb cells may be drawn out but the bottom edge of the foundation is not continued to the bottom bar and the comb in this frame will not be quite as strong as if it was attached to the bottom bar.

Some times the bees will even remove wax from a foundation sheet to use in comb building somewhere else and the sheet looks untidy with holes. When this frame is needed they will repair it for honey

storage and brood rearing. It may have a few holes that bees use as short cut to move from one side of the comb to the other.

If a sheet of foundation is not held securely in the top bar it will bend over under the weight of bees until it rests against the next frame. In this case the bees will attach it firmly to the next frame and the beekeeper will have to cut the comb to remove the frame. The beekeeper could press the comb back into shape.

Often there are a few cells with drone brood and this is normal. However an older frame or a frame with damaged comb may have a lot of drone brood sized comb and this is not desirable as the bees will spend much time and food reserves raising large amounts of drone bees and less honey. These frames should be removed from the centre of the brood nest to the edges where the brood can hatch and the frame remain empty of brood. The frame can then be removed from the hive and a new sheet of wax foundation installed.



If the lug of the frame rots and breaks off a nail can be inserted and the frame used a time or two.



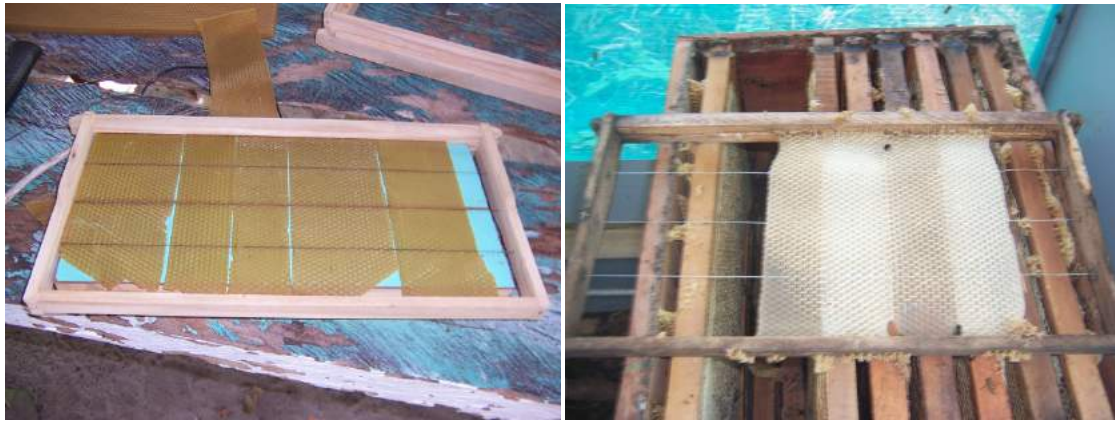


When a new sheet of wax foundation is installed, the old wire is often no longer tight and this can be pulled tight and an extra nail used to hold it tight.

If the wire is rusty it will need scraping to clean it and give a good electrical contact for the battery wires.

Sometimes an old wire needs replacing with new frame wire.

Often while installing new sheets of wax foundation short pieces are wasted but these are useful if cut to half length and placed side by side vertically in the frame and installed with a battery. The bees will build them together and make a good comb of it.



Important. Save those small bits of wax foundation sheet to use together in a new frame.

Those old frames that are wax moth damaged are better to be replaced with new sheets of wax foundation but often parts of the comb are still good and in that case the most damaged portion is cut out leaving a large section that the bees in a strong colony, during a nectar flow or when fed, will rebuild.

Even frames with no wax foundation can be used if placed between two frames of drawn comb or in between two brood frames. The bees can rebuild them like new.

It is not good practice to have large spaces in a box without frames since a strong nectar flow will cause the bees to build their own honey comb all over the place and make working the hive a difficulty and harvesting honey a long difficult and messy task. It is better to spend time manipulating frames to have the bees build all their comb inside these frames and inspections and operations are then easy to carry out.



Important. Never leave empty spaces in the hive. Always fill every box with frames.

As a brood comb gets older the cell gets smaller and darker. It becomes more likely that various diseases build up in this old comb and the health of the colony can suffer. It is wise to replace these old comb by cutting out the old and installing a new sheet of wax foundation. Perhaps two or three of the oldest brood comb in each hive should be replaced each year.

Important. Replace old dark brood comb every year.

Maintaining frames.

Frame top bars will rot if water runs in between the boxes so the best rain protection possible will prolong frame life.

Old brood comb will likely harbour disease so a four year replacement plan for cutting out old dark comb and inserting a new sheet of wax foundation will help reduce sickness.

Wax foundation is expensive so whenever possible it is good to have the bees repair or even completely rebuild a new sheet of comb. If an empty frame is placed between two brood comb the bees are likely to build new worker brood comb exactly where it should be. This will only happen when nectar or sugar syrup are abundant. Small deviations may be bent into shape with the fingers to help the production of the best comb.

## The Smoker, its Manufacture and Use

The smoker is the most important tool of the beekeeper.

A very good durable smoker can be made from scrap.

Items needed.

- One long and one short oil or fuel filter.
- 4 small screws
- An inner tube from a medium sized car or small truck.
- A few 1/8<sup>th</sup> inch pop rivets

- A small piece of sheet metal
- One metre of number 8 wire
- 50cm of tie wire
- A spring, (perhaps a spring mattress spring)
- A piece of wood about 18cm wide, 50cm long, cut to 12mm thick

Construction method:-

With a hacksaw, cut out the top of the filters.

The short filter must telescope over the long filter so the top 2 cm of the short filter needs to be beaten on an anvil or sturdy iron until it fits easily over the top of the long filter.



A 12mm hole is drilled in the bottom of each filter as shown. If you do not have a drill large enough a smaller hole will do if some suitable tool is forced into the hole to enlarge it to about 12mm.

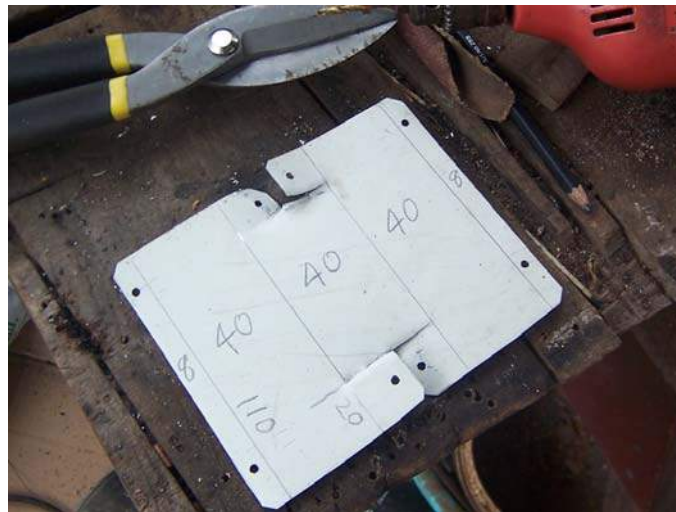




A round fire grate is cut from the piece of sheet metal with three supporting legs and numerous holes as shown. One 1/8<sup>th</sup> inch hole is drilled in one supporting leg and the grate is pop riveted in place inside the long filter.



A bracket is cut from the sheet metal 110mm by 136mm and marked, drilled and cut as shown.



Bend the bracket using a vice or two pieces of clamped wood.



Cut a section of the inner tube 20cm long. Calculate the diameter, add an extra centimetre, and cut two round discs from the timber.

A groove is now cut around each wooden disc. A table mounted router makes this easy.



Drill a 6 mm hole 200mm up from the edge of one wooden disc.

Place the spring in the centre of the discs and mark then cut out a depression 5 mm deep to locate the spring inside the bellows.

Cut an 18 cm long section of inner tube and insert a wooden disc and clamp with the number "8" wire bent as shown. Insert the small sheet metal plate under the ends of the number "8" wire and tighten and hold with the tie wire.



Place the spring in position and insert the other wooden disc into the inner tube and clamp. Cut off the loose ends of tie wire and bend the ends of the number 8 wire down a bit and fold the inner tube over the wires.

With a router or chisel cut a finger grip into the top inner face of the bellows wooden disc as shown.



Cut a small piece of sheet metal and roll into a tube and insert into the fire chamber air hole at the bottom of the long filter.





Carefully align the hole in the bellows with the air inlet tube of the bellows and screw the bellows onto the fire chamber bracket.

To use the smoker light a piece of newspaper and drop into the fire chamber.



Add fuel while pumping the bellows to make a hot fire. A tightly rolled bundle of carton will be adequate if you cannot find any dried leaf or other fuel.



To stop the fuel burning too quickly between uses try plugging the smoke hole with a wad of grass.



## The Climate Change Bee House

A bee house with many bee hives raised above the ground along each side wall and with entrances exiting through the screened house wall is a good way to keep hives of bees.



Bee exit near the roof

1. The hives are protected from the hot sun.
2. and the rain.
3. This means that wooden boxes will last longer.
4. The beekeeper can work comfortably in the rain or hot sun.
5. When the beekeeper is working in a hive the bees are very quiet and less likely to sting.
6. Queen bee rearing is made easy.
7. Because the hives are raised above the ground the beekeeper does not bend over and his back will be stronger.
8. The beehives are more protected during hurricanes and they can be tied down.
9. The lid can be substituted for a sheet of flat metal which reduces the cost of the hive.

The house should be 2 metres wide or a little wider.

The house should be 1.5 metres long for each group of four bee hives. This allows a space between each group of 2 bee hives to place a honey box while working in the brood boxes.

A house 9 metres long will hold 24 bee hives.

Each entrance should be painted in a different colour using white, black, yellow, blue, black, white, blue, yellow, black, blue, white and yellow.



Red is not used since to a bee red is black. There should be not bee entrance into the house but only a means of escape at the top of the wall below the roof.

The bee house should be oriented east west and not north south. This gives better shade from the sun.





## The Colony

### Life History of the Honey Bee Colony



#### Birth

The life of a honey bee colony begins with the issuance of a new swarm from a parent honey bee colony.

There is one queen bee, from 4000 to 16000 worker bees and a few drone bees in this swarm.

The queen bee is the fertile female and becomes the mother of every bee in the colony.

The worker bees are also female and as their name implies, carry out all the activities for colony survival except egg laying.

The drone bees are the male bees. A few of these drone bees may mate with a virgin queen bee then die. The presence or absence of drone bees and their stages of brood can be used by the beekeeper to determine the wellbeing of the colony.



**A small swarm 1**





This swarm finds a temporary resting place, a branch or other object a metre or few metres above the ground to hang on.

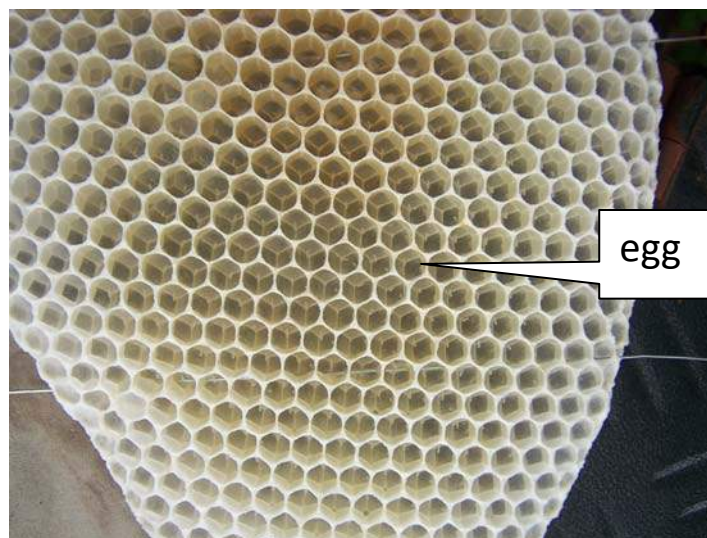
Scout bees are sent out to find a more suitable permanent nesting site. It may take a few hours or a day or two for the returning scout bees to agree on the best nest site as scout bees must go and check each of the best nesting sites themselves to reach a consensus.



When a site is decided on the whole swarm departs as a single unit and flies in a straight line just a few metres above the ground to the new nesting site.

The worker bees immediately begin constructing new comb for brood rearing and for food storage.

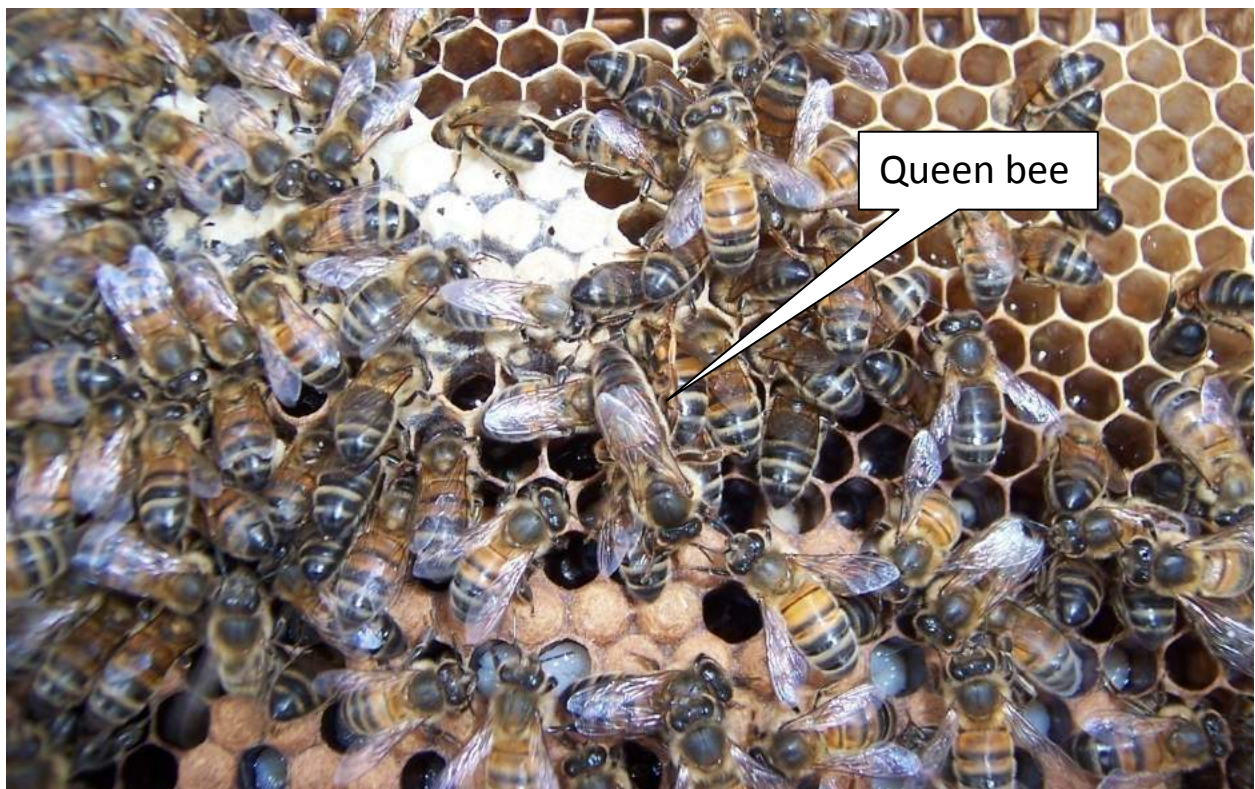
#### **New brood comb with eggs 1**



Scout bees are sent out to find nectar and pollen sources. When these scout bees return they dance to say where the food source is to be found so that more workers are recruited to that task. These recruits



fly straight to the food source indicated by the dancing scout bee, fill their honey stomachs with nectar and return to the hive.



. The queen bee is feed royal jelly by the worker bees and she lays many eggs every day all year. If you were to weigh the eggs laid you will find that she lays more than her own body weight in eggs each day. It is very important to have a good queen and that she is young and well fed.

### **A brood comb**



Three weeks after the queen laid the first eggs these hatch as young adult bees and will spend about three weeks doing house work.

All of these baby bees from egg to larva to pupa are called brood. The work of the house bees consists of:-

- cell cleaning and capping,
- brood and queen tending,
- comb building, cleaning and food handling,
- ventilating,
- and guarding.

**These bees are guarding and ventilating**





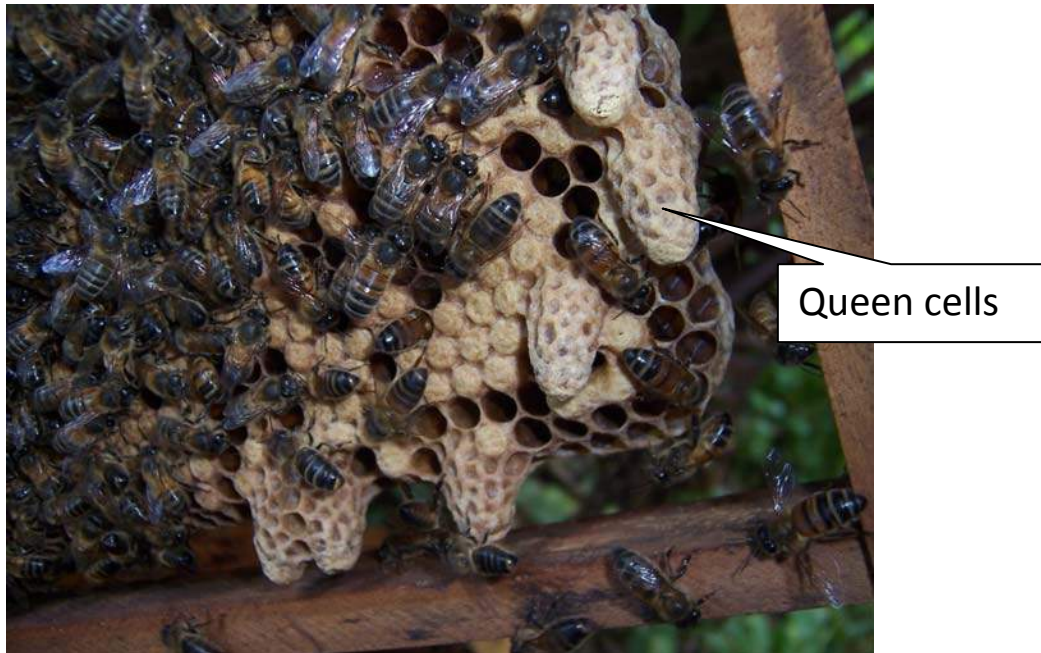
After house work is taken over by younger bees these older bees begin foraging for nectar, pollen, water and propolis and may live for as little as three weeks at these tasks if work is very busy but much longer if there is not much food to gather.

### **Frames of honey**

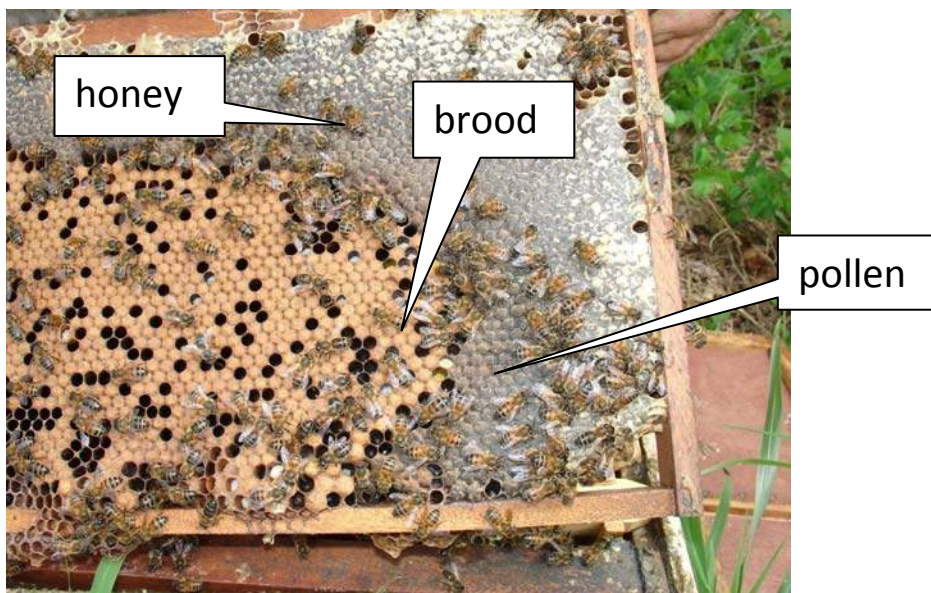


It is important for the survival of the colony that a great amount of nectar is gathered, processed into honey and stored and also pollen too since this is the protein food necessary for brood feeding. To achieve this there must be many worker bees, up to 80000 during the times when the nectar flow is on.





When the colony is strong it may decide to rear a new queen bee so that a new swarm may be sent out to start a new colony.



Eventually a time will come when the weather is wet and flowers with nectar are hard to find and the stored food will be needed. This is called the dearth time and the reason for the collecting and storing of food so that the colony will survive this period and not die of starvation.

Many colonies do die at this time.

#### **This colony of bees is starving hungry**



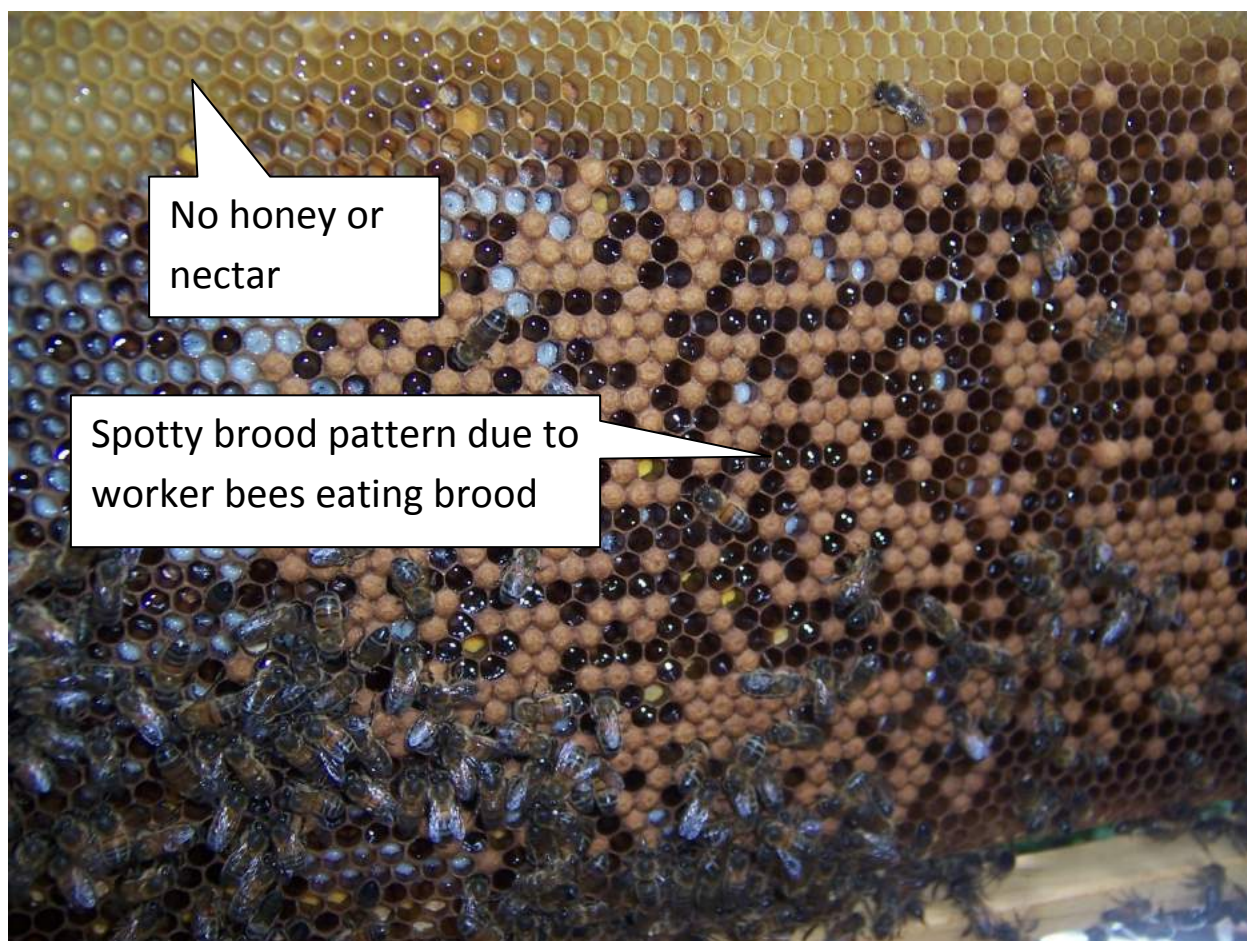
At the end of the rainy period the colony is much reduced in worker bee numbers and much of the stored honey is consumed when new nectar is again available in quantity and the colonies that have survived the dearth period begin to recover. New nectar and pollen is brought in and used to feed increasing numbers of brood. This period is called the build-up period. Eventually more food will be brought in than can be used to feed brood and this will be stored as honey.

When the colony is strong enough, a new swarm will issue with the old queen and a young virgin queen will be left in the hive to mate and take over duties as egg layer and mother.

The Dearth January1 –April 19

The wet rain time when little or no nectar and pollen are available. Those bee colonies with plenty of saved honey and pollen will remain strong by eating stored food. Those colonies with little food stores will starve and even eat the brood to stay alive. These bees will easily become angry and sting. March and April will be very hungry time.





Build-up April 20 to May 30

The rain stops and many trees and other plants produce much nectar and pollen. Those bee colonies still alive bring in food to feed many young bees (the brood) and the population of bees increases.

The nectar flow June 1 to October 31

There may be minor and major nectar flows from June 1 to the end of October. If the bee colonies are strong they will store honey for the beekeeper. During September and October a stronger nectar flow occurs.

Mixed nectar flow and dearth November and December.

During these two months a strong nectar flow with lots of good honey may occur and or periods of hunger or dearth.

From a wild hive it may be possible to harvest 5kg, 10kg or even 20kg of honey from the best hives. It is not likely that more than 20 kg of honey can be obtained.

The following table is for you to write your own observations over several years to find the nectar flows and dearth periods for your area.



## The Castes of the Bees

There are three different kinds of honey bee that can be found in the bee hive.

There are 4000 to 70000 worker bees in a colony. These bees are female and do all the works needed inside the hive and outside to gather food propolis and water.



There is one fertile female bee, the queen bee, who is the mother of every bee in the hive. She lays the eggs which are then looked after by the worker bees. She may live for several years.



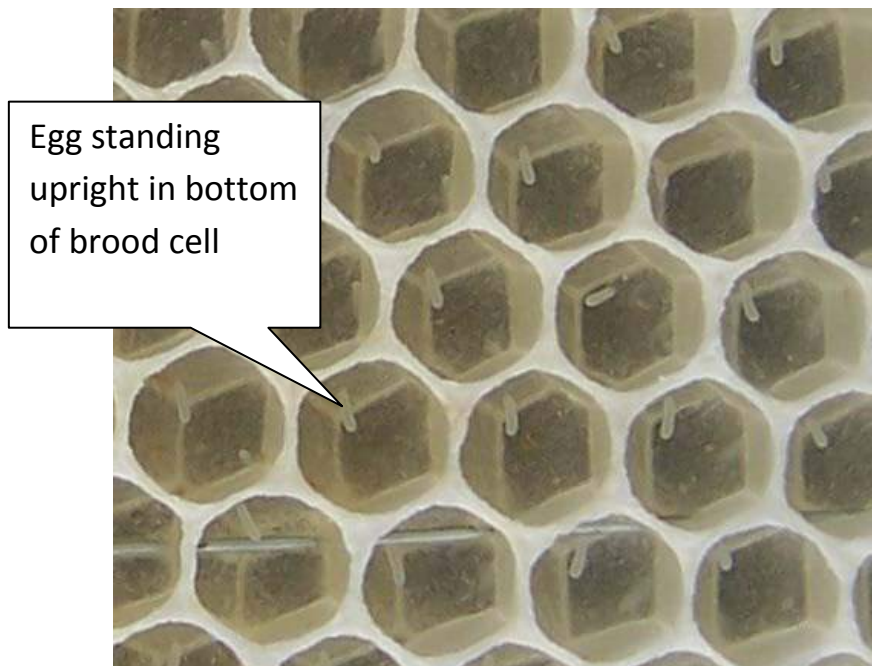
There may also be from zero to a few hundred drone bees which are the male bees. These bees may mate with a virgin queen bee outside the hive high in the air. If they do they die immediately. In times of hunger they are forced outside to die.



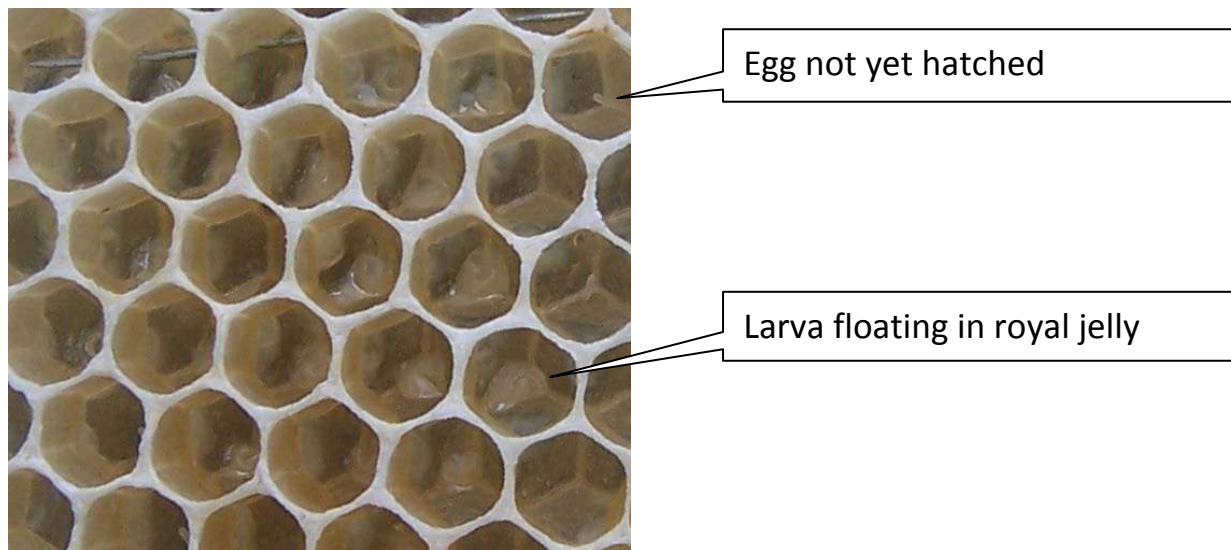
## **Growth of the Worker Bee**

The Life of the bee (growth)

The queen bee lays an egg in the bottom of a cleaned brood cell.



In three days a larva hatches from the egg. This larva is immediately fed a special food called royal jelly produced in the brood food glands in the heads of house bees.







She will be fed royal jelly for two and a half days.

For another two and a half days she will be fed honey and pollen. To feed the young larvae it is essential that the five to ten day old house bees eat both honey and pollen.



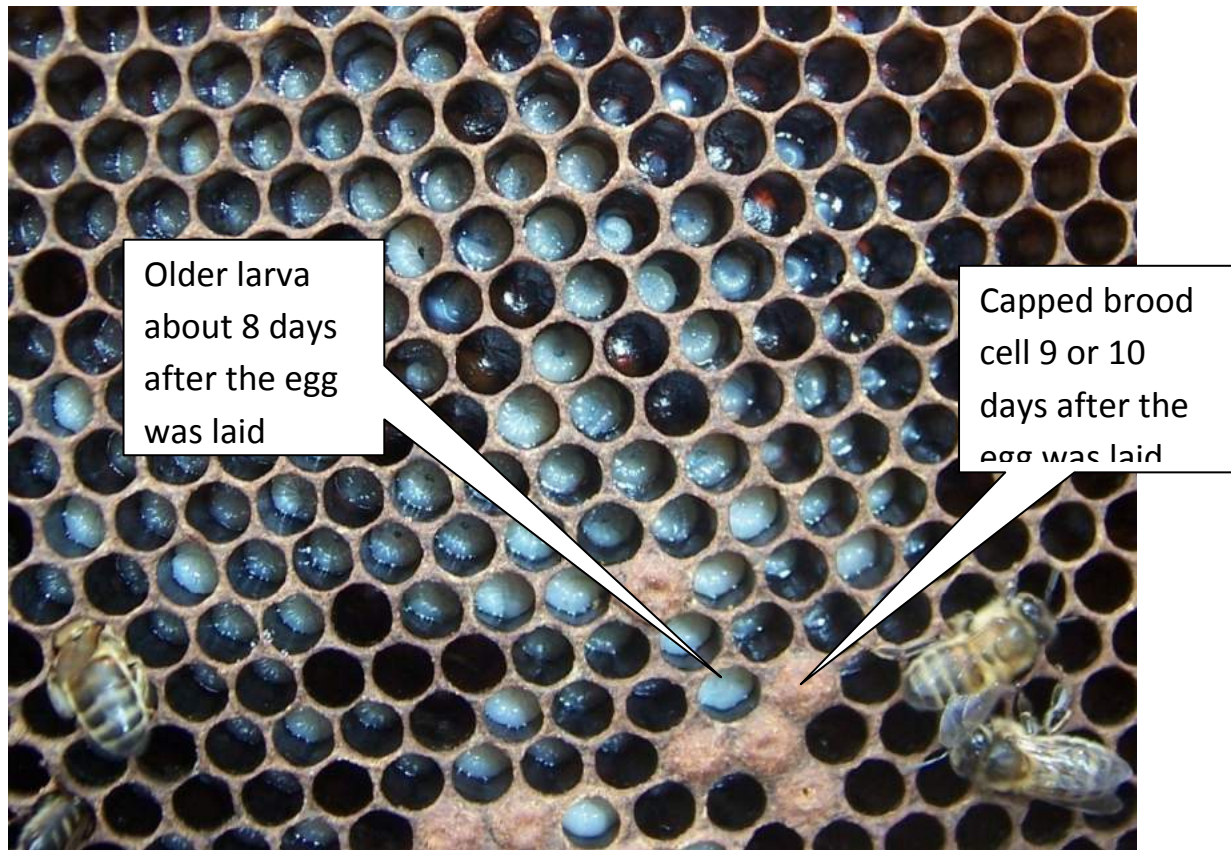
Honey



Pollen collected from many different plants and stored for future requirement



After two days the young larvae are no longer fed royal jelly but pollen and honey. Only the larvae to become new queen bees are fed royal jelly.



On the ninth day after the egg was laid, a wax cap is formed over the larva.

On the twelfth day the larva (plural larvae) pupates and is now called a pupa (plural pupae)





Twenty-one days after the egg was laid the young worker bee bites away the cap of the cell and emerges.

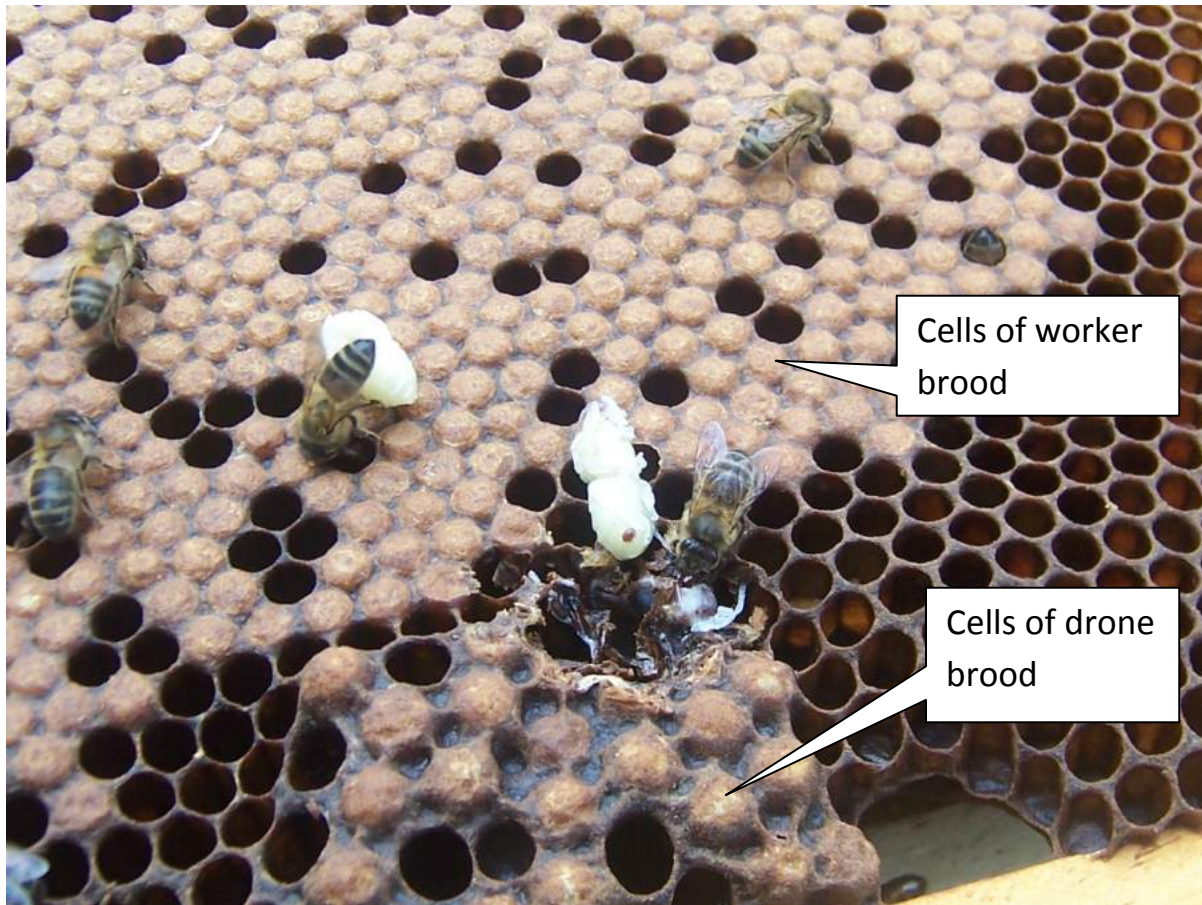
The drone bee takes twenty four days to emerge.

The queen bee emerges on the sixteenth day.

The worker brood can be distinguished from the drone brood by the size of cell, the worker bee has a smaller cell than the drone bee and the shape of the capping is slightly raised whereas the drone cell cap is more raised or dome shaped. The queen cells hang vertically and are much larger than drone and worker cells.

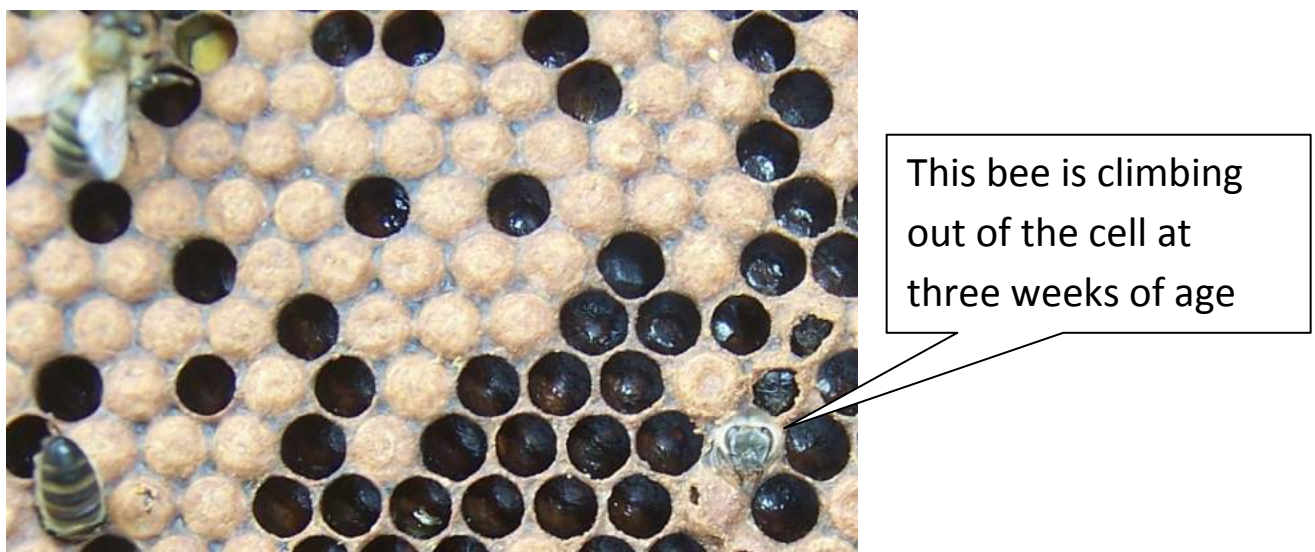


Queen cells



### Works of the House Bee

The worker bee emerges 21 days after the egg was laid and she will spend three weeks doing various tasks inside the hive.







This is a very young bee.  
Note the soft fir or hair  
over its body.

First she may spend a couple of days cleaning cells.

Then she may spend some time feeding nectar and pollen to older larvae.

As she gets older, about 6 days old, she may begin to feed royal jelly to very young larvae and the queen bee.

In the third week of house duties she may do any of a number of different tasks such as building wax comb, receiving nectar from field bees and processing and storing the honey, packing honey brought in by field bees and perhaps guards duties at the entrance.

These house bees are also responsible for temperature control in the hive. If it is hot these bees fan air over little droplets of water brought in by field bees to keep the temperature in the brood nest at 35 degrees. If it is cold then these bees cluster together to keep the brood nest warm, still at 35 degrees.

## Works of the Field Bee

The field bee begins outside work when she flies from the entrance in short orientation flights. This helps her recognize the area around her hive so that she can return without getting lost. As she flies further she will begin to collect nectar and or pollen.





She may also gather propolis and water as these also are need for the survival of the colony.

If there is no nectar flow on she may live more than a month. During a heavy nectar flow she will work very hard flying to gather nectar and returning to deliver the nectar to house bees for processing and storage. In this case she may live for only three weeks.

## Seasonality in the Honey Bee Colony

1. Dearth period. This is when food is scarce and death of a bee colony is possible through starvation. This would be the rainy season especially March and early April. It is also possible for hunger times in prolonged dry periods.



2. The build up period is when pollen and nectar are again available and the colony that has survived the dearth period gathers food to feed a growing population of young bees. The bees are not able to gather honey for harvest because there are very few workers to do this work and all the colonies resources of labour and food are used to increase the population.



3. The nectar flow is when the colony is strong enough to gather large quantities of nectar and process and store this in new comb. This can happen in a very short time and the beekeeper must be ready for it.  
There may be more than one nectar flow in one year. A small colony of bees will not store much honey in a nectar flow but rather use the flow to build up.



## Pest and Diseases of the Honey Bee

In Vanuatu our most serious pest of honey bees is the varroa mite called *varroa jacobsoni*. This small eight legged mite arrived on Efate with the Asian honey bee from Indonesia about 2010.



This mite can be found by lifting out the drone brood and quickly looking for the little brown speck that is the mite. It walks over the body of the drone bee and sucks out the blood making it weak.





Varroa Jacobsoni is found only on the island of Efate where it is living in every hive of European honey bees. For this reason, live honey bees can never be moved from Efate to another island in Vanuatu.

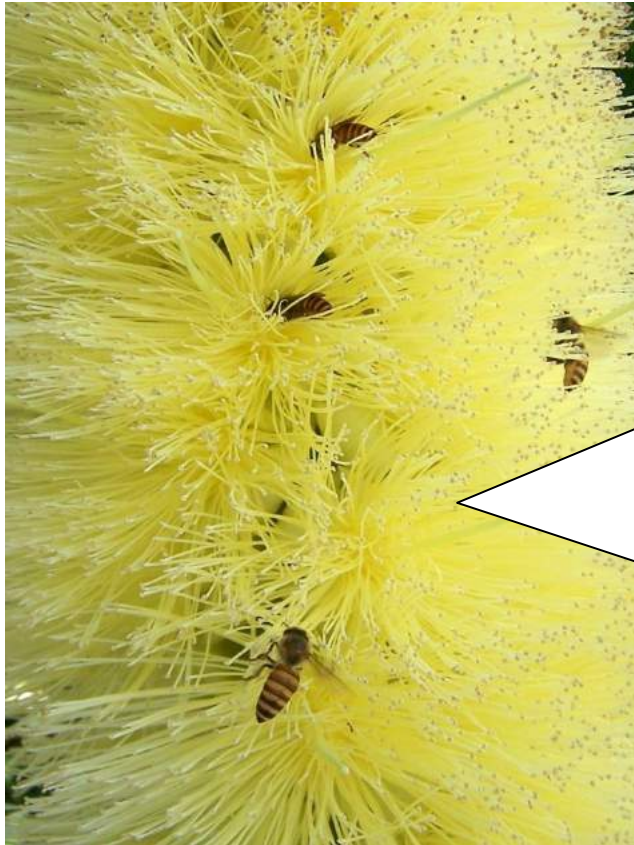
Great care is also needed to prevent the spread of the Asian honey bee to other islands in Vanuatu.

Two diseases of brood are also matters of concern to the Vanuatu beekeeping industry. American Foul Brood Disease and European Foul Brood Disease can be transmitted to Vanuatu honey bees through the jars of honey coming from overseas. Both of these diseases are serious and are not currently reported anywhere in Vanuatu. It is therefore important for beekeepers to learn to recognize these diseases should they appear in Vanuatu and then a quarantine imposed on that island group to prevent the spread of that disease.

## **Raw Materials Exploited by Honey Bees**

### **The Nectar flow (The Honey flow)**

When every condition is right, certain flowers begin secreting nectar.



This navel tree is in flower and secreting nectar. We can say a nectar flow is in progress. However this will only cause a honey flow when there are a large number of flowers all producing nectar in a quantity that causes a rapid build up of honey stores in the bee hive. If there are only a few navel trees with flowers like this they will provide only valuable feed honey but no build up of stored honey.

Honey bees find these flowers and recruit more worker bees to gather more nectar to store in the hive. The house bees receive this nectar from the field bees and process and store it in wax cells of the honey comb. Only very populous colonies will store lots of honey.



When this flower begins to bloom it often marks the beginning of a nectar flow. This photo was taken 22 April 2013 close to Port Vila.

The beginning of a nectar flow can be seen when many bees are flying from the hive. Looking inside the hive the beginning of white waxing can be seen on the edges of older darker comb.



New white wax on the edges of older darker wax comb indicate that a nectar flow is beginning.

When there is no nectar flow the stored honey is thick and will not come out of the comb. Fresh nectar can be shaken from the frame and rains down in a shower. The beekeeper must have extra boxes of frames ready for this honey.



Fresh nectar droplets shaken from a comb indicate a nectar flow is in progress. This is from nakavika flowers on South Efate in the last few days of July

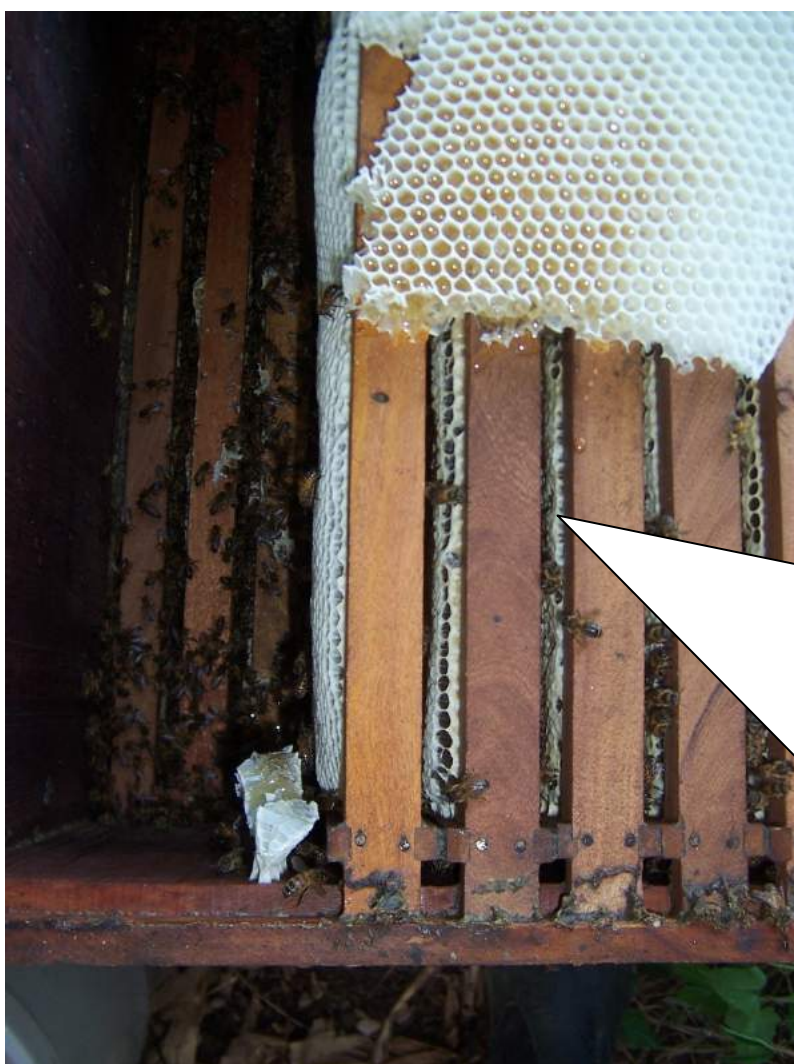
Some many bees will be seen on a tree or other plant and make so much noise that they can be heard from far away. Then you can say that the honey is coming from that tree or flower.





This nakavika is in flower but will bloom only for a few days. It will produce a very small honey flow only where there are many trees. Normally there are too few nakavika trees to produce a honey flow.

Other house bees make more wax to build more honey comb. This new wax is very white.



This is new nectar and new wax. Notice the bright white colour of the new wax honey comb. This is what the beekeeper has been preparing for. The date is 22 April 2013 near the abbatoir at Port Vila. This nectar flow has been in progress for some time. About seven kilograms of honey were harvested from each hive from

The scale hive can be used to plot the daily weight gain of the bee hive.



The information gathered will be useful to find the nectar flow times.

Next year management plans can be made to make the honey bee colonies ready for these nectar flows.

In this way maximum honey crops can be obtained.

A simple scale hive can be built using a spring balance scale with a stable “A” frame built from bush timbers so the hive sits on a platform near the scale. The end of the two arms of the “A” frame are placed on blocks to lift the frame above the ground. It is not necessary to have accurate weight measurements but only to measure the fluctuations in weight so that those days or weeks when large weight gains are noted will indicate the nectar flows. This data can be co-related to meteorological data such as temperature, rain, humidity, sunshine and wind. It may then be possible to predict dates of nectar flow variances with projected meteorological data.

## Wax Rendering

1. Cell cappings wax from extracting honey makes the best quality bees wax and should be processed separate from old brood comb or dirtier wax. Put 8 or 10 cm of water into a large pot then put the wax in but do not fill more than  $\frac{3}{4}$  to the top of the pot. Heat over a carefully controlled fire until the wax is melted. Stir to hurry the melting.





2. Remove from the fire and skim floating bodies from the surface of the wax. Sieve these through mosquito netting.



3. Carefully ladle pure wax from the surface into suitable moulds.
4. This wax will still have small amounts of debris and can be remelted and poured into a calico bag and squeezed while still hot. This will give a very clean wax that can be used in the making of candles and things like furniture polish and face creams.



## Products and Services of Bee Keeping

### Pollination

The following table lists crops that benefit from honey bee pollination.

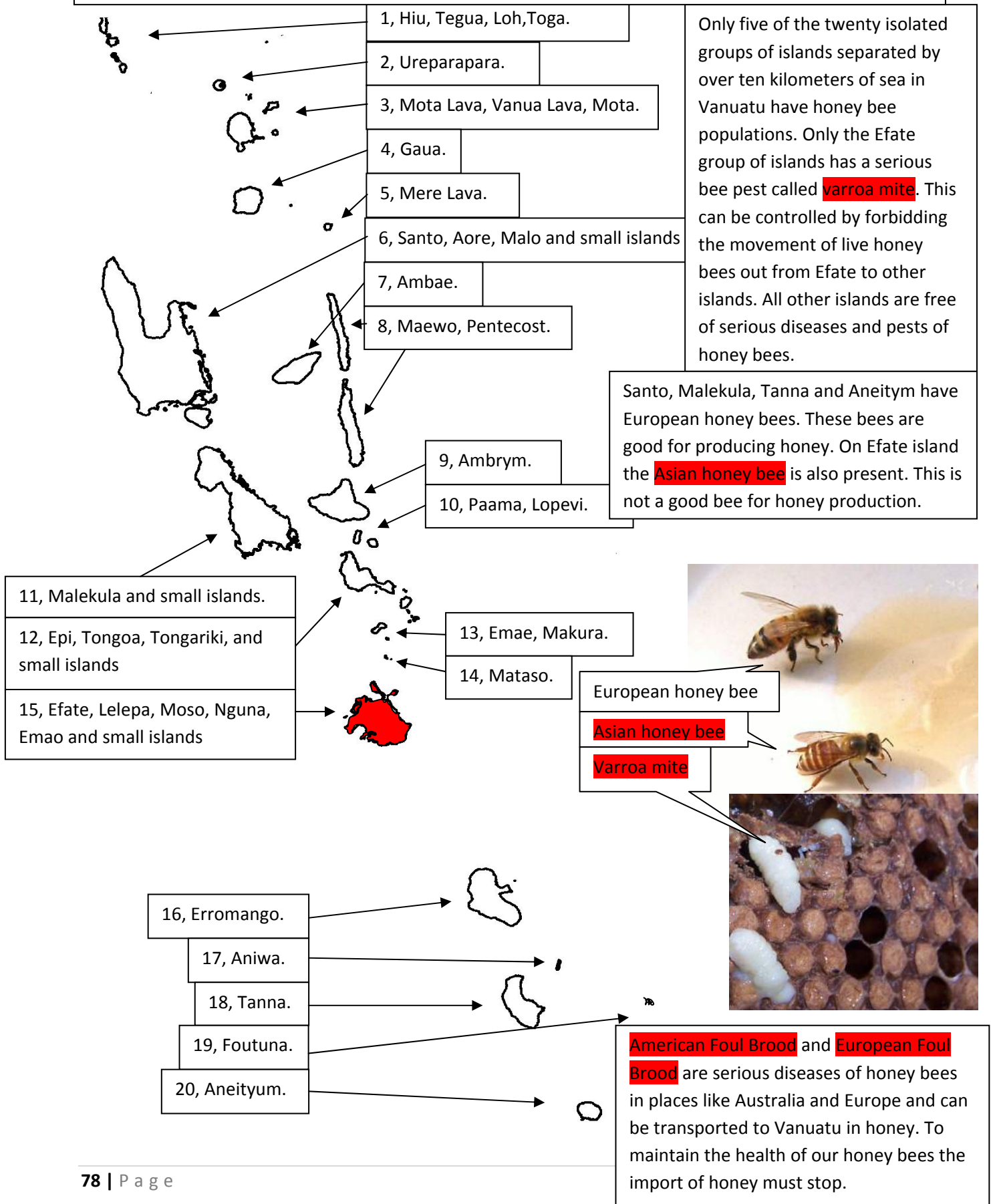
Cashew nut	Not many trees growing in Vanuatu but pollination is essential
Star fruit	A few trees are growing in Vanuatu and pollination impact greatly increases fruiting
Capsicum	Pollination is important in green houses but not so much in the open fields.
Pawpaw	Fruiting is helped a little with pollination insects
Watermelon	5 hives per hectare is recommended and pollination is essential
Coconut	A moderate improvement in fruiting with pollination
Coffee	A moderate improvement in fruiting with pollination
Melon	7 hives per hectare is recommended and pollination is essential
Cucumber	4 hives per hectare is recommended and pollination impact is great
Pumpkin	3 hives per hectare. Pollination is essential
Passionfruit	1 hive per hectare.
Lime	Unknown but pollination is greatly beneficial
Glycine	A modest improvement in seed yield should a farmer in Vanuatu harvest seed from this pasture legume
Lychee	A little improvement in fruiting from pollination
Macadamia	Pollination essential but very little grown in Vanuatu
Mango	A great improvement with pollination but flies, ants and wasps also play a pollinating roll in this fruit.
Avocado	A great impact with pollination of this fruit. 3 hives per hectare.
Peach	2 hives per hectare are recommended. Fruit yield is greatly improved with pollination but peach is found only in the south
Guava	A modest improvement in fruiting with pollination
Raspberry	3 hives per hectare are recommended and pollination effect is great
Eggplant	Pollination in green houses important but not so much in the open
Tamarind	Fruiting is a little improved with pollination

Putting Vanuatu into three groups of islands:-

1. All of the Banks and Torres islands, Ambae, Maewo and Pentecost, Ambrym, Paama, Lopevi, Epi, Tongoa, Tongariki, Emae, Makura, Mataso, Erromango, Aniwa, Foutuna and Aneityum. These islands will benefit greatly with the introduction of honey bees to help the pollination of watermelon, pumpkin, cucumber and possibly citrus fruits.
2. Santo, Malekula, Tanna and Aneityum. Since these islands have feral populations of honey bees the improvement in fruiting of the watermelons, pumpkins, cucumbers, starfruit and citrus fruits will not likely alter with added numbers of hives of honey bees unless large densities of these or other crops requiring pollination are planted.
3. Efate and close islands now are serviced also by the asian honey bee in large numbers and even in green houses this bee is evident in pollination. Only if green houses were to be truly insect proofed and when large crops of pumpkin, citrus or other are planted will additional hives be beneficial to the yield of fruits and seeds.

Also please note that insects other than European honey bees play important pollination roles and some crops are not pollinated by bees at all.

## Distribution of Honey Bees and Diseases in Vanuatu





## Test Questions for Bee Keepers

- 1) A very good brood pattern like this means the queen bee is good.



- 2) The queen bee. She is longer than the worker bee.



3) The Asian honey bee found on Efate. If you find this bee on another island, please report immediately to the Department of Agriculture.



4) A frame of capped brood.





5) A drone bee. (The male bee)



6) A frame of honey but not ready for harvesting.





7) A comb with pollen.



8) Empty cells close to the brood indicate these hives of honey bees are very hungry.



- 9) A spotty brood pattern like this means that the bees are hungry or sick.

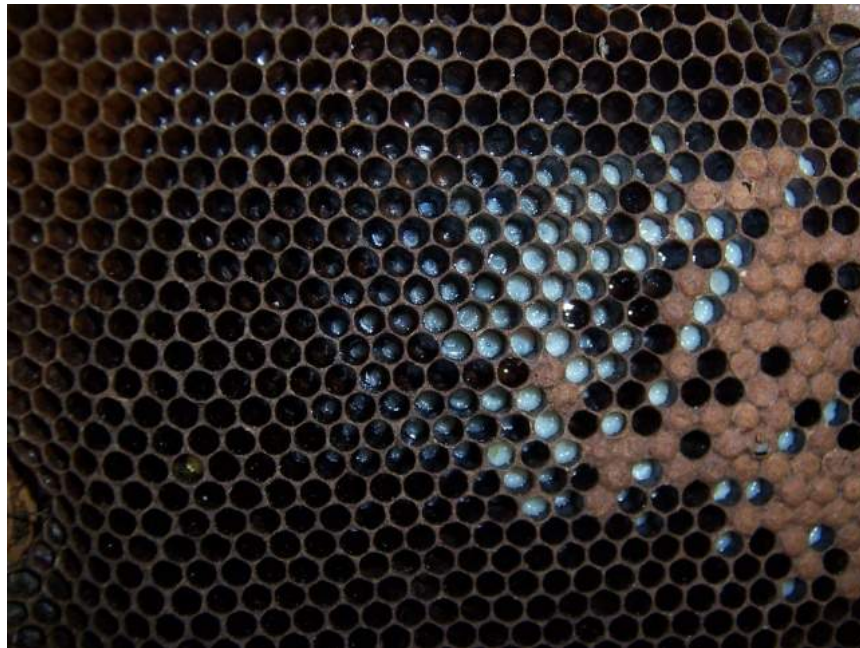


- 10) Honey bees with pollen.





- 11) A comb with larvae and capped brood.



- 12) Men carrying a hive of honey bees.





- 13) A sugar syrup feeder.



- 14) A veil.



- 15) A comb with young larvae.



- 16) A smoker. This is most important to control the bees.





- 17) One bee hive. There are three boxes in this hive.



- 18) A frame of honey and brood. Do not harvest this honey. The bees need some too.





- 19) A queen bee laying an egg.



- 20) A young larva in royal jelly.



21) A new laid egg.



22) A swarm of bees.





- 23) A frame of honey ready to harvest.



- 24) White wax indicates a nectar flow is in progress.

