

Beekeeping in Scotland - No 3 - Bee Biology

Nobody be put off by the science of beekeeping. This set of notes it is to try and help you to understand, regardless of whether you are a beekeeper, a little about why bees - and beekeepers - do some of the things that they do.

Bees are insects - worldwide.

There are thousands of different insect species across the world - so what makes bees especially interesting? Here are a few reasons why they are important:

- They provide useful products for humans, such as honey and wax.
- They can be kept easily in captivity, or 'farmed'. They are kept in boxes called Beehives.
- They occur widely throughout the world.
- They can survive largely on natural resources for food
- They are important as pollinators, ensuring the success of many agricultural crops

Honeybees (*Apis mellifera*) occur widely throughout Europe, Africa and eastwards into Asia. There are similar related species elsewhere in the world, but this is the only species of honeybee found in Scotland. Honeybees occur naturally in the wild, where they normally live in hollow spaces in trees or buildings.



This bees' nest was located in a hollow horizontal branch of a beech tree in a woodland in North East Scotland. It was found when the tree, which had become dangerous, had to be felled. The lower face of the branch was removed to expose the bees' wax combs, hanging side by side in vertical sheets in the hollow space inside the branch.

Other species of bee are found in Scotland, including solitary species. Perhaps the most conspicuous however are the bumblebees. These are social bees, like honeybees, but do not collect honey in sufficient quantity or quality to be of any commercial importance.

Bee Hives

Q. What do beehives look like?

Many beekeepers in Scotland use a type of hive known as the National. This is a hive made up of square section boxes, which contain the frames of comb, and are placed one on top of the other.





A group of beekeepers prepare to examine some hives. The three nearest have the roof still in place; the farthest away has had the roof removed and the beekeeper is holding the board which lies below the roof and covers the bees.

The beekeeper holds up for examination one of the removable wooden frames containing the comb, which contains a mixture of bee larvae and stored honey and pollen. The tops of the remaining frames are clearly visible still in the box containing them.



A closer view of one of the frames of comb. The large oval area in the centre of the frame contains mostly sealed over pupated larvae. These cells are capped over with wax by the workers.

Before hives with removable wooden frames were invented, bees were kept in a variety of hollow containers in which they were free to build comb just as they liked. The trouble with this arrangement was that the combs could not be removed to be inspected or moved from one hive to another, which made efficient beekeeping rather more difficult.



Here is a photograph of one of the older types of beehive used in Scotland. It is made from coils of tightly bound straw, and is called a skep. Skeps were not very waterproof, and easily blown away, so were usually kept under some sort of more substantial shelter. A recess, called a bee bole, in a stone wall was a common location for a beehive, where in winter it would be packed around with straw to help keep the cold away from the bees. The photograph shows a skep resting in a bee bole, in the walled garden of a medieval monastery in North Scotland. This bee bole is probably at least 200 years old.



It is still possible to keep bees in a skep, although this is becoming increasingly difficult with the advent of new diseases which affect the bee colony. Compare this photograph with that of a wild bees nest, in a hollow tree (page 1).

Bee products

Bees and humans have been closely associated for a long time, as human societies have exploited the industrious activity of honeybees. Even stone-age cave dwellers exploited wild colonies of bees, robbing them of some of their honey.

Q What are the main products of honeybees which humans can use?

The main honeybee products which humans can use are honey and beeswax. Honey has been used for centuries as a natural sweetener, having been found in ancient Egyptian tombs. It is increasingly popular as a natural and largely organic sweetener in today's health conscious society. Honey also has some very interesting and useful properties as an antibiotic - that is to say, it has the ability to kill bacteria.

Beeswax has likewise been prized over the centuries as a very clean burning source of light, since it makes excellent candles. Its use in this respect was in many countries reserved almost exclusively for the Christian Church, and this tradition continues today with a high percentage of beeswax used in Church candles. The wax is also now extensively used in cosmetics, medicine and in furniture and leather care products.

Other honeybee products include such things as pollen, propolis, royal jelly and even bee venom, harvested from their stings.

Q. What are these other products used for?

Pollen is used as a health food supplement. Propolis is a mixture of natural plant resins which bees collect to, amongst other things, stop up small holes and cracks in their nests, and it has strongly antiseptic properties, and is used medicinally as a tincture. Royal jelly, the special food fed to young bees and young queen bees in particular, is a highly concentrated mixture of proteins, sugars and free amino acids. It also finds uses as a health food and cosmetic. Bee venom is only just beginning to be studied in detail. It is a highly complex mixture of chemicals, and shows promise in treating a number of medical conditions, including arthritis.

What are Honeybees?

Honeybees are insects. They have a body which is divided into three main parts (a head, thorax, and abdomen), and six legs and two pairs of wings attached to the thorax. Which other creatures can you think of which are also insects?

Other insects include such things as butterflies and moths, flies (but not spiders, which have eight legs!), dragonflies and fleas. The wings are not obvious in all of them, but they are indeed all insects.



The Red Admiral Butterfly and its larva (also known as a caterpillar). This larva feeds on nettle leaves.



Dragonfly and - right - its larval stage, called a nymph. Note that the dragonfly life cycle only includes three



stages - egg, nymph, and adult - in contrast to the bee and the butterfly, which have four stages (egg, larva, pupa and adult). Notice too that the nymph looks very much like the adult insect, except that the wings are not fully developed. The butterfly larva, on the other hand, looks nothing like the adult butterfly

Q. What do baby honeybees look like?



Baby bees - called bee larvae or grubs - can be seen in the section of comb shown above. They lie in the bottom of some of the cells, small whitish caterpillar-shaped creatures curled around like a letter "C". At the bottom left of the picture you can see two cells containing eggs.

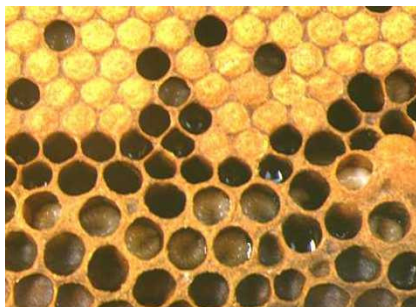
How many different sorts of honeybee are there in a colony?

There are usually three different sorts of bees, or castes, in the colony. There is only one female capable of laying fertile eggs, called the queen bee (left). (The white dot on her thorax is a small blob of paint, used by the beekeeper to help find the queen easily.) These eggs can develop into workers (non egg-laying females) or males, usually called drones. They can also, if fed appropriately, grow into new queens. Below left, the queen on the beekeeper's hand.



Right, a section of comb showing two special elongated cells in which young queen bees are being raised.

Most of the bees in the colony are workers, which are females which cannot normally lay eggs. Their bodies are modified for the production of wax, for building comb, and for foraging for food. Below left is a frame of comb taken from a beehive, on which you can see an area of comb containing bee grubs.



The photograph right shows an area of comb, containing bee larvae and covered by worker bees.



The third caste are the males or drones. They are larger than the workers but with a blunt ending body, and larger eyes. No drones are present on these pictures. However, note the two different sizes of cells in the comb shown right. The smaller ones contain worker grubs, and the larger ones, drone grubs.



How many bees are there in the colony?

The average colony of bees contains up to 50,000 individuals. The number is at its highest in the early to middle part of the summer, when a few thousand drones (males) will be present in addition to the queen and workers. It is at this time that additional queens are raised, and so there may, for a short while at least, be more than one queen in the colony as well.

In late autumn and winter, the number of bees is reduced to just a few thousand, with only one queen, and usually no males, although a very small number of males are sometimes present.

What Do Honeybees Eat?

Honeybees feed on the nectar and pollen produced by flowers. Nectar is a sugary liquid secreted by special parts of the flower called nectaries. It is produced by the flowers to attract insects, such as honeybees, to the flower to feed on it. As they do so, they pick up grains of pollen on their body hairs, and these are transferred to the next flower which the bees visits. This transfer of pollen is essential in order for the flower to produce seeds, but many flowers produce far more pollen than they need for this purpose. This excess pollen is also gathered by the bees for food.



What happens to the pollen in the bees' nest? The pollen is stored by the bees to be eaten later, or fed to the bee grubs.

Left, comb with pollen, honey and brood. In the photograph, the wax cells on the top left have been filled with pollen, packed tightly in by the bees with a little honey added to help preserve the pollen. The pollen is stored adjacent to the eggs and larvae (in the cells on the right) because it will mostly be needed to feed to those larvae as they grow. Some of the cells on the bottom left contain honey or nectar, which is glistening on the surface under the light.

What are the main components of nectar and pollen, and why are they important to bees?

Nectar is a dilute solution of sugars in water, and also contains a few minerals. Although the water part is important for the bees, the main importance is the sugar. This is the carbohydrate or 'starchy' part of the bees' diet, and provides them with energy to move, fly, search for food, and to keep their nest warm. Most of the water is extracted by the bees from the nectar, and it is then turned into honey as it reacts with other substances added by the worker bees. Once its water content is low enough, it can be stored indefinitely without fermenting or spoiling, so long as it is sealed from the air.



Right - a section of honey comb showing some stored pollen, alongside cells with

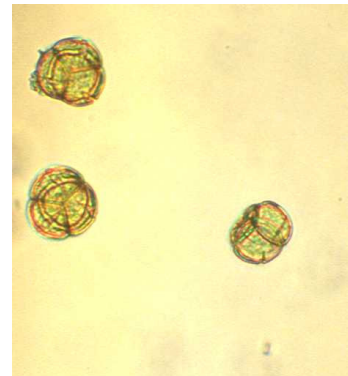
liquid nectar glistening in them. The cells at the top left contain either pollen or honey, and have been sealed over or 'capped' with wax by the bees to keep the air away and to preserve the contents.



This vertical section through a comb of honey illustrates a number of features. The midrib, which divides the cells on the opposite faces of the comb, is clearly seen. Notice too that the cells on the opposite faces are offset from each other. Perhaps most amazing is the fact that the cells tilt down slightly at their inner end - this helps to stop the liquid honey from falling out. The meniscus, or top surface of the liquid honey, is also clearly visible in some of the cells.

Pollen is also very important to the bees as a food. It is their equivalent of our 'meat' as its main component is protein, plus some vitamins and minerals.

The photograph above was taken through a microscope, and shows highly magnified grains of pollen, from the flowers of Ling Heather (*Calluna vulgaris*). The pollen grains of each plant species are unique in appearance. Their occurrence in small amounts in all honey allow the floral source of the honey to be identified by the beekeeper.



What is Beeswax?

Wax is produced by special glands on the bees' abdomen, from which it is secreted in the form of tiny oval scales. These scales are chewed by the bees and moulded into shape, and used to make the familiar honeycomb consisting of regular hexagonal compartments or 'cells'. The comb is light in weight, but very strong, and can support a very great weight of honey contained inside it.

The comb is used to store food, and also for rearing more bees. The queen lays eggs in the cells, which contain the larvae until they mature into fully grown bees.

What do wax scales look like?

Wax scales are tiny flakes secreted from glands on the underneath the worker bees' abdomen. Only workers can produce wax.



The wax scale from each segment's gland tends to be of a slightly different shape, as shown in this photograph. The natural size of the scales is approximately one millimetre long.