

Honeybees Past and Present

Humans and bees have had a long historical relationship with one another. Cave paintings in Valencia, Spain dating back to 6000 BC, show “honey hunters” robbing honey from wild honeybees. Overtime, honey hunters became beekeepers, and domesticated the honey bee.

Honeybees became a part of human civilization. So much so that even Aristotle, the Greek philosopher, wrote about bees in detail. Aristotle noted that a single bee tended to specialize in a certain flower type while foraging. A behavioral fact that has been confirmed by present day research. Aristotle however, was wrong many things, including honey, which he thought fell from the air, and was collected in the field by the bees.

During Roman Empire times there were even organized beekeeping centers and many monasteries also had bees. *Apis mellifera*, the European honeybee was and still is the most commonly used species of bee throughout the world. Honeybees however were not found in the Americas until the late 1600 and early 1700s when European settlers imported colonies to the eastern parts of the U.S. The bees made their way to Alaska and California by the early 1800's, and eventually to Hawaii.



This ornament found in Crete (dating from 2000-1700 BC) represents the Melissae or Melissai, the Greek nymphs of honey bees.

In the early 1850s, members of the Royal Hawaiian Agricultural Society created a committee to establish honeybees in the Hawaiian Islands. Attempts to send honeybees from Boston to Hawaii were unsuccessful due to the long trip. Shipping routes during this time went around Cape Horn, the southern tip of South America, thus honeybee colonies arrived in poor condition and failed to establish. However, a few years later the importation of honeybees to the western parts of the U.S. created an ideal opportunity to ship honeybees to Hawaii due to the shorter length of travel.

In October 1857, three colonies were sent to Honolulu, HI from San Jose, CA and arrived in good health. Dr. William Hillebrand, a physician and botanist was entrusted by the society to care for the hives, which eventually grew to nine colonies within a year. For the remaining part of the century, beekeeping with honeybees was a primarily a hobbyist activity. However, by the 1890s, the ranching industry Hawaii saw a dramatic increase in production. This led to an increase in use of honeybees to pollinate the alouoba tree, locally known as kiawe. In addition, the discovery of new nectar sources in Hawaii led to an increase of honey yields, which further stimulated the industry.

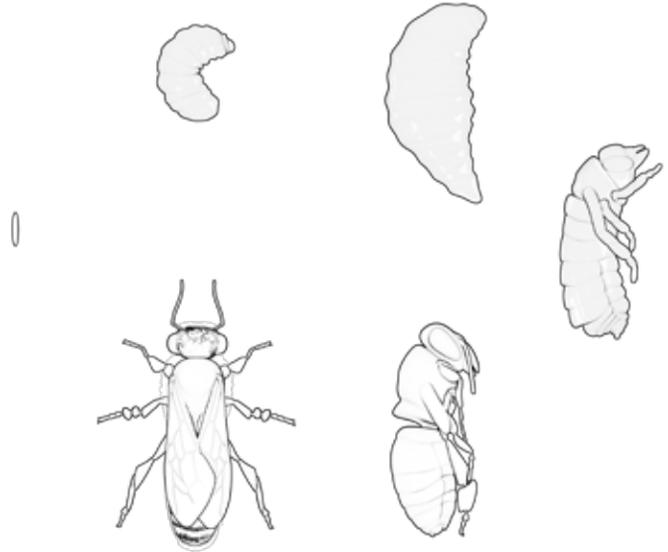
During the late 1890's honeybee colonies were exported to Kona aid in coffee production and to increase the kiawe bean yield for cattle feed. By 1893, the first honey company was started by Lee and Oswald St. John Gilbert of Honolulu. The brothers started the Sandwich Island Honey Company from a swarm of bees that landed in their backyard. By 1908, the Sandwich Island Honey Company managed over twenty thousand hives on all major islands. Around this time, a second honey company, The Hawaiian Honey Company, located in Ewa managed approximately eighteen hundred colonies of honeybees, which produced approximately 180,000 pounds of honey annually.

By the 1910's honeybee colonies were found throughout the Hawaiian Islands and a thriving beekeeping industry was established. Over 2400 colonies were managed by Molokai Ranch, which at one point, was one of the world's largest producer of honey. Kauai and Lanai also joined in and new honey companies were created colonies during the early 1900's, taking advantage of the boom in honey production and trade. Beekeeping on Maui reached its peak during the 1930's where over 255,000 pound of honey were sold.

The glory days of beekeeping took a downward turn in the 1937 with the appearance of a bacterial disease called American Foulbrood. The hardest hit island was Molokai, and from 1938 to 1948, honey production on that island virtually stopped. Over time a few surviving colonies have helped rebuild the island bee population, but Molokai is no longer the center of beekeeping for Hawaii. Instead, it is the Big Island of Hawaii that has become the site of the largest beekeeping operations on the islands. Beekeepers on this island produce honey as well as “queen bees”. The queen bees are sold commercially to beekeepers and growers in the mainland US and Canada. Roughly half a million honeybee queens are shipped every year to support pollination of mainland crops including almonds, blueberries, cranberries, and apples. Local honey production has also increased and Hawaii's beekeepers produced some of the most unique honeys in the US. Currently, there are over 10,000 honeybee colonies throughout the Hawaiian Islands, producing over 750,000 pounds of honey each year.

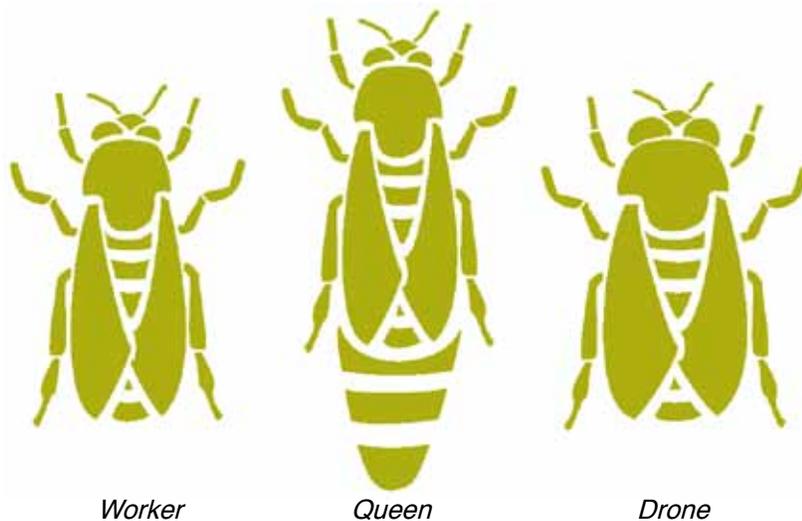
Honeybee Life Cycle

The life cycle of honeybees, like those of butterflies and moths, involve a dramatic transformation from a larva to an adult. The queen lays eggs inside the cells, and the eggs hatch into larvae. The duration of the larval stage of bees varies depending on what caste they belong to. Workers, which are all females, and smaller in size, develop quicker than the larger males, called drones. Once the larva is old enough, the adult workers cap the cell and the larva begins to transform into a pupa. The transformation starts when the larva spin a very delicate cocoon and becomes a pre-pupa. During this stage the pre-pupa sheds the larval skin and then, slowly, it transforms into a pupa. Bee pupa have distinct bee looking heads and the body segments, legs and wing buds are also developing. At the end of the pupal stage the bee molts once again into an adult. The young bee now chews her cell open and joins the colony! In total worker bees spend about a week in open brood cells as larvae, and close to 12 days inside capped cells undergoing a transformation during the pupal stage.



Honeybee Caste

The *Apis* genus is composed of eight different species of honey bee, including *Apis mellifera* which has been extensively domesticated for the past 5,000 years. Just as there exist many different dog breeds, there are also numerous different 'races' of *Apis mellifera*. *Apis mellifera ligustica* or the 'Italian' race is preferred by bee keepers because it produces large amounts of high-quality honey and is known for its gentle, non-aggressive nature. In Hawaii, we have a mixture of Italian and German bees, which can be a little more aggressive.



Worker Bees

The vast majority of all bees in a hive are worker bees. Workers are the daughters of the queen and they are sterile females. For the first two weeks of their life, they work within the hive performing nurse duties such as cleaning the hive and feeding larvae. As they age they begin to do other chores such as, manipulating and building cells with wax, packing pollen brought by other workers, and attending to the queen needs. As the workers get to be eighteen days old they spend time guarding the entrance of the colony. Around day twenty, workers begin to leave the hive to forage, collecting both pollen (in the pollen baskets on their hind legs) and nectar (which is stored in a special honey sac in the digestive system). A typical managed colony in Hawaii usually has around 25,000 to 30,000 adult worker bees.

Drone Bees

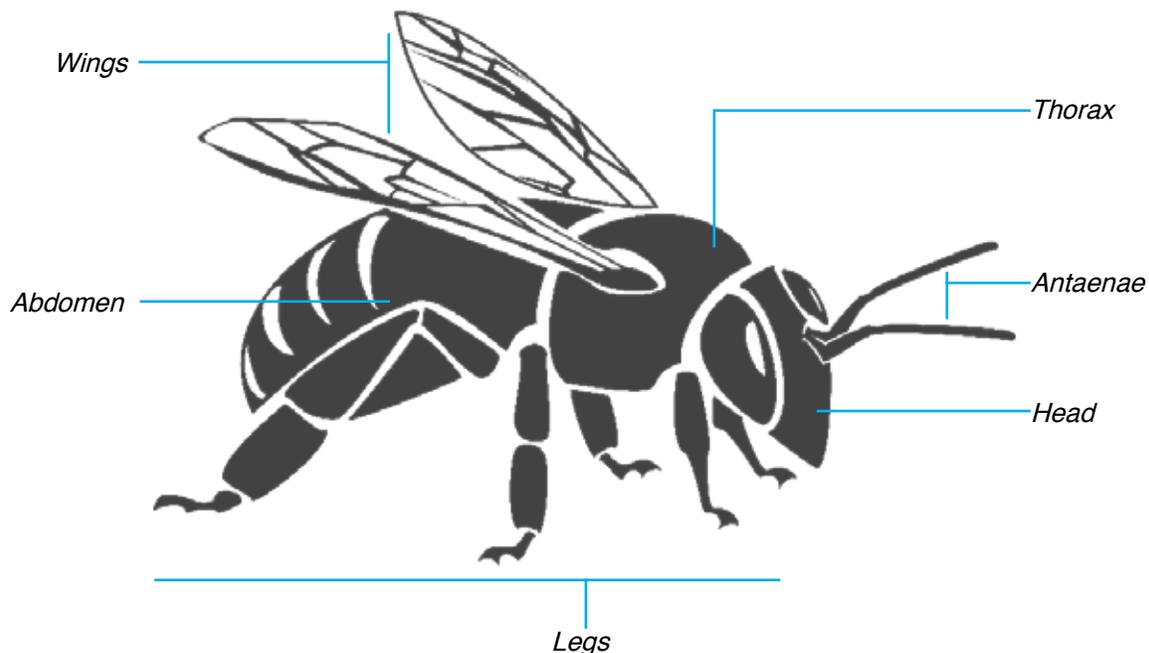
The drones, or fertile males, compose a small fraction of the hive population. They are readily distinguished from workers by their larger size, massive eyes, and lack of a stinger. Drones do not contribute to hive care or maintenance, nor do they aid in foraging. Decidedly weak flyers, their sole purpose is to mate with virgin queens only to die shortly after successful reproduction. If resources are scarce in a hive with an already fertile and egg-laying queen, workers will evict drones to fend for themselves. In Hawaii, drone production season is very variable and highly influenced by microclimatic conditions.

The Queen Bee

The queen is the largest and longest-lived bee in the colony. She is also the only sexually developed female. Her role in the hive is to lay eggs in the brood cells. The queen is capable of determining whether to release stored sperm (from her previous matings) to create sterile females or to withhold the sperm and create drones. Queens can live around two to three years but beekeepers tend to replace them annually or every other year as egg production diminishes with age. Naturally, a colony will make a new queen if the original is old, weak, or infertile by feeding female larva royal jelly up until pupation. The first new queen to emerge stings and kills her competitors while they are still in their cells. In tropical areas, such as Hawaii, where queens lay eggs continuously throughout the year, it is recommended that beekeepers replace the queen annually to ensure strong colonies.

Basic Bee Anatomy

Like all insects, bee bodies are composed of three distinct parts: the head, the thorax, and the abdomen which are made up of small chitin plates and form the exoskeleton of the bee. All bees have two pairs of wings and three pairs of legs which emerge from the thorax.

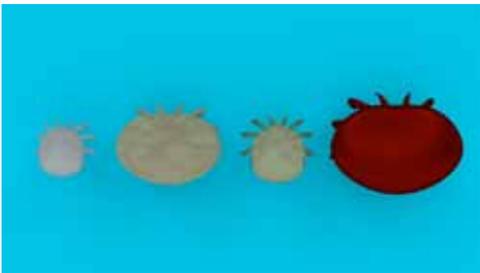


Honeybee Pests and their Impact to Beekeeping and Sustainable Agriculture

For the last 150 years, the introduced European honeybee, *Apis mellifera*, has been an integral part of the agricultural system in Hawaii and the Pacific. However, due to great geographical isolation of the islands, the local honeybee populations were free of many pest and diseases that had spread on the mainland US and Europe over the last 20 years. In 2007, a devastating honeybee pest, the Varroa mite, was discovered in Hawaii and in 2010, another bee parasite, the small hive beetle, was also detected in Hawaiian honeybee colonies. These parasites, associated viruses, and fungal diseases have caused large colony losses for the local beekeepers and greatly reduced the population of managed bees available for pollination in agricultural fields. In addition, these new pest and diseases have decimated the feral honeybee populations on the affected islands. These “wild bees” used to contribute to the pollination of many crops, however, their services had been largely unnoticed by the community. The sudden reduction of the feral bee population in conjunction with the decline of managed colonies has created a grave “pollinator shortage” in Hawaii that we are just beginning to address.

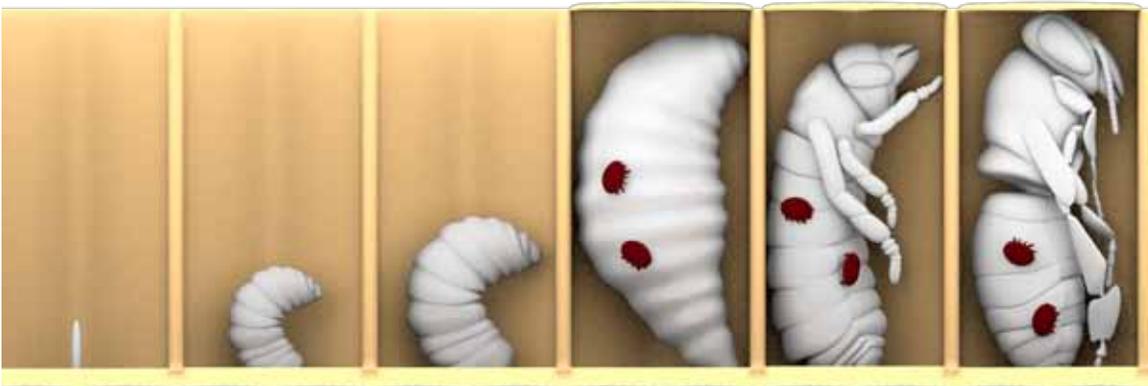
The Varroa Mite

Varroa destructor is a parasitic mite that ranks among the most destructive bee pests worldwide. Varroa mites feed on the haemolymph (blood) of developing pupa and adult bees. Parasitized pupae are weakened or may die. The bees immune system is severely compromised by the mites and the bees may also become infested with deformed wing virus (DWV), which is spread by the mites.



Female mites are dark red in color and their reproductive cycle takes place exclusively inside the bees cells.

The great majority of colony losses are due to varroa and consequently beekeepers have tried using a large number of treatments, some of which have had strong negative side effects on the bees. The problem of chemical residues from mite control At CTAHR we are concentrating in using organic mite control treatments to promote bee health.



Two adult female mites on the comb.



Worker bee with Deformed Wing Virus

Small Hive Beetle

The Small Hive Beetle, *Aethina tumida*, is a honeybee pest indigenous to South Africa. Adult beetles are considered opportunist scavengers and seem to prefer weakened or “stressed” colonies to lay their eggs. SHB larvae consume brood, pollen, and honey. Females can lay up to 2000 eggs during their lifetime and in tropical conditions there can be up to 6 generations/year. The beetles cannot be eliminated once they are established however beekeepers can adjust their hive management and extraction techniques to reduce the impact of this pest. The SHB has the potential to infest honey-houses and spoil honey. Consequently beekeepers need to increase their cleanliness and modify their storage methods to minimize the damage caused by SHB larvae.

