# Western honey bee

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The **western honey bee** or **European honey bee** (*Apis mellifera*) is a species of honey bee. The genus name *Apis* is Latin for "bee", and *mellifera* means "honey-bearing". As of October 28, 2006, the Honey Bee Genome Sequencing Consortium fully sequenced and analyzed the genome of *Apis mellifera*. Since 2007, attention has been devoted to colony collapse disorder, a decline in European honey bee colonies in a number of regions.

## Contents



**Western honey bee**

**Scientific classification**

| | |
|---|---|
| Kingdom: | Animalia |
| Phylum: | Arthropoda |
| Class: | Insecta |
| Order: | Hymenoptera |
| Family: | Apidae |
| Genus: | *Apis* |
| Species: | ***A. mellifera*** |

**Binomial name**

***Apis mellifera***

Linnaeus, 1758

**Subspecies**[1]

**Northwestern Europe**

- *A. m. mellifera*

**Southwestern Europe**

- *A. m. artemisia*
- *A. m. carnica*
- *A. m. cecropia*
- *A. m. iberiensis*
- *A. m. ligustica*
- *A. m. macedonica*
- *A. m. madaros*
- *A.m. ruttneri*
- *A. m. siciliana*
- *A. m. sossimai*

**Middle East**

- *A. m. adami*
- *A. m. anatoliaca*
- *A. m. caucasia*
- *A. m. cypria*
- *A. m. meda*
- *A. m. remipes*
- *A. m. syriaca*

**Africa**

- *A. m. adansonii*
- *A. m. capensis*
- *A. m. intermissa*
- *A. m. jemenitica*
- *A. m. lamarckii*
- *A. m. litorea*
- *A. m. monticola*
- *A. m. sahariensis*
- *A. m. scutellata*
- *A. m. unicolor*

**Synonyms**

*Apis mellifica* Linnaeus, 1761

# Geographic distribution

The western honey bee is native to Europe, Asia and Africa. During the early 1600s it was introduced to North America, with other European subspecies introduced two centuries later.[2] Since then, it has spread throughout the Americas.

Western honey bees evolved into geographic races as they spread from Africa into Eurasia,[3] and 28 subspecies based on these geographic variations are recognized.[1] All races are cross-fertile, although reproductive adaptations may make interbreeding unlikely. The subspecies are divided into four major branches, based on work by Ruttner and confirmed by mitochondrial DNA analysis. African subspecies belong to branch A, northwestern European subspecies branch M, southwestern European subspecies branch C and Mideastern subspecies branch O. These subspecies are listed and grouped in the sidebar. Regions with local variations may be identified as subspecies in the future; *A. m. pomonella*, from the Tian Shan, would be included in the Mideastern subspecies branch.

Geographic isolation led to adaptation as honey bees spread after the last ice age. These adaptations include brood cycles synchronized to the blooming period of local flora, forming a winter cluster in colder climates, migratory swarming in Africa and enhanced foraging behavior in desert areas.

# Biology and life cycle


Larvae (*left*) and eggs (*right*)

In the temperate zone honey bees survive winter as a colony, and the queen begins egg-laying in mid- to late winter in preparation for spring (probably triggered by day length). The only fertile female, she lays the eggs from which all the other bees are produced. Except for a brief periods (when she may fly to mate with drones or leave in later life with a swarm to establish a new colony), the queen rarely leaves the hive after the larvae have become bees. She deposits each egg in a cell prepared by worker bees. The egg hatches into a small larva fed by "nurse" bees (worker bees who maintain the interior of the colony). After about a week, the larva is sealed in its cell by the nurse bees and begins its pupal stage. After another week, it emerges as an adult bee.

For the first ten days of their lives, female worker bees clean the hive and feed the larvae. After this, they begin building comb cells. On days 16 through 20, workers receive nectar and pollen from older workers and store it. After the 20th day, a worker leaves the hive and spends the remainder of its life as a forager. The average population of a healthy hive in midsummer may be as high as 40,000 to 80,000 bees. The larvae and pupae in a frame of honeycomb are known as "frames of brood", and are sold (with adhering bees) to start new beehives.


Pupae of drones

Workers and queens are fed royal jelly during the first three days of their larval stage. Workers are then switched to a diet of pollen and nectar (or diluted honey), while queens will continue to receive royal jelly (which helps large, sexually developed larvae reach the pupal stage more quickly). Queen breeders consider good nutrition during the larval stage critically important for queen quality, with good genetics and sufficient mating contributing factors. During the larval and pupal stages, parasites may damage (or destroy) the pupa or larva.

Queens are not raised in the typical horizontal brood cells of the honeycomb. A queen cell is larger and oriented vertically. If workers sense that an old queen is weakening, they produce emergency cells (known as supersedure cells) made from cells with eggs or young larvae and which protrude from the comb. When the queen finishes her larval feeding and pupates, she moves into a head-downward position and later chews her way out of the cell. At pupation, workers cap (seal) the cell. Shortly before emerging from their cells, young queens may often be heard "piping". The queen makes this sound to evaluate her space, and piping seems to calm worker bees.[4]


Development of a drone pupa

Although worker bees are usually infertile females, when some subspecies are stressed they may lay fertile eggs. Since workers are not fully sexually developed, they do not mate with drones. Fertile eggs would be haploid (having only the genetic contribution of their mother), and these haploid eggs would always develop into drones. Worker bees secrete the wax used to build the hive, clean, maintain and guard it, raise the young and forage for nectar and pollen.

Worker honey bees have a modified ovipositor, a stinger, with which they defend the hive; unlike bees of any other genus and the queens of their own species, this stinger is barbed. Contrary to popular belief, a bee does not always die soon after stinging; this misconception is based on the fact that a bee will usually die after stinging a human or other mammal. The stinger and its venom sac, with musculature and a ganglion allowing them to continue delivering venom after they are detached, are designed to pull free of the body when they lodge. This apparatus (including barbs on the stinger) is thought to have evolved in response to predation by vertebrates, since the barbs do not function (and the stinger apparatus does not detach) unless the stinger is embedded in elastic material. The barbs do not always "catch", so a bee may occasionally pull its stinger free and fly off unharmed (or sting again).

# Drones

Drones are the colony's male bees. Since they do not have ovipositors, they do not have stingers. Drone honey bees do not forage for nectar or pollen. The primary purpose of a drone is to fertilize a new queen. Many drones will mate with a given queen in flight; each will die immediately after mating, since the process of insemination requires a lethally convulsive effort. Drone honey bees are haploid (single, unpaired chromosomes) in their genetic structure, and are descended only from their mother (the queen). In temperate regions drones are generally expelled from the hive before winter, dying of cold and starvation since they cannot forage, produce honey or care for themselves. There has been research into the role *A. mellifera* drones play in thermoregulation within the hive. Given their larger size (1.5x), drones may play a significant role. Drones are typically located near the center of hive clusters for unclear reasons. It is postulated that it is to maintain sperm viability, which drops off at cooler temperatures. Another possible explanation posed, is that a more central location allows drones to contribute to warmth, since at temperatures below 25C their ability to contribute declines.[5]

# Life expectancy

Although the average lifespan of a queen in most subspecies is three to five years, reports from the German-European black bee subspecies previously used for beekeeping indicate that a queen can live up to eight years.[6] Because a queen's store of sperm is depleted near the end of her life, she begins laying more unfertilized eggs; for this reason, beekeepers often replace queens every year or two.

The lifespan of workers varies considerably over the year in regions with long winters. Workers born in spring and summer will work hard, living only a few weeks, but those born in autumn will remain inside for several months as the colony clusters. On average during the year, about one percent of a colony's worker bees die naturally per day.[7] Except for the queen, all of a colony's workers are replaced about every four months.

# Honey production

Bees produce honey by collecting nectar, a clear liquid consisting of nearly 80 percent water and complex sugars. The collecting bees store the nectar in a second stomach and return to the hive, where worker bees remove the nectar. The worker bees digest the raw nectar for about 30 minutes, using enzymes to break down the complex sugars into simpler ones. Raw honey is then spread in empty honeycomb cells to dry, reducing its water content to less than 20 percent. When nectar is being processed, honey bees create a draft through the hive by fanning with their wings. When the honey has dried, the honeycomb cells are sealed (capped) with wax to preserve it.


Honey bee with "tongue" partially extended

When a hive detects smoke, many bees become nonaggressive; this is thought to be a defense mechanism. Wild colonies generally live in hollow trees; when they detect smoke, they are thought to prepare to evacuate from a forest fire with as much food as they can. To do this, they go to the nearest honey-storage cells and gorge on honey. In this state they are docile, since defending against predation is less important than saving as much food as possible.

# Thermoregulation

The honey bee needs an internal body temperature of 35 °C (95 °F) to fly; this temperature is maintained in the nest to develop the brood, and is the optimal temperature for the creation of wax. The temperature on the periphery of the cluster varies with outside air temperature, and the winter cluster's internal temperature may be as low as 20–22 °C (68–72 °F).

Honey bees can forage over a 30 °C (54 °F) air-temperature range because of behavioral and physiological mechanisms for regulating the temperature of their flight muscles. From low to high air temperatures, the mechanisms are: shivering before flight, and stopping flight for additional shivering; passive body-temperature regulation based on work, and evaporative cooling from regurgitated honey-sac contents. Body temperatures differ, depending on caste and expected foraging rewards.[8]

The optimal air temperature for foraging is 22–25 °C (72–77 °F). During flight, the bee's relatively large flight muscles create heat which must dissipate. The honey bee uses evaporative cooling to release heat through its mouth. Under hot conditions, heat from the thorax is dissipated through the head; the bee regurgitates a

Enlarged image of a honey bee's "tongue"

droplet of warm internal fluid — a "honeycrop droplet" – which reduces the temperature of its head by 10 °C (18 °F).[9]

Below 7–10 °C (45–50 °F) bees are immobile, and above 38 °C (100 °F) their activity slows. Honey bees can tolerate temperatures up to 50 °C (122 °F) for short periods.

# Queens

Periodically, the colony determines that a new queen is needed. There are three general causes:

1. The hive is filled with honey, leaving little room for new eggs. This will trigger a swarm, where the old queen will take about half the worker bees to found a new colony and leave the new queen with the other half of the workers to continue the old one.
2. The old queen begins to fail, which is thought to be demonstrated by a decrease in queen pheromones throughout the hive. This is known as supersedure, and at the end of the supersedure the old queen is generally killed.
3. The old queen dies suddenly, a situation known as emergency supersedure. The worker bees find several eggs (or larvae) of the appropriate age range and attempt to develop them into queens. Emergency supersedure can generally be recognized because new queen cells are built out from comb cells, instead of hanging from the bottom of a frame.

Regardless of the trigger, workers develop the larvae into queens by continuing to feed them royal jelly (which triggers extended pupal development).

Peanut-like queen brood cells extend outward from the brood comb.

When the virgin queen emerged, she was thought to seek out other queen cells and sting the infant queens within; should two queens emerge simultaneously, they were thought to fight to the death. However, recent research has indicated as many as 10 percent of *Apis mellifera* colonies may maintain two queens. Although the mechanism by which this occurs is not yet known, it has reportedly occurred more frequently in some South African subspecies. The queen asserts control over the worker bees by releasing a complex suite of pheromones known as queen scent.

After several days of orientation in and around the hive, the young queen flies to a drone congregation point – a site near a clearing and generally about 30 feet (9.1 m) above the ground – where drones from different hives congregate. They detect the presence of a queen in their congregation area by her smell, find her by sight and mate with her in midair; drones can be induced to mate with "dummy" queens with the queen pheromone. A queen will mate multiple times, and may leave to mate several days in a row (weather permitting) until her spermatheca is full.

The queen lays all the eggs in a healthy colony. The number and pace of egg-laying is controlled by weather, resource availability and specific racial characteristics. Queens generally begin to slow egg-laying in the early fall, and may stop during the winter. Egg-laying generally resumes in late winter when the days lengthen, peaking in the spring. At the height of the season, the queen may lay over 2,500 eggs per day (more than her body mass).

She fertilizes each egg (with stored sperm from the spermatheca) as it is laid in a worker-sized cell. Eggs laid in drone-sized (larger) cells are left unfertilized; these unfertilized eggs, with half as many genes as queen or worker eggs, develop into drones.

# Queen-worker conflict

When a fertile female worker produces drones, a conflict arises between her interests and those of the queen. The worker shares half her genes with the drone and one-quarter with her brothers, favoring her offspring over those of the queen. The queen shares half her genes with her sons and one-quarter with the sons of fertile female workers.[10] This pits the worker against the queen and other workers, who try to maximize their reproductive fitness by rearing the offspring most related to them. This relationship leads to a phenomenon known as "worker policing". In these rare situations, other worker bees in the hive who are genetically more related to the queen's sons than those of the fertile workers will patrol the hive and remove worker-laid eggs. Another form of worker-based policing is aggression toward fertile females.[11] Some studies have suggested a queen pheromone which may help workers distinguish worker- and queen-laid eggs, but others indicate egg viability as the key factor in eliciting the behavior.[12][13] Worker policing is an example of forced altruism, where the benefits of worker reproduction are minimized and that of rearing the queen's offspring maximized.

In very rare instances workers subvert the policing mechanisms of the hive, laying eggs which are removed at a lower rate by other workers; this is known as anarchic syndrome. Anarchic workers can activate their ovaries at a higher rate and contribute a greater proportion of males to the hive. Although an increase in the number of drones would decrease the overall productivity of the hive, the reproductive fitness of the drones' mother would increase. Anarchic syndrome is an example of selection working in opposite directions at the individual and group levels for the stability of the hive.[14]

Under ordinary circumstances the death (or removal) of a queen increases reproduction in workers, and a significant proportion of workers will have active ovaries in the absence of a queen. The workers of the hive produce a last batch of drones before the hive eventually collapses. Although during this period worker policing is usually absent, in certain groups of bees it continues.[15]

According to the strategy of kin selection, worker policing is not favored if a queen does not mate multiple times. Workers would be related by three-quarters of their genes, and the difference in relationship between sons of the queen and those of the other workers would decrease. The benefit of policing is negated, and policing is less favored. Experiments confirming this hypothesis have shown a correlation between higher mating rates and increased rates of worker policing in many species of social hymenoptera.[16]

# Genome

The European honey bee is the third insect, after the fruit fly and the mosquito, to have its genome mapped. According to scientists who analyzed its genetic code, the honey bee originated in Africa and spread to Europe in two ancient migrations.[3] Scientists have found that genes related to smell outnumber those for taste, and the European honey bee has fewer genes regulating immunity than the fruit fly and the mosquito.[17] The genome sequence also revealed that several groups of genes, particularly those related to circadian rhythm, resembled those of vertebrates more than other insects. Another significant finding from the honey bee genome study was that honey bee was the first insect to be discovered with a functional DNA methylation system because functional key enzymes (DNA methyl-transferase 1 and 3) were identified in the genome. DNA methylation is one of the important mechanisms in epigenetics to study gene expression and regulation without changing the DNA sequence, but modifications on the DNA. [18] DNA methylation later was identified to play an important role in gene regulation and gene alternative splicing.[19] The genome is unusual in having few transposable elements, although they were present in the evolutionary past (inactive remains have been found) and evolved more slowly than those in fly species.[17]

### Pheromones

Pheromones (chemical communication) are essential to honey-bee survival. Honey bees use pheromones for nearly all behaviors, including mating, alarm, defense, orientation, kin and colony recognition, food production and integrating colony activities.

### Communication


A large honey-bee swarm on a fallen tree trunk

Honey-bee behavior has been extensively studied, since bees are widespread and familiar. Karl von Frisch, who received the 1973 Nobel Prize for physiology and medicine for his study of honey-bee communication, noticed that bees communicate with dance. Through these dances, bees communicate information regarding the distance, the situation, and the direction of a food source by the dances of the returning (honey bee) worker bee on the vertical comb of the hive.[20] Honey bees direct other bees to food sources with the round dance and the waggle dance. Although the round dance tells other foragers that food is within 50 metres (160 ft) of the hive, it provides insufficient information about direction. The waggle dance, which may be vertical or horizontal, provides more detail about the distance and direction of a food source. Foragers are also thought to rely on their olfactory sense to help locate a food source after they are directed by the dances.

Another means of communication is the shaking signal, also known as the jerking dance, vibration dance or vibration signal. Although the shaking signal is most common in worker communication, it also appears in reproductive swarming. A worker bee vibrates its body dorsoventrally while holding another bee with its front legs. Jacobus Biesmeijer, who examined shaking signals in a forager's life and the conditions leading to its performance, found that experienced foragers executed 92.1 percent of observed shaking signals and 64 percent of these signals were made after the discovery of a food source. About 71 percent of shaking signals occurred before the first five successful foraging flights of the day; other communication signals, such as the waggle dance, were performed more often after the first five successes. Biesmeijer demonstrated that most shakers are foragers and the shaking signal is most often executed by foraging bees on pre-foraging bees, concluding that it is a transfer message for several activities (or activity levels). Sometimes the signal increases activity, as when active bees shake inactive ones. At other times, such as the end of the day, the signal is an inhibitory mechanism. However, the shaking signal is preferentially directed towards inactive bees. All three forms of communication among honey bees are effective in foraging and task management.

## Beekeeping

The honey bee is a colonial insect which is housed, fed and transported by beekeepers. Honey bees do not survive and reproduce individually, but as part of the colony (also known as a superorganism).

Honey bees collect flower nectar and convert it to honey, which is stored in the hive. The nectar, transported in the bees' stomachs, is converted with the addition of digestive enzymes and storage in a honey cell for partial dehydration. Nectar and honey provide the energy for the bees' flight muscles and for heating the hive during the winter. Honey bees also collect pollen, which supplies protein and fat for the bee brood to grow. Centuries of selective breeding by humans have created bees which produce far more honey than the colony needs, and beekeepers (also known as apiarists) harvest the surplus honey.

Queen bee with workers

Beekeepers provide a place for the colony to live and store honey. There are seven basic types of beehive: skeps, Langstroth hives, top-bar hives, box hives, log gums, D. E. and miller hives. All U.S. states require beekeepers to use movable frames to allow bee inspectors to check the brood for disease. This allows beekeepers to keep Langstroth, top-bar and D.E. hives without special permission, granted for purposes such as museum use. The type of beehive significantly impacts colony health and wax and honey production. Modern hives also enable beekeepers to transport bees, moving from field to field as crops require pollinating (a source of income for beekeepers).


Honey bees removed from the hive for inspection by a beekeeper

In cold climates, some beekeepers have kept colonies alive (with varying degrees of success) by moving them indoors for winter. While this can protect the colonies from extremes of temperature and make winter care and feeding more convenient for the beekeeper, it increases the risk of dysentery and causes an excessive buildup of carbon dioxide from the bees' respiration. Inside wintering has been refined by Canadian beekeepers, who use large barns solely for the wintering of bees; automated ventilation systems assist in carbon-dioxide dispersal.

## Breeding


Honeybee in a park in Tokyo

A number of traits are present in subspecies of Western honey bees, which may be enhanced by breeding:

- *Egg-laying rate* – Queens can lay from a few hundred to about 5,000 eggs per day.
- *Egg viability rate* – Ranges from zero to 100 percent of eggs which hatch and develop into bees
- *Brood cycle length* – From 17 to 21 days for worker bees
- *Brood nurturing* – A measure of how intently nurse bees nurture the brood
- *Foraging aggressiveness* – Determines honey-production potential
- *Time of foraging* – Some bees forage earlier in the day, or later in the evening, than others.
- *Disease resistance* – A measure of innate tolerance to brood and adult diseases
- *Pest resistance* – A measure of innate tolerance to pests, such as tracheal and varroa mites
- *Defensive behavior* – Determines aggressiveness and propensity to sting
- *Swarming tendency* – Determines the timing and success of colony reproduction
- *Winter hardiness* – Clustering behavior and ability to survive extended low temperatures
- *Life span* – From 22 to 305 days for workers; average is 36 days.
- *Body size* – Small bees are typical in Africa, with larger bees in colder climates.
- *Sense of smell* – Ability to detect flower odors and respond to nectar availability
- *Hygienic cleaning behavior* – A major component of disease and pest resistance
- *Time of brood development* – Bees must begin brood-rearing at least eight weeks before nectar flows.

- *Thrift* – Adjustment of brood production to available food sources for efficient resource use
- *Honey arrangement* – Location of honey relative to the brood nest
- *Pollen collection* – Amount and floral source of pollen are genetically controlled.
- *Type of nectar collected* – Impacts honey quality
- *Comb building* – Willingness to build comb and expand the colony
- *Capping structure* – Ranges from flat and watery to grayish-white and dome-shaped
- *Propolis collection* – Associated with wintering success; ranges from none to covering all hive surfaces
- *Brace comb construction* – Ranges from very little to cross comb throughout the colony
- *Abdominal color* – Ranges from black to tan, yellow or orange stripes
- *Antenna structure* – Number and placement of sensors is inherited and associated with smell.
- *Number of drones produced* – Ranges from very few to 25 percent of brood combs
- *Number of queens produced* – Ranges from a few to several hundred

## Products

### Honey bees

A primary product of honey bees is more honey bees. Honey bees are bought as mated queens, in spring packages of a queen with 2 to 5 pounds (0.91 to 2.27 kg) of bees, as nucleus colonies (which include frames of brood) and as full colonies. Commerce in bees dates to prehistory, and modern methods of producing queens and dividing colonies for increase date to the late 1800s. Bees are typically produced in temperate to tropical regions and sold to colder areas; packages of bees produced in Florida are sold to beekeepers in Michigan.

### Pollination

The honey bee's primary commercial value is as a pollinator of crops. Although orchards and fields have increased in size, wild pollinators have dwindled. In a number of regions the pollination shortage is addressed by migratory beekeepers, who supply hives during a crop bloom and move them after the blooming period. Commercial beekeepers plan their movements and wintering locations according to anticipated pollination services. At higher latitudes it is difficult (or impossible) to winter over sufficient bees, or to have them ready for early blooming plants. Much migration is seasonal, with hives wintering in warmer climates and moving to follow the bloom at higher latitudes. In California almond pollination occurs in February, early in the growing season before local hives have built up their populations.


Beehives set up for pollination

Almond orchards require two hives per acre (2,000 m² per hive) for maximum yield, and pollination is dependent on the importation of hives from warmer climates. Almond pollination (in February and March in the United States) is the largest managed pollination event in the world, requiring more than one-third of all managed honey bees in the country. Mass movements of bees are also made for apples in New York, Michigan, and Washington. Despite honey bees' inefficiency as blueberry pollinators,[21] large numbers are moved to Maine because they are the only pollinators who can be easily moved and concentrated for this and other monoculture crops. Bees and other insects maintain flower constancy by transferring pollen to other

Honey bees immersed in yellow beavertail cactus pollen in the High Desert of California

biologically specific plants;[22] this prevents flower stigmas from being clogged with pollen from other species.[23]

### Honey

Honey is the complex substance made from nectar and sweet deposits from plants and trees which are gathered, modified and stored in the comb by honey bees. Honey is a biological mixture of inverted sugars, primarily glucose and fructose. It has antibacterial and antifungal properties, and will not rot or ferment when stored under normal conditions. However, honey will crystallize over time. Although crystallized honey is acceptable for human use, bees can only use liquid honey and will remove and discard crystallized honey from the hive.

Bee carrying pollen in a basket back to the hive

### Beeswax

Video of bee collecting pollen from crocuses

Mature worker bees secrete beeswax from glands on their abdomen, using it to form the walls and caps of the comb. When honey is harvested, the wax can be collected for use in products like candles and seals.

### Pollen

Bees collect pollen in a pollen basket and carry it back to the hive, where it is a protein source for brood-rearing. Excess pollen can be collected from the hive; although it is sometimes consumed as a dietary supplement by humans, bee pollen may cause an allergic reaction in susceptible individuals.

### Propolis

Propolis is a resinous mixture collected by honey bees from tree buds, sap flows or other botanical sources, which is used as a sealant for unwanted open spaces in the hive. Although propolis is alleged to have health benefits (tincture of Propolis is marketed as a cold and flu remedy), it may cause severe allergic reactions in some individuals. Propolis is also used in wood finishes, and gives a Stradivarius violin its unique red color.

### Royal jelly

Royal jelly is a honey-bee secretion used to nourish the larvae. Although it is marketed for its alleged health benefits, it may cause severe allergic reactions in some individuals.


An African honey bee in Tanzania extracts nectar from a flower, as pollen grains stick to its body

# Hazards and survival


A bee swarm. Bees are non-aggressive in this state, since they have no hive to protect.

European honey-bee populations face threats to their survival. North American and European populations were severely depleted by varroa-mite infestations during the early 1990s, and US beekeepers were further affected by colony collapse disorder in 2006 and 2007.[24] Improved cultural practices and chemical treatments against varroa mites saved most commercial operations; new bee breeds are beginning to reduce beekeeper dependence on acaricides. Feral bee populations were greatly reduced during this period; they are slowly recovering, primarily in mild climates, due to natural selection for *varroa* resistance and repopulation by resistant breeds. Insecticides, particularly when used in excess of label directions, have also depleted bee populations as bee pests and diseases (including American foulbrood and tracheal mites) are becoming resistant to medications.

## Environmental hazards

Africanized bees have spread across the southern United States, where they pose a slight danger to humans (making beekeeping—particularly hobby beekeeping—difficult). As an invasive species, feral honey bees have become a significant environmental problem in non-native areas. Imported bees may displace native bees and birds, and may also promote the reproduction of invasive plants ignored by native pollinators. Unlike native bees, they do not properly extract or transfer pollen from plants with pore anthers (anthers which only release pollen through tiny apical pores); this requires buzz pollination, a behavior rarely exhibited by honey bees. Honey bees reduce fruiting in *Melastoma affine*, a plant with pore anthers, by robbing its stigmas of previously deposited pollen.[25]

## Predators

### Insects

- Asian giant hornet - Southeast Asia
- Robber flies
- Dragonfly
  - Green Darner
- European beewolf - Europe and North Africa
- Chinese mantis
- Bald-faced hornet
- Common water strider
- Yellowjacket

### Spiders

- Six-spotted fishing spider
- Green lynx spider
- Goldenrod spider [26]
- Black argiope

### Reptiles and amphibians

- American toad
- Anoles
- Bullfrog
- Wood frog

### Birds

- Bee-eater
- Common grackle
- Ruby-throated hummingbird
- Tyrant flycatcher
- Great crested flycatcher

### Mammals

- Bear
- Human
- Least shrew
- Opossum
- Raccoon
- Honey badger
- Skunk

# Designated U.S. state insect

- Arkansas (1973)
- North Carolina (1973)
- New Jersey (1974)
- Georgia (1975)
- Maine (1975)
- Nebraska (1975)
- Kansas (1976)
- Louisiana (1977)
- Vermont (1977)
- Wisconsin (1977)
- South Dakota (1978)
- Mississippi (1980)
- Utah (1983)
- Missouri (1985)
- Tennessee (1990) – official agricultural insect
- Oklahoma (1992)

- West Virginia (2002)

# See also

- Bee sting therapy
- Beeline
- Bee bearding
- Ecological importance of bees
- Worker policing

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# External links

- Beediseases (http://www.beediseases.host-ed.me/) Honey-bee diseases by Guido Cordoni
- Honey Bee Pheromones (https://web.archive.org/web/20071016183114/http://www.geocities.com/Athens/Olympus/3294/pheromo.htm) at the Wayback Machine (archived October 16, 2007)
- Cornwall Honey Beepedia (http://www.cornwallhoney.co.uk/bees.htm)
- BeeSource (http://www.beesource.com/)
- Honey Bee *Apis mellifera* diagnostic pictures, descriptions, natural history (http://www.cirrusimage.com/bees_honey.htm)
- Beekeeping explained (http://www.fao.org/docrep/x0083e/X0083E06.htm) by the Food and Agriculture Organization
- Brainy Bees Think Abstractly (http://www.sciam.com/article.cfm?articleID=000475FC-9CB6-1C5E-B882809EC588ED9F)
- Anatomy of the honeybee (http://www.fao.org/docrep/t0104e/T0104E06.htm#Chapter%203%20Anatomy%20of%20the%20honeybee) by the FAO
- *Apis mellifera pomonella*, a new honey-bee subspecies from Central Asia; Apidologie 34 (2003) 367-375; Sheppard and Meixner (http://www.edpsciences.org/articles/apido/pdf/2003/04/M3412.pdf)
- *Apis mellifera* (http://entnemdept.ufl.edu/creatures/MISC/BEES/euro_honey_bee.htm) on the UF-IFAS Featured Creatures website

**External identifiers for *Apis mellifera***

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|---|---|
| Encyclopedia of Life | 1045608 (http://www.eol.org/pages/1045608) |
| ITIS | 154396 (http://www.itis.gov/servlet/SingleRpt/SingleRpt?search_topic=TSN&search_value=154396) |
| NCBI | 7460 (http://www.ncbi.nlm.nih.gov/Taxonomy/Browser/wwwtax.cgi?mode=Info&id=7460) |

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