Africanized bee

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The **Africanized bee**, also known as the **Africanised honey bee**, and known colloquially as "**killer bee**", is a hybrid of the Western honey bee species (*Apis mellifera*), produced originally by cross-breeding of the African honey bee (*A. m. scutellata*), with various European honey bees such as the Italian bee *A. m. ligustica* and the Iberian bee *A. m. iberiensis*.

The Africanized honey bee was first introduced to Brazil in the 1950s in an effort to increase honey production, but in 1957, 26 swarms accidentally escaped quarantine. Since then, the species has spread throughout South America and arrived in North America in 1985. Hives were found in south Texas of the United States in 1990.[1]

Africanized bees are typically much more defensive than other species of bee, and react to disturbances faster than European honey bees. They can chase a person a quarter of a mile (400 m); they have killed some 1,000 humans, with victims receiving ten times more stings than from European honey bees.[2] They have also killed horses and other animals.[3]

Africanized bee	
	
Scientific classification	
Kingdom:	Animalia
Phylum:	Arthropoda
Class:	Insecta
Order:	Hymenoptera
Suborder:	Apocrita
Subfamily:	Apinae
Tribe:	Apini
Genus:	*Apis*
Species:	*Apis mellifera*
Subspecies	
HYBRID (see text)	

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History

There are 28 recognized subspecies of *Apis mellifera* based largely on geographic variations. All subspecies are cross-fertile. Geographic isolation led to numerous local adaptations. These adaptations include brood cycles synchronized with the bloom period of local flora, forming a winter cluster in colder climates, migratory

swarming in Africa, enhanced (long-distance) foraging behavior in desert areas, and numerous other inherited traits.

The Africanized honey bees in the Western Hemisphere are descended from hives operated by biologist Warwick E. Kerr, who had interbred honey bees from Europe and southern Africa. Kerr was attempting to breed a strain of bees that would produce more honey and be better adapted to tropical conditions (i.e., more productive) than the European strain of honey bee currently in use throughout North, Central and South America. The hives containing this particular Africanized subspecies, were housed at an apiary near Rio Claro, São Paulo, in the southeast of Brazil and were noted to be especially defensive. These hives had been fitted with special excluder screens (called queen excluders) to prevent the larger queen bees and drones from getting out and mating with the local population of European bees. According to Kerr, in October 1957 a visiting beekeeper, noticing that the queen excluders were interfering with the worker bees' movement, removed them resulting in the accidental release of 26 Tanganyikan swarms of *A. m. scutellata*. Following this accidental release, the Africanized swarms spread out and cross-bred with local European colonies; their descendants have since spread throughout the Americas. Because their movement through South and Central America was rapid and largely unassisted by humans, Africanized bees have earned the reputation of being one of the most successful biologically invasive species of all time.

The first Africanized bees in the US were discovered in 1985 at an oil field in the San Joaquin Valley of California. "Bee experts theorized the colony had arrived hidden in a load of oil-drilling pipe shipped from South America."[4] The first permanent colonies arrived in Texas, from Mexico, in 1990. In the Tucson region of Arizona, a study of trapped swarms in 1994 found that only 15 percent had been Africanized; this number had grown to 90 percent by 1997.[5]

Though Africanized bees display certain behavioral traits that make them less than desirable for commercial beekeeping, excessive defensiveness and swarming foremost, they have now become the dominant type of honey bee for beekeeping in Central and South America due to their genetic dominance as well as ability to out-compete their European counterpart, with some beekeepers asserting that they are superior honey producers and pollinators.

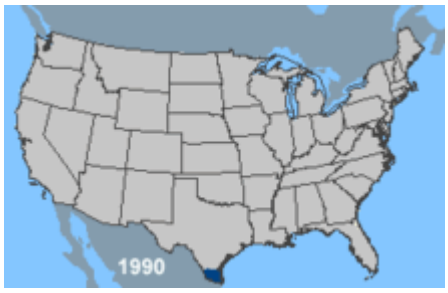
The major differences between Africanized and other Western bee types are:

- Tends to swarm more frequently and go farther than other types of honey bees.
- Is more likely to migrate as part of a seasonal response to lowered food supply.
- Is more likely to "abscond"—the entire colony leaves the hive and relocates—in response to stress.
- Has greater defensiveness when in a resting swarm, compared to other honey bee types.
- Lives more often in ground cavities than the European types.
- Guards the hive aggressively, with a larger alarm zone around the hive.
- Has a higher proportion of "guard" bees within the hive.
- Deploys in greater numbers for defense and pursues perceived threats over much longer distances from the hive.
- Cannot survive extended periods of forage deprivation, preventing introduction into areas with harsh winters or extremely dry late summers.

Geographic spread throughout North America

African honeybees are considered an invasive species in the Americas. As of 2002, the Africanized honeybees had spread from Brazil south to northern Argentina and north to Central America, Trinidad (West Indies), Mexico, Texas, Arizona, Nevada, New Mexico, Florida, and southern California. Their expansion stopped for a time at eastern Texas, possibly due to the large population of honey bee hives in the area. However, discoveries of the Africanized bees in southern Louisiana indicate this subspecies has penetrated this barrier,[6] or has come as a swarm aboard a ship.

In June 2005, it was discovered that the bees had penetrated the border of Texas and had spread into southwest Arkansas. On September 11, 2007, Commissioner Bob Odom of the Louisiana Department of Agriculture and Forestry said that Africanized honey bees established themselves in the New Orleans area.[7] In February 2009,



Map showing the spread of Africanized honey bees in the United States from 1990 to 2003

Africanized honeybees were found in southern Utah.[8][9] The bees had spread into eight counties in Utah, as far north as Grand and Emery counties by May 2017.[10]

In October 2010, a 73-year-old man was killed by a swarm of Africanized honey bees while clearing brush on his south Georgia property, as determined by Georgia's Department of Agriculture. In 2012 state officials reported that a colony was found for the first time in a bee keepers colony in Monroe County, eastern Tennessee.[11] In June 2013, 62-year-old Larry Goodwin of Moody, TX was killed by a swarm of bees.[12]

In May, 2014 Colorado State University confirmed that bees from a swarm which had aggressively attacked an orchardist near Palisade, in West Central Colorado, were from an Africanized hive - and the hive was subsequently destroyed.[13]

In tropical climates they effectively out-compete European bees and, at their peak rate of expansion, they spread north at a rate of almost two kilometers (about one mile) a day. There were discussions about slowing the spread by placing large numbers of docile European-strain hives in strategic locations, particularly at the Isthmus of Panama, but various national and international agricultural departments were unable to prevent the bees' expansion. Current knowledge of the genetics of these bees suggests that such a strategy, had it been attempted, would not have been successful.[14]

As the Africanized honeybee migrates further north, colonies continue to interbreed with European honeybees. In a study conducted in Arizona in 2004 it was observed that swarms of Africanized bees were capable of taking over weakened European honey bee hives by invading the hive, then killing the European queen and establishing their own queen.[15] There are now relatively stable geographic zones in which either African bees dominate, a mix of African and European bees is present, or only non-African bees are found, as in the southern portions of South America or northern North America.


Bee hive on Gila River Indian Community land

African honeybees abscond (abandon the hive and any food store to start over in a new location) more readily than European honeybees. This is not necessarily a severe loss in tropical climates where plants bloom all year but in more temperate climates it can leave the colony with insufficient stores to survive the winter. Thus Africanized bees are expected to be a hazard mostly in the Southern States of the United States, reaching as far north as the Chesapeake Bay in the east. The cold-weather limits of the African bee have driven some professional bee breeders from Southern California into the harsher wintering locales of the northern Sierra Nevada and southern Cascade Range. This is a more difficult area to prepare bees for early pollination placement in, such as is required for the production of almonds. The reduced available winter forage in northern California means that bees must be fed for early spring buildup.

The arrival of the Africanized honey bee in Central America is threatening the ancient art of keeping *Melipona* stingless bees in log gums even though they do not interbreed or directly compete with each other. The honey production from a single hive of Africanized bees can be 100 kg annually and far exceeds the much smaller 3–5 kg of the various *Melipona* stingless species. Thus economic pressures are forcing beekeepers to switch from the traditional bees of their ancestors to the new reality of the Africanized honey bee. Whether this will lead to their extinction is unknown, but they are well adapted to exist in the wild, and there are a number of indigenous plants that the Africanized honey bees do not visit, so their fate remains to be seen.

Foraging behavior

Africanized honey bees have a set of characteristics with respect to foraging behavior. Africanized honey bees begin foraging at young ages and harvest a greater quantity of pollen with respect to their European counterparts (*Apis mellifera*). This may be linked to the high reproductive rate of the Africanized honey bee which requires pollen to feed the greater number of larvae.[16] Africanized honey bees are also sensitive to sucrose at lower concentrations. This adaptation causes foragers to harvest resources with low concentrations of sucrose that include water, pollen, and unconcentrated nectar. A study comparing *A. m. scutellata* and *A. m. ligustica* published by Fewell and Bertram in 2002 suggests that the differential evolution of this suite of behaviors is due to the different environmental pressures experienced by African and European subspecies.[17]

Variation in honey bee proboscis extension response

Africanized honey bees pollinate an Opuntia engelmannii-Yellow Cactus Flower, in the Mojave desert

Honey bee sensitivity to different concentrations of sucrose is determined by a reflex known as the proboscis extension response or PER. Different species of honey bees that employ different foraging behaviors will vary in the concentration of sucrose that elicits their proboscis extension response.[18]

For example, European honey bees (Apis mellifera) forage at older ages and harvest less pollen and more concentrated nectar. The differences in resources emphasized during harvesting are a result of the European honey bee's sensitivity to sucrose at higher concentrations.[19]

Evolution of foraging behavior in honey bees

The differences in a variety of behaviors between different species of honey bee are the result of a directional selection that acts upon several foraging behavior traits as a common entity.[19] Selection in natural populations of honey bee show that positive selection of sensitivity to low concentrations of sucrose are linked to foraging at younger ages and collecting resources low in sucrose. Positive selection of sensitivity to high concentrations of sucrose were linked to foraging at older ages and collecting resources higher in sucrose.[19] Additionally of interest, “change in one component of a suite of behaviors appear[s] to direct change in the entire suite.”[19]

Proximate causes

There are multiple ways of considering the cause of directional selection on this set of foraging behaviors in honey bees. A proximate factor is one that is developmental and influential on behavior within the lifetime of an organism.[20] Neurological and developmental differences lead to directional selection and changes in the set of foraging behaviors between generations of honey bees. Levels of stress as measured by levels of octopamine is one such contributing developmental factor.[19]

Ultimate causes

An ultimate factor is one that explains long term evolutionary advantages of behavior in an organism.[20] Proboscis extension response to different concentrations of sucrose is a genotypic trait; the genes vary with respect to the sucrose concentration level at which proboscis extension response is manifested. Natural selection is able to directly shift the set of foraging behaviors by operating on the distribution of these genes in the honey bee population.[19]

When resource density is low in Africanized honey bee habitats, it is necessary for the bees to harvest a greater variety of resources because they cannot afford to be selective. Honey bees that are genetically inclined towards resources high in sucrose like concentrated nectar will not be able to sustain themselves in harsher

environments. The noted PER to low sucrose concentration in Africanized honey bees may be a result of selective pressure in times of scarcity when their survival depends on their attraction to low quality resources.[21]

Morphology and genetics

An African bee extracts nectar from a flower as pollen grains stick to its body in Tanzania. (This is a purebred African bee, not an 'Africanized' hybrid bee.)

The popular term "killer bee" has only limited scientific meaning today because there is no generally accepted fraction of genetic contribution used to establish a cut-off. Although the native African *Apis mellifera scutellata* are smaller, and build smaller comb cells than the European bees, their hybrids are not smaller. Africanized bees have slightly shorter wings, which can only be recognized reliably by performing a statistical analysis on micro-measurements of a substantial sample. One problem with this test is that there are also other subspecies, such as *Apis mellifera iberiensis*, which have shorter wings. This trait is thought to derive from ancient hybrid haplotypes thought to have links to evolutionary lineages from Africa. Some belong to *Apis mellifera intermissa* but others have an indeterminate origin; the *Egyptian honeybee* (*Apis mellifera lamarckii*), present in small numbers in the southeastern United States, has the same morphology. Currently testing techniques have moved away from external measurements to DNA analysis, but this means the test can only be done by a sophisticated laboratory. Molecular diagnostics using the mitochondrial DNA (mtDNA) cytochrome b gene can differentiate *A. m. scutellata* from other *A. mellifera* lineages, though mtDNA only allows one to detect an Africanized colony that has an Africanized queen, and not colonies where a European queen has mated with Africanized drones.[22] A test based on single nucleotide polymorphisms has recently been created to detect Africanized bees based on the proportion of African and European ancestry.[23]

The Western honey bee is native to the continents of Europe, Asia, and Africa. As of the early 1600s, the insect was introduced to North America, with subsequent introductions of other European subspecies two centuries later.[24] Since then, they have spread throughout the Americas. The 28 subspecies can be assigned to one of four major branches based on work by Ruttner and subsequently confirmed by analysis of mitochondrial DNA. African subspecies are assigned to branch A, northwest European subspecies to branch M, southwest European subspecies to branch C, and Mideast subspecies to branch O. The subspecies are grouped and listed. There are still regions with localized variations that may become identified subspecies in the near future, such as *A. m. pomonella* from the Tian Shan mountains, which would be included in the Mideast subspecies branch.

The Western honey bee is the third insect to have its genome mapped, and is unusual in having very few transposons. According to the scientists who analyzed its genetic code, the western honey bee originated in Africa and spread to Eurasia in two ancient migrations.[25] They have also discovered that the number of genes in the honey bees related to smell outnumber those for taste.[26] The genome sequence revealed several groups of genes, particularly the genes related to circadian rhythms, were closer to vertebrates than other insects. Genes related to enzymes that control other genes were also vertebrate-like.[27]

The A. m. iberica haplotype is present in the honey bees of the western United States,[28] Mexico and South America, where the honey bees are not native. They were introduced from Spain during the conquest of America, from populations of indeterminate origin with African haplotypes. Apis mellifera iberica is a hybrid between the North African and European bees, Apis mellifera mellifera, and Apis mellifera intermissa.[29] Presents six haplotypes different, five of them correspond to an evolutionary lineage from Africa and one from Western Europe. From this, infer the hybrid nature of this subspecies, is similar to that of African populations in the number of alleles detected and the values of genetic diversity. Additionally *A.m.intermissa* genoma, present in *A.m.iberica* belongs to a group shown by experiment to have similar mtDNA, this including *A. m. monticola*, A. m. scutellata, *A. m. adansonii* and *A. m. capensis*.[30][31][32]

There are two lineages of African subspecies *Apis mellifera scutellata* in the Americas: actual matrilinial descendants of the original escaped queens and a much smaller number that are African through hybridization. The matrilinial descendants carry African mtDNA, but partially European nuclear DNA, while the bees that are African through hybridization carry European mtDNA, and partially African nuclear DNA. The matrilinial descendants are in the vast majority. This is supported by DNA analyses performed on the bees as they spread northwards; those that were at the "vanguard" were over 90% African mtDNA, indicating an unbroken matriline,[33] but after several years in residence in an area interbreeding with the local European strains, as in Brazil, the overall representation of African mtDNA drops to some degree. However, these latter hybrid lines (with European mtDNA) do not appear to propagate themselves well or persist.[34] Population genetics analysis of Africanized honey bees in the United States, using a materially inherited genetic marker, found 12 distinct mitotypes, and the amount of genetic variation observed supports the idea that there have been multiple introductions of AHB into the United States.[35]

Consequences of selection

The chief difference between the European races or subspecies of bees kept by beekeepers and the African stock is attributable to both selective breeding and natural selection. By selecting only the most gentle, non-defensive races, beekeepers have, over centuries, eliminated the more defensive races and created a number of subspecies suitable for apiculture. The most common race used in Europe and the United States today is the Italian bee, *Apis mellifera ligustica*, which has been used for over a thousand years in some parts of the world and in the Americas since the arrival of the European colonists.

In central and southern Africa there was formerly no tradition of beekeeping, and the hive was destroyed in order to harvest the honey, pollen and larvae. The bees adapted to the climate of sub-Saharan Africa, including prolonged droughts. Having to defend themselves against aggressive insects such as ants and wasps, as well as voracious animals like the honey badger, African Bees evolved as a race of highly defensive bees unsuitable by a number of metrics for domestic use.

As Africanized bees migrate into regions, hives with an old or absent queen can become hybridized by cross-breeding. The aggressive Africanized drones outcompete European drones for a newly developed queen of such hive, ultimately resulting in hybridization of the existing colony. Requeening, a term for swapping out the old queen with a new, already fertilized one, can reduce hybridization in apiaries. As a prophylactic measure, the majority of beekeepers in North America tend to requeen their hives annually, maintaining strong colonies and avoiding hybridization.

Defensiveness

Africanized bees exhibit far greater defensiveness than European honey bees, and are more likely to attack a perceived threat by relentless attacking in large swarms. These hybrids have been known to pursue a perceived threat for a distance of well over 500 meters (1640 ft).

The venom of an Africanized bee is the same as that of a European honey bee, but since the former tends to sting in far greater numbers, the number of deaths from them are naturally greater than from European honey bees.[36] While allergies to the European honey bee may cause death, death and complications from African bee stings are usually not caused from allergies to their venom. Humans stung many times by the African honey bees can exhibit serious side effects such as inflammation of the skin, dizziness, headaches, weakness, edema, nausea, diarrhea, and vomiting. Some cases even progress to affect different body systems by causing increased heart rates, respiratory distress, and even renal failure.[37][38] African bee sting cases can become very serious, but they remain relatively rare and are often limited to accidental discovery in populated areas.

Impact on human population

Fear factor

The Africanized bee is widely feared by the public,[39] a reaction that has been amplified by sensationalist movies (such as *The Swarm*) and some of the media reports. Stings from Africanized bees kill on average one or two people per year.[40]

As the bee spreads through Florida, a densely populated state, officials worry that public fear may force misguided efforts to combat them.

> News reports of mass stinging attacks will promote concern and in some cases panic and anxiety, and cause citizens to demand responsible agencies and organizations to take action to help ensure their safety. We anticipate increased pressure from the public to ban beekeeping in urban and suburban areas. This action would be counter-productive. Beekeepers maintaining managed colonies of domestic European bees are our best defense against an area becoming saturated with AHB. These managed bees are filling an ecological niche that would soon be occupied by less desirable colonies if it were vacant.
>
> — Florida African Bee Action Plan[41]

Misconceptions

The sting of the Africanized bee is no more potent than any other variety of honey bee, and although they are similar in appearance to European bees, they actually tend to be slightly smaller and darker in color. Although Africanized bees do not search for humans to attack, they are more dangerous because they are more easily provoked, quicker to attack in greater numbers, and then pursue the perceived threat farther, sometimes for up to a kilometer (approx. 5/8 mile) or more. While studies have shown that Africanized bees can infiltrate European bee colonies and then kill and replace their queen (thus usurping the hive), this is less common than other methods. Wild and managed colonies will sometimes be seen to fight over honey stores during the dearth (periods when plants are not flowering), but this behavior should not be confused with the aforementioned activity. The most common way that a European hive will become Africanized is through cross-breeding during a new queen's mating flight. Studies have consistently shown that Africanized drones are more numerous, stronger and faster than their European cousins and are therefore able to out-compete them during these mating flights. The results of mating between Africanized drones and European queens is almost always Africanized offspring.[42]

Impact on existing apiculture

In areas of suitable temperate climate, the survival traits of Africanized colonies help them outperform European honey bee colonies. They also return later and basically work under conditions that often keep European bees hive-bound. This is the reason why they have gained a well-deserved reputation as superior honey producers, and those beekeepers who have learned to adapt their management techniques now seem to prefer them to their European counterparts. Studies show that in areas of Florida that contain Africanized honey bees, the honey production is higher than in areas in which they do not live.[43] It is also becoming apparent that Africanized bees have another advantage over European bees in that they seem to show a higher resistance to several health issues including parasites such as *Varroa destructor*, some fungal diseases like chalkbrood and even the mysterious colony-collapse disorder which is currently plaguing beekeepers. So despite all its negative factors, it is possible that the Africanized honey bee might actually end up being a boon to apiculture.

Queen management in Africanized bee ar eas

In areas where Africanized bees are well established, purchased and pre-fertilized (i.e. mated) European queens can be used to maintain a hive's European genetics and behavior. However, this practice can be expensive since these queens must be purchased and shipped from breeder apiaries in areas which are completely free of Africanized bees, such as northern U.S. states or Hawaii. As such this is generally not practical for most commercial beekeepers outside of the U.S. and one of the main reasons why Central and South American

beekeepers have had to learn to manage and work with the existing Africanized honey bee. Any effort to cross-breed virgin European queens with Africanized drones will result in the offspring exhibiting Africanized traits; only 26 escaped swarms in 1957, and nearly six decades later there does not appear to be a lessening to any noticeable degree of the typical Africanized characteristics.

Gentle Africanized bees

Not all Africanized hives display the typical hyper-defensive behavior, which may provide bee breeders a point to begin breeding a gentler stock.[44] Work has been done in Brazil towards this end, but in order to maintain these traits, it is necessary to develop a queen breeding and mating facility in order to requeen colonies and to prevent reintroduction of unwanted genes or characteristics through unintended cross-breeding with feral colonies. In Puerto Rico, some bee colonies are already beginning to show more gentle behavior. This is believed to be because the more gentle bees contain genetic material that is more similar to the European honey bee although they also contain African honey bee material.[45] Also while bee incidents are much less common than they were during the first wave of Africanized bee colonization, this can be largely attributed to modified and improved bee management techniques. Prominent among these are locating bee-yards much further from human habitation, creating barriers to keep livestock at enough of a distance to prevent interaction, and education of the general public to teach them how to properly react when feral colonies are encountered and what resources to contact. The Africanized bee is considered the bee of choice for beekeeping in Brazil.

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Further reading

- Collet T.; Ferreira K.M.; Arias M.C.; Soares A.E.E.; Del Lama M.A. (2006). "Genetic structure of African honeybee populations (*Apis mellifera* L.) from Brazil and Uruguay viewed through mitochondrial DNA COI–COII patterns". *Heredity*. **97** (5): 329–335. PMID 16955114. doi:10.1038/sj.hdy.6800875.

External links

- Africanized Bee Fact Sheet includes information on biology, habits, habitat and prevention tips
- African honey bee on the UF / IFAS Featured Creatures Web site
- Species Profile- Africanized Honeybee (*Apis mellifera scutellata Lepeletier*), National Invasive Species Information Center, United States National Agricultural Library. Lists general information and resources for Africanized Honeybee.
- The short film *Africanized Bee Alert (1985)* is available for free download at the Internet Archive