

**Armed Forces Pest Management Board
Technical Guide No. 34**

Bee Resource Manual with Emphasis on the Africanized Honey Bee



**Published and Distributed by the
Armed Forces Pest Management Board
US Army Garrison—Forest Glen
2460 Linden Lane, Building 172
Silver Spring, MD 20910-1230**

**Office of the Under Secretary of Defense
(Acquisitions and Sustainment)**

November 2013

Revised December 2016

All the publicity about Africanized bees, from killer bee honey to tabloid journalism, may actually have helped the beekeeping industry. The movies, books, and press reports have brought bees to the public's attention, and beekeepers have capitalized on this notoriety to make their point that bees are a critical part of North American agriculture, particularly with regard to crop pollination. We can expect a new wave of publicity as the bees spread through the southern United States, but let us hope that the scare stories have run their course. It is time for responsible journalism to take over; we need sound, accurate information about bees in general, and especially about Africanized bees. Beyond that, the factual story of the Africanized bees is as riveting as the lurid sting tales. Frightening the public is easy, informing it is more difficult; but it is information, not horror that is needed now. The media created and exaggerated the killer bee monster; it is time to reduce it to its true size.

— Mark L. Winston, *Killer Bees, The Africanized Honey Bee in the Americas*, Harvard University Press, 1992.

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Acknowledgements

Most of the information in the first (1995) edition of this Technical Guide was compiled by Charles L. Cole, Professor and Extension Entomologist, and Millisa A. Rowell, Extension Assistant, Texas Agricultural Extension Service, Riverside Campus, Box 2150, Bryan, Texas 77806-2150. Permission to use their findings for Department of Defense purposes is greatly appreciated. Thanks also to LCDR H. R. Stevenson and LTC William J. Sames, IV for additional data used to produce this Guide.

The 2013 edition of TG 34 was the responsibility of 1LT Tyler W. Ito, U.S. Army Public Health Command Region – South, with external reviews by the voting members of the AFPMB's Medical Entomology Committee and editing by Dr. Richard G. Robbins, Information Services Division/AFPMB. Mr. David W. Hill, AFPMB IT Net Administrator, formatted this document for the Internet.

Introduction

Since their introduction into the Americas in the late 1950s, Africanized honey bees have received a great deal of attention concerning their impact on human welfare. More often than not, Africanized or "killer" bees have been depicted as bloodthirsty beasts out to sterilize their expanding habitat of nearly anything that moves. In reality, research and experience have taught us that Africanized honey bees (AHBs) warrant concern but certainly not hysteria, which may lead to unwise management decisions.

What are Africanized bees and what is their significance? Africanized bees are simply a strain of *Apis mellifera*, the same species introduced from Europe that produces our honey and pollinates many of our plants. An African strain was introduced to South America in an effort to produce a bee better suited to the tropics. Honey bees aren't native to the Americas, and the European bees introduced up to that point were poorly adapted to tropical environments. African bees were brought to Brazil in 1956 by biologists wanting to create an African/European hybrid that would perform well in the South American climate. But in 1957 measures to contain the colonies were accidentally removed and several swarmed into the countryside.

The newly released AHBs survived exceptionally well in South America – so well, in fact, that they quickly displaced existing European strains, even those maintained by commercial beekeepers. But as they spread, problems arose and the differences between the domesticated European bees and AHBs soon became apparent:

1. Africanized bees are extremely sensitive to the slightest disturbance, and the hive responds with massive and persistent stinging attacks.
2. Africanized bees are difficult to manage and have a strong tendency to leave existing hives (abscond) and settle elsewhere.
3. Africanized bees, although better at surviving in the tropics, are poor producers of surplus honey.

By the time these negative aspects were understood, the Africanized strain had already established a permanent presence in the Americas and soon spread north to Central America, Mexico and, eventually, the southern United States.

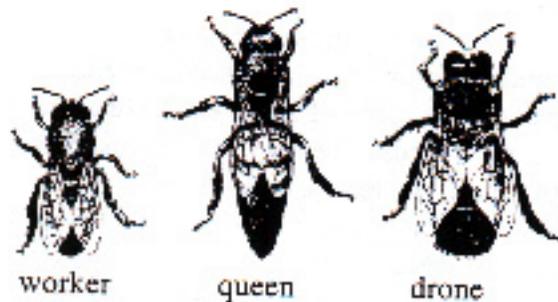
Although AHBs weren't the monsters seen in popular fiction, people and endemic animals in the Americas were unfamiliar with their aggressive response and this has led to the deaths of hundreds of people and animals. South Americans soon learned to live with the bees. For example, the highest recorded number of fatalities due to AHB attacks in Venezuela was nearly a hundred people in 1978, but those numbers dropped to twenty by 1985. Beekeepers learned to take proper precautions and Venezuelans became familiar with potential dangers.

AHBs are a real and significant threat for those who must live with them, but they can be dealt with as long as the appropriate precautions and control measures are taken. This Technical Guide has been developed with the assistance of the Texas Agricultural Extension Service to provide DoD pest management and public health officials with an understanding of honey bee biology, the potential impact of AHBs, and the measures we must undertake to assure the well-being of our personnel.

Biology and Habits of the Honey Bee

Biology

The honey bee undergoes complete metamorphosis, passing through four stages: egg, larva, pupa, and adult. Bees develop into three different castes: workers, queens, and drones.



Developmental time and longevity vary with each caste and among races. [Table 1](#) shows the difference between AHBs and EHBs. When honey bees emerge as adults, they continue to develop. At first their body is soft, but the cuticle hardens in about 12-24 hours. During the next few days, glands and reproductive organs (in the queens and drones) develop and mature. Drones produce semen in about 12 days and queens begin to lay eggs about three days after mating. In a typical colony there will be only one laying queen, 100-300 drones, and 20,000-60,000 workers.

When mature, virgin queens take a mating flight and mate with 10-15 drones. About three days later the queen begins to lay eggs. A queen may lay as many as 1,500 eggs in a single day and around 200,000 eggs in a year. The queen controls whether or not the eggs are fertilized, using sperm stored in her spermatheca. Fertilized eggs develop into females (workers) and unfertilized eggs develop into males (drones). About 99 percent of the eggs laid by a queen are fertilized and develop into workers.

Habits

Swarming:

Swarming is a form of reproduction at the colony level and is also a natural means of honey bee dispersion. A new honey bee colony is established when a swarm leaves their parent colony to seek out a new nesting site. A swarm contains the original queen and takes with it 50-90% of the parent colony population. After leaving the colony, a swarm can travel a few to several hundred yards until clustering on a low hanging tree limb or structure. While the swarm is clustered at their temporary location, scout bees search and agree on a suitable nesting site for the establishment of a new colony. Swarms may stay in their temporary location for a few hours to a few days. However, if the scout bees are unable to find a suitable nesting site, the swarm may start constructing their combs on the tree limb or structure they have clustered on.

Swarms in the frenzy of flight can be terrifying to the uninitiated, but it is during swarming that honey bees are least defensive. While the swarm is clustered, beekeepers can easily hive the bees, and then transport the colony to another location. Honey bee "swarming season" is often a 4-6 week period and occurs typically in late spring or early summer.

Abscending:

Abscending is a behavioral trait of all honey bees. It is much more common in the AHB than in the EHB. Abscending occurs when all the adult bees, including the queen, workers and drones, leave the old nest and relocate to a new site. Abscending is usually the result of a severe disturbance, such as predator activity, flooding, starvation, or other major stress factors. Abscending bees may travel 30-50 miles before finding a suitable nest site. Long flights may have to be interrupted several times to forage for food.

Food Gathering:

Worker bees forage for nectar, pollen, propolis, and water. They bring these raw materials back to the colony for use or storage. Nectar is converted from sucrose, a complex sugar, into fructose and glucose, simple sugars, by enzyme activity in the bee's "honey stomach." Then it is dehydrated from 60-65% water to the 17-20% water found in ripe honey.

Honey bees greatly depend on pollen as their main source of proteins, fatty substances, minerals, and vitamins. Pollen is an essential component in the production of larval food for healthy brood development. Worker bees collect pollen from the anthers of flowers by dislodging and then packing the pollen grains into "pollen baskets" located on their hind legs. The bee returns to the hive and then deposits the pollen load into a cell.

Worker bees also forage for propolis, often called "bee glue." Propolis is tree resin, brown and gummy in nature, that is collected from the buds of trees. It may be mixed with wax and used to seal cracks or sometimes encase objects that are too large for cleaning bees to remove from the hive.

Water is collected by foragers and has three important functions in the colony: to dilute thick honey, to maintain the desired humidity in the hive, and to maintain the proper temperature.

Robbing:

Robbing is a type of foraging behavior where bees from one colony take honey from other nearby colonies. This often occurs when nectar is scarce or unavailable, or when there are weak colonies next to stronger colonies. Robbing further weakens already ill colonies and may contribute in the spread of diseases and parasites.

Defensive Behavior:

Stinging is a defensive behavior. Virtually all defensive behavior occurs in the immediate vicinity of the hive. Away from the hive, bees literally have to be forced to sting. Swarming bees are rarely defensive and do not sting unless provoked. However, "hunger swarms" or absconding bees are usually very defensive and are frequently the cause of stinging incidents.

A bee's stinger is barbed so that when it stings, the stinger, poison sac, surrounding muscles and nerves are torn from its body. Thus, a bee can sting only once, after which it soon dies. After the bee has departed, the stinger will continue to pump venom until the poison sac empties. An alarm pheromone (odor) is also released that will attract other bees to the area and prompt an aggressive response, thus increasing the chances of additional stinging. This alarm odor is detectable to humans and has a scent similar to banana oil. The alarm pheromone response is one of the biggest factors in the AHB's excessive stinging characteristic.

Stimuli that have a tendency to increase the defensive behavior of bees include sudden and rapid movements, jarring or bumping hives or frames, vibrations and noise such as operating lawn mowers or tractors, odors (both good and bad), and dark colors. Bees are also more defensive in cooler, cloudy weather.

Several basic differences exist between the activities and habits of temperate honey bees (European strains) and tropical honey bees (the Africanized strain). These are listed in [Table 2](#).

Africanization of the Honey Bee

The Africanized honey bee is simply a hybrid honey bee, a result of breeding the European honey bee, *Apis mellifera mellifera*, with the African honey bee, *Apis mellifera scutellata*. The genetic differences in the hybrid Africanized bee make its habits different from those of the domestic European honey bee cultured in the United States.

Africanization

The AHB is the same species of honey bee commonly cultured for honey and wax production and for pollination services. It is a hybrid resulting from crossing a tropical (African) strain and a temperate (European) strain of honey bee. These two strains have been isolated genetically for more than 2,000 years. They have been separated environmentally by more than 70 degrees of latitude and geographically by the Sahara Desert. Each strain has developed its own particular habits.

For more than 300 years honey bees have been bred in the Americas. Honey bee breeding programs have used genetic material from all over the world, including Africa, but have concentrated mostly on European strains. Desired characteristics include winter hardiness, tendency not to swarm, gentleness, low drone production, and other valuable traits.

The African strain of the honey bee is a tropical bee and has been selected by nature more than by man. African bee strains tend to be more defensive, swarm more often, and don't conform as well to our "American" bee management practices.

In 1956, a Brazilian researcher traveled to Africa in search of new genetic material for the Brazilian bee breeding program. Temperate bees had not adapted well to conditions in Brazil, and researchers were therefore seeking a bee that would survive and be more productive in Brazil's tropical climate. A total of 170 African queens were collected and sent to Brazil. Of these, 48 survived the trip and were introduced into colonies at the research station in São Paulo. In 1957, queen excluders were accidentally removed from the entrances of 26 colonies. These colonies soon swarmed and established feral colonies in the area. The breeding program continued into the 1970s, with African bees and hybrid queens being widely distributed among beekeepers in southern Brazil. Brazilian scientists recognized the problems with the AHB and proposed management practices that would alleviate them. A survey of beekeepers showed that some had quit the business due to difficulties in managing these bees. Among beekeepers remaining in business, there was a preference for the AHB because of its high productivity.

Once released into nature, the AHB spread throughout Brazil by swarming and absconding. It moved south to about 32 degrees latitude. It continued its spread northward, through Central America and Mexico at 200-300 miles a year, reaching Panama in 1980, Mexico in 1985, and the United States in 1990 ([Figure 1](#)).

In advance of the natural spread of the AHB, numerous "man-assisted" swarms were detected in the United States. The man-assisted AHB swarms occurred as early as 1979 and as far north as Baltimore, MD, and Strong Point, NY. Upon detection, these swarms were eliminated, thus preventing the establishment of the AHB in the United States at that time.

The name "Killer Bee" evolved in a unique way. It was first used in 1965 by Time Magazine when recapping a press release from the Brazilian military, which at the time

was trying to discredit certain scientists by reporting all stinging incidents, including those from wasps, as due to the AHB. The name caught on and has been used in at least four movies in the United States, including one called "The Swarm." Newspapers, television, and radio have used the name in headlines and in bold print. This has created not only an awareness of the bee but in some instances near hysteria. Mike Allsopp, with the Agricultural Research Council in South Africa, wrote "In my opinion the entire AHB saga is one dominated by paranoia and misinformation." Mark Winston, Professor of Biological Sciences at Simon Fraser University and author of "Killer Bees, The Africanized Honey Bee in the Americas," in referring to the printed media, books and movies, has written "There is no pretense of accuracy, and imagination has taken over to bring us wildly exaggerated horror stories that play on our innate fear of stinging insects."

Ironically, the paranoia created by misinformation and exaggeration could mask some real problems associated not only with the AHB but also with the EHB, wasps, and other stinging insects.

Characteristics of the AHB

A number of specific behavioral characteristics have been identified in the AHB.

Aggressive Hive Defense and Stinging:

Although the AHB does not attack unprovoked, it is very defensive of its colony. When compared to the EHB, it is much easier to provoke and is extremely sensitive to the slightest disturbances. The AHB responds quicker and in larger numbers when its colony is threatened. Also, once provoked, the AHB remains agitated for a longer period of time and pursues perceived threats over a greater distance (approximately 400 meters) than does the EHB. Disturbing an AHB colony may result in 6-10 times as many stings as European bees inflict. This phenomenon is attributed to the AHB's more acute sensitivity and response to the "alarm pheromone," a chemical odor that is released after stinging is initiated.

Excessive Swarming:

The AHB will swarm more frequently than the EHB. Typically, an EHB colony swarms once every year or two; an AHB colony may swarm 4-8 times a year. Generally, an AHB swarm is much smaller than an EHB swarm; some aren't much larger than a coffee cup. Swarming reduces the number of bees in a colony, thus reducing the work force, resulting in diminished honey production. Management practices directed at reducing swarming, such as dividing large colonies into smaller colonies and frequent harvesting of honey, add costs for beekeepers.

Excessive Absconding:

While absconding is rare in the EHB, it's rather common with the AHB. Absconding not only results in loss of a managed colony but adds to the feral population competing with managed bees for nectar and pollen.

Selection of Nesting Site:

EHBs are very particular in selecting nesting sites. They prefer hollow trees, wall voids or other cavities (about 10 gallons in size) well above the ground that are clean and dry. The AHB will nest almost anywhere that is protected from the weather. Selected sites are often much smaller, closer to the ground, and may not be as protected from the elements. This lack of selectivity is thought by some to be due to greater competition resulting from the larger number of AHB swarms.

Reproductive Capacity:

Compared with the EHB, the AHB devotes a greater percentage of its nest to brood production and less to honey storage. Because the developmental period of the AHB is shorter than that of the EHB, it's able to produce more bees in less time.

Number of Feral Colonies:

In areas where the AHB has become established, a noticeable increase in the number of feral honey bee colonies occurs. This is generally thought to be the result of higher reproductive capacity, increased swarming rate, and tendency to abscond. However, in much of the area where the AHB is now established, feral colonies were extremely rare, probably because the EHBs were not adapted to the tropical climate. This marked increase of feral colonies may not be as great in an area where feral bees are common.

Winter Survival:

Since the AHB is tropical in nature, it may not be able to regulate its body temperature as efficiently as the EHB. Studies indicate that the AHB does not form as efficient a cluster during cold weather as the EHB.

Colony Takeover:

Many researchers have reported that AHB swarms often take over EHB colonies, particularly colonies that do not have functional queens. However, EHB swarms will do the same. The importance of such takeovers is questionable. Work by researchers at the University of Georgia suggests that hive takeovers are a minor problem.

Mating Advantage:

An AHB colony produces more drones than an EHB colony of equal size. In areas where the AHB has become established, the EHB queens appear to mate with AHB drones at a

much higher frequency than with EHB drones. Similar behavior in areas where large numbers of EHB colonies are maintained is being studied.

Identification

Identifying the different races of honey bees and their hybrids is very difficult. The characteristics used for identification differ only slightly and overlap considerably among individuals. Accurate identification is not only difficult but time-consuming and expensive.

Rapid and accurate identification of AHB and EHB strains is very important for monitoring the presence and spread of bees through an area. This element is essential in implementing regulatory and management actions involving AHBs. Several techniques have been used to identify AHB, though none are 100 percent effective. They include:

1. **Morphometrics:** This technique utilizes precise measurements of specific body parts. Computer-assisted measurements are made of 25 characters on 10 bees. An average is determined and used to distinguish the EHB from the AHB. Variations of this technique include the Fast Africanized Bee Identification System (FABIS), in which only three characters are measured. The FABIS II technique uses seven measurements.
2. **ELISA Procedure for AHB Proteins:** The ELISA procedure for identifying the AHB uses electrophoresis and isoelectric focusing to identify specific proteins unique to the AHB. About 90% of all AHB contain at least one of these proteins. A sample of three bees can provide an accuracy of 99.9%.
3. **DNA Analysis:** DNA contains the molecular code for genetically inherited characters. Bee DNA can be extracted and used to identify the AHB.
4. **Other Sources:** Other techniques for identifying different strains of the honey bee include cuticular hydrocarbons, flow cytometry, and the use of a portable audiometer.

Monitoring the Natural Dispersion of the AHB with Pheromone Traps

The northward movement of the AHB has been monitored through South and Central America and through Mexico, into Texas and other areas of the U.S. By examining samples of bees taken from pheromone traps, from feral swarms, and from feral colonies, scientists have been able to trace the movement of the AHB. At present, two national agencies monitor AHB populations in the U.S.:

1. The Animal and Plant Health Inspection Service (APHIS), of the USDA.
2. The Agricultural Research Service (ARS), of the USDA.

Medical Aspects of Bees

Although serious reactions from bee venom occur in only a very small percentage of the population, all persons should be aware of the possibility that medical complications may result from stings to themselves, children, and others.

This section addresses the medical aspects of bee stings. It provides information on the venom itself and reactions to the venom. Also included is information on symptoms, first aid, and diagnosis of stings. Specific at-risk groups are discussed as well as what may be done to reduce the risk of interaction with bees. A review of the problems associated with the AHB in Central America and Mexico shows that AHB should not become a significant public health threat anywhere in the United States. Bee venom is toxic ([Chart 1](#)); the lethal dose of bee venom for humans is about 10 stings per pound of body weight, assuming that all of the bee's venom is injected by the sting. Deaths due to the toxic effects of venom received in multiple stings are extremely rare. However, somewhere between 1-4% of the population is hypersensitive to honey bee venom. Some people are so hypersensitive that one sting can be fatal.

Reactions to honey bee stings range from slight pain and swelling to much more serious symptoms, including anaphylaxis ([Chart 2](#)). Physicians, Emergency Medical Services, and other health care personnel are generally well educated in the diagnosis and treatment of bee stings and anaphylaxis.

The venoms of the AHB and the EHB are almost identical. Medical literature provides no evidence suggesting that AHB stings are more toxic than EHB stings. The amount of venom per sting does vary between the AHB and the EHB, with the AHB having approximately 27% less venom per sting, a possible indication that the AHB poison sac is smaller.

In the United States, deaths from all hymenopteran insects (bees, wasps, yellow jackets, fire ants) average between 40 and 50 per year. The arrival of the AHB in the United States has created a public awareness of the health risks associated with the bee. This awareness has provided an opportunity to educate the public on medical aspects of the AHB and the risks associated with all honey bees and other stinging hymenopterans.

The impact of the AHB on public health and on the health of domestic animals will depend on three factors. First, and probably most important, is the amount of contact between the AHB and the public, or their domestic animals. Second, the degree of knowledge the public has about encounters with the AHB, with stinging incidents, and how to deal with them. And third, the availability and quality of medical assistance available. As the AHB progressed through South and Central America and into Mexico, adequate and timely medical assistance was often absent. In the United States, medical assistance from knowledgeable personnel is practically taken for granted. This factor alone will lessen the seriousness of multiple stinging incidents.

Because of increases in numbers of feral bee colonies when the AHB becomes established in an area, and the possible increased interaction with people and animals, the number of stinging incidents should increase, as will the number of people requiring medical treatment. Some predictions estimate stinging incidents increasing by four or five times present levels. The number of serious incidents can be reduced significantly through an intense educational program to inform the general public on how to deal with bees and potential bee problems.

Handling Medical Problems

All persons should know whether or not they are hypersensitive (allergic) to bee and wasp stings. Persons who do not know should see their doctor and be tested. Hypersensitive persons should carry medication when frequenting an area where interaction with bees and wasps may occur. Parents of hypersensitive children should alert school nurses, day care facilities, or babysitters concerning their children's condition, and provide medications where necessary. Hypersensitive persons should inform fellow students, business associates, coworkers, or fellow sports enthusiasts of their condition.

All persons should be familiar with the symptoms of hypersensitivity and, if symptoms occur after being stung, should seek medical attention immediately.

Allergic Reactions

A single bee sting is seldom fatal unless one has a severe allergic reaction. Swelling of the affected area is a normal reaction to bee stings and does not indicate a systemic allergy. Early symptoms of an allergic reaction include a tingling sensation on the palms, bottoms of the feet, tongue and lips, tightening of the throat, dizziness, and nausea. Allergy tests are available but can be expensive. If their normal routine does not bring them in contact with insects, people should not have to take the test. However, beekeepers or other persons who work where bees are present should take the test. As well, fire fighters or police officers who may be answering emergency calls for insect stings should be tested. Allergy testing will determine how sensitive a person is, and will build up the person's immunity with small, regularly scheduled injections of the bee venom. Kits are available as a prescription item for people who are allergic to bee stings. Such kits are equipped with syringes and epinephrine for emergency treatment.

First Aid for Stinging Victims

1. If the victim is showing no signs of dizziness or difficulty in breathing, or has been stung only once, practical first aid measures are:
 - A. Remove sting with a sideways scraping movement of a fingernail, credit card, or dull knife to prevent more venom from being pumped in by the venom sac. Do not use tweezers or squeeze the sting, as this will inject more venom into the victim. The venom from an AHB sting is no more toxic than that of other bees.

- B. Apply a baking soda and cold cream paste, or wet salt. To be most effective, do this within five minutes after the sting.
 - C. Apply an ice pack to relieve pain and calamine lotion to relieve itching.
 - D. Watch for any unusual reaction, such as the appearance of red blotches anywhere on the body within 2 to 20 minutes, or breathing difficulties. People who experience difficulty in breathing after having been stung by any insect must seek medical attention within 15-20 minutes. Administer artificial respiration or CPR if the victim stops breathing.
 - E. Administer anaphylaxis treatment to those individuals who are severely allergic to bee stings and have been prescribed treatment by a physician.
2. Keep the victim calm.
 3. Give the victim an antihistamine tablet, if available. First aid kits for treating localized bee stings are available at some sporting and camping stores.
 4. Take people who have been stung repeatedly to a medical facility for a complete examination. Remove stings as described earlier.
 5. Seek medical attention immediately if a person with health problems is stung by an insect.
 6. Stay with the victim until medical care arrives.

Stinging Incidents

Accurate records of stinging incidents seldom exist. Even records of serious, multiple stinging incidents often are at best sketchy. If AHB has become established in your area, then routine procedures for reporting AHB findings and attacks should be established.

At-Risk Groups

Certain groups in the population may be considered "at-risk" for incidents involving bees. These groups fall into two categories: those who are more likely to interact with bees, and those who are incapable of handling an interaction with bees.

Children: Children may fall into either of the above categories. Playing outdoors, children are exposed to habitats that increase the chances of interaction with bees. Upon encountering bee swarms or colonies, children have a tendency to disturb them. This can bring about a defensive reaction from the insects, resulting in a serious incident. Younger children encountering bees in a defensive behavior may not know what to do, or may not be able to seek cover. Therefore, they can be extremely vulnerable.

Children should be taught what bees look like. They should be instructed to avoid possible problems. The following instructions may be used even with very young children:

1. Keep your distance (Stay away).
2. Don't disturb (Bug a Killer Bee – NOT!).
3. Leave the area (Don't bug a bee).
4. Report the incident (Tell parents, teachers, or other adults about the bees).

Elderly: Elderly people who can't move out of an area rapidly can be vulnerable to multiple stings if bees are encountered. The physical condition and health of elderly persons may also place them in the at-risk group. The elderly need not give up picnics or outings, or such recreational pursuits as hiking, fishing, hunting, or other outdoor activities. However, they should consider the possibility of encountering bees and prepare for such an encounter. Suggestions for those wishing to frequent habitats favorable to bees and wasps are listed below:

1. If possible, have the area "checked out" in advance.
2. If possible, always have "cover" nearby, such as a vehicle, house, or barn.
3. Always bring a companion along (two are even better).
4. If bees are encountered, do not disturb them.
5. Carry some type of protection, such as a blanket in a boat or tarp in a vehicle.

Handicapped: Handicapped persons placed in a situation where bees are behaving defensively may not be able to leave the area or seek cover fast enough to prevent multiple stings. Those requiring assistance walking may be especially vulnerable. Handicapped persons should avoid habitats that may contain bees. If they wish to frequent such areas, the following suggestions may help prevent problems:

1. Have the area scouted for stinging insects prior to use.
2. Avoid use of perfumes, shaving lotions, hair sprays, and other sweet-smelling cosmetics.
3. If encountered, do not disturb bees.
4. Carry a blanket, jacket, or other protective covering to use if bees attack.
5. Arrange for emergency assistance beforehand.

Outdoor Workers and Military: Persons working outdoors could be considered at risk if their work involves exposure to habitats likely to be occupied by bees. The risk is greater when operating mowers, weed eaters, heavy equipment, chainsaws, or other tools that may provoke defensive behavior from bees. Workers unable to flee, such as those on poles or scaffolding, are at higher risk. Military, such as infantry, may move into unknown areas containing bee populations. Even night maneuvers can bring personnel in contact with bees. Personnel should be instructed in the possibility of encountering bees and other venomous pests. If a few commonsense steps are followed, work should not be hampered, even in areas that most likely contain bees:

1. Check out areas where workers' mobility may be restricted (poles, towers, manholes, scaffolding, under buildings).
2. If bees are encountered, do not disturb them.

3. Contact an authorized and experienced person to eliminate the bees before work continues.
4. If risks are great and encounters frequent, protective equipment, such as a veil and full bee suit or coveralls, should be available for use.

Sports Enthusiasts: Hunters, fishermen, hikers, and other sports enthusiasts can be at-risk due to their increased chances of entering bee habitats. Sports enthusiasts may reduce the risk of bee stings by following a few commonsense suggestions:

1. Always be on the alert for potential problems.
 2. Check out cabins, deer stands, and boats before use.
 3. Seek help or advice from an experienced person before attempting to eliminate bee colonies.
 4. Do not attempt to "burn-out" bee colonies by pouring gasoline or other flammable liquids on them.
 5. KNOW if you are hypersensitive to bee venom and carry necessary medication.
 6. If you are hypersensitive, always participate with a companion.
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Control of Bees

Honey bees play an important role in agriculture. For decades entomologists have been including a strong statement about the protection of honey bees in their insect control guides and pest management programs. However, when honey bees become a threat to public health or the welfare of domestic animals, they must be dealt with differently. When bees colonize an area frequented by humans or domestic animals, they become a pest or health risk. At such times they must be removed or eliminated.

Bees that need to be removed fall into two categories: swarms and established colonies.

Bee Swarms: Capturing swarms is a common method of obtaining bees by hobbyists and commercial beekeepers. Swarms are captured and introduced into hives with removable frames, where they can be managed properly for honey production or pollination services.

Capturing a swarm is a relatively easy procedure because bees are less defensive when swarming. However, it is not recommended for those who aren't familiar with the habits of bees or who don't have the proper protective equipment.

Once the AHB is established in an area, it is more difficult to get beekeepers to capture swarms for their own use. They will not wish to risk capturing a swarm that may be Africanized.

Swarms seldom remain long before scout bees find a suitable site to colonize. However, it may be desirable, in an area where the AHB is established, to eliminate swarms in an effort to prevent colonization of certain sites, such as in or near dwellings.

Swarms may be eliminated with approved insecticides. They may also be eliminated by spraying with soapy water. Liquid dishwashing detergent in a 5% solution is recommended (1 cup of detergent/gal). A high volume spray achieves the best effect. Avoid fine mists.

A swarm of honey bees is a temporary inconvenience that may last a few hours or days. Honey bees in a swarm are usually gentle because they have stomachs full of honey. If left undisturbed, a swarm will locate new quarters and often disappear as quickly as it appeared. In the past, local beekeepers collected swarms to put into their unused hives. They would at times charge a nominal fee for their time and effort.

REMEMBER: a swarm is only temporary and will move away as soon as the bees find a new home. Only in unusual situations will a swarm remain to build comb and not move from a cluster site.

Bee Colonies: Although feral colonies seldom cause problems unless provoked, if they are established in an area where interaction with man or domestic animals may occur, they should be eliminated. Once a colony is established it will defend its nest. Only experienced persons with protective equipment should attempt to remove or eliminate bee colonies.

Numerous insecticides are approved for use on bees. These chemicals are very effective when used properly. Detergent or soapy water doesn't work effectively on an established colony, because honeycomb prevents adequate penetration of the detergent solution.

Bee colonies may be removed physically by hand or by vacuuming with special types of vacuums. Once collected, the bees can be placed in a hive, released at a different location, or killed with insecticide.

Removing Bees

Occasionally, even honey bees are considered pests and must be dealt with like any other unwanted insect. Because of the attention recently focused on AHBs, it is important to provide homeowners, pest control operators, and others with sound information on how to deal with honey bees when they are pests.

Bee colonies may nest in tree hollows or in structures, such as attics, between the wall studs of houses or garages, within porch roofs, or in similar areas.

Bees in Buildings: Bees nesting in buildings, unlike swarms, are a great problem. There is no easy, convenient method of removing the bees. However, every effort should be made to determine the extent of the nest and to give priority to removing and relocating the bees, brood, and honey stores. Simply killing the bees will only make for more complex problems in the future. For instance, an unattended nest of beeswax, honey, brood, and pollen will attract other insects and animals. Wax moths will enter to consume the wax, cockroaches and ants will find the brood and honey. Decaying brood

and fermenting honey will cause undesirable odors. Melting wax and honey can soak into walls, making them impossible to paint or wallpaper. Walls will also remain moist to the touch for a considerable period of time.

If removing the bees and their nest is not practical, then other methods of dealing with them can be considered. The following steps are appropriate guidelines.

Locating Bees: The first step in eliminating the pest problem is locating the nest and getting rid of the adult bees. It may be difficult to locate the comb as it may be some distance from the entrance/exit used by the bees. Some of the most common methods of locating comb are:

1. If bees are inside a wall with sheetrock on one side, feel the sheetrock for warmth; tap the sheetrock and listen for a solid sound vs. a hollow sound. Listen also for buzzing when tapping.
2. If bees are in a wood, brick, or sheetrock wall, when you think you have located the nest, drill a hole (1/16") large enough for a coat hanger wire. Straighten out a coat hanger and stick it in the hole. You should have honey or wax on the hanger when you withdraw it. Work close to the top of the wall with holes and coat hanger because bees always hang the honeycomb down from an overhead support.

Removal of the Comb: In some instances, it will be quite expensive to attempt removal of the nest. The homeowner may be willing to put up with the smell and take his/her chances with damage from honey-soaked walls. If the bees need to be removed and there is no rush to remove them, consider eliminating the bees in mid-winter because they have their lowest population and lowest honey stores at this time. On very cold days they will not be able to fly very well and will represent a reduced threat to the remover and any spectators. Several materials can then be used to poison honey bees:

1. Aerosol sprays. Aerosol sprays may be very effective if sprayed through the holes drilled for the coat hanger probe. It may be necessary to drill a number of holes to inject an aerosol spray.
2. Spray concentrates or dusts. Some insecticide liquids or dusts are also very effective for controlling bees and wasps. Equipment to mix and apply such formulations is necessary.

Insecticide should be applied at the entry/exit area of the nest and, if feasible, directly onto the nest (drilling small holes to the nest may be necessary). The nest itself may be some distance upwards, left or right from the entry/exit area and is almost always suspended from some overhead support. Several repeat applications are usually necessary to kill the bees. Whenever using an insecticide, **check the container label for proper concentration, safe use, and area requirements.** For nests in trees or garages, removal usually is not necessary.

Problems Associated With Bee Control

Only qualified, experienced personnel should be allowed to remove or destroy bee colonies. The following must be considered:

1. Effective, approved pesticides.
2. Safety of the applicator and onlookers.
3. Possible damage, such as staining of wallpaper or wood trim.
4. Pesticide residue that may be harmful to foraging domestic bees.
5. Problems associated with dead bees, honey, and comb after bees are killed.
6. Possibility of reinfestation if structure is not modified or fully repaired.

Publications that elaborate on bee removal and control are:

1. "Disposing of Africanized Swarms or Feral Colonies" by Dr. James E. Tew & A.M. Collins
2. "How to Remove Bees from Buildings" by Ward Stanger
3. "Control of Honey Bees in and around Homes" by Drs. Alton Sparks and Philip Hammon

Handling Bee Problems

It is better to prevent bee stings than treat them. This section includes information that may be used to make an area safer by reducing interactions between people and bees. Tips are given that will help prevent interactions with bees.

Safening an Area

"Safening" is a term we can use for action taken to modify a habitat, structure, or other factor that will result in a safe environment for people or domestic animals. With respect to bees, this is usually action taken to reduce or eliminate a population. It could also be action taken to prevent or discourage bees from colonizing an area.

Safening the Home: Homes may be made safer by locating and removing bee colonies. Desirable nesting sites may be reduced by discarding barrels, old appliances, abandoned cars, piles of debris, and other materials. Hollow trees and logs should be removed. Cavities in landscape trees may be filled with foam insulation. Loose insulation beneath mobile homes, and open vents beneath homes or attics should be repaired. Vents should be screened with wire mesh small enough to prevent bee entry. Knot holes and cracks in houses, barns, and storage structures need to be repaired or filled. Holes made for utilities and plumbing should be inspected, and any openings should be closed or filled to prevent entry of bees.

Safening the School: Safening a school is much like safening a home. Inspections should be made periodically, such as just prior to the beginning of each school year. All

colonies should be removed and modifications made to prevent recolonization. Students should be informed about bees and instructed to report any swarm or colony immediately.

Safening Recreation Areas and Training Sites: All inside and outside facilities of parks and recreational areas should be thoroughly inspected. All bee colonies should be eliminated and modifications made to prevent future colonization. High-use areas, such as campsites, boat launches and picnic grounds, should be re-inspected periodically to remove any new colonies of bees. In large wooded areas used for recreational purposes or training sites, signs can be posted informing people that bee swarms may be encountered, requesting that such swarms not be disturbed, and directing that swarms be reported to appropriate authorities.

Avoiding Bee Problems

Most serious incidents involving bees can be avoided with a little effort. In areas where the AHB has become established, people should learn the basics about bees and their habits. When activities increase the possibility of interaction with bees, care should be taken to reduce incidents.

Lawnmowers, Weedeaters, and Chain Saws: Bees dislike the noise, vibrations, and air movement created by lawnmowers. Quick inspection of an area to be mowed or shredded can often reveal bee or wasp colonies that would be disturbed by such actions. Removal of bee colonies prior to mowing dramatically reduces the likelihood of multiple stings.

Domestic Animals: Dogs and other domestic animals have been killed by bee stings. Wherever the AHB becomes established, the number of animal deaths due to bee stings is predicted to increase four to five times. Animals that are not confined seldom receive many stings because they usually flee the area defended by the bees. Animals in pens or that are tied cannot run away and may receive a lethal dose of venom. Animals should not be confined or tied unless the area has first been checked to make sure that no bee colonies are established nearby.

Large Motorized Equipment: Large equipment can incite an AHB attack through disturbance by engine noise and exhaust, or simply by hitting the colony. Persons most susceptible to attack are those who operate vehicles with open cabs, such as jeeps, "Humvees," bulldozers, backhoes, and tractors. Troop-carrying vehicles may also be at risk. In the event of an AHB attack, exposure can be minimized if the cab can be quickly closed.

Where To Get More Information About Africanized Honey Bees

For additional information on AHB, the following are recommended:

1. Review the references listed in this document.
2. Conduct an internet search for your question.
3. Visit the U.S. Department of Agriculture web sites on AHB or search the internet for the AHB site for your state of interest. For example, a map showing the current range of AHB in the U.S. is located at: <https://www.ars.usda.gov/news-events/news/research-news/2007/usda-map-of-africanized-honey-bee-spread-updated/>

Glossary

Abscond: When an entire colony of bees leaves an established hive.

Anaphylactic Shock: A life-threatening condition that may be brought on by a severe reaction to bee stings.

Anther: Part of a plant that contains and develops pollen.

Apiary: A group of bee colonies kept in one location (bee yard).

Bee bread: Pollen stored in cells of the comb.

Bee gum: Usually a hollow log hive.

Bee space: A space (1/4-5/16 inch) big enough to permit free passage for a bee but too small to encourage comb building. Leaving a bee space between parallel beeswax combs and between the outer comb and the hive walls is the basic principle of hive construction.

Bee tree: A hollow tree occupied by a colony.

Bee venom: Poison injected by a bee sting.

Brood: Immature or developing stages of bees, including eggs, larvae (unsealed brood), and pupae (sealed brood).

Cell: The six-sided compartment of a honey comb, used to raise brood or to store honey and pollen. Worker cells approximate five/linear inch; drone cells are larger, averaging four/linear inch.

Chromosomes: The structures in an animal or plant cell that carry the genes.

Colony: Social community of several thousand worker bees, usually containing one queen, with or without drones.

Comb foundation: Thin sheet of beeswax impressed by mill to form bases of cells; some foundation is also made of plastic and metal.

Drone: Male honey bee.

Feral: Wild, unmanaged.

Frame: Rectangular, wooden honeycomb supports, suspended by top bars in hive bodies.

Honey stomach (honey sac): An enlargement of the posterior end of the esophagus in the bee abdomen. It is the sac in which the bee carries nectar from the flower to the hive.

Hybrid: Offspring from two unrelated (usually inbred) lines.

Hymenoptera: Insect order to which all bees belong, as well as ants and wasps.

Hyper-allergic: Prone to severe allergic reaction; hyper-allergic persons may be at risk from a single sting.

Inbred: A homozygous organism usually produced by inbreeding.

Inbreeding: Mating among related individuals.

Incident: Any contact between bees and humans, or at-risk animals.

Langstroth: A minister from Pennsylvania who patented the first hive incorporating a bee space, thus providing for removable frames. The modern hive frequently is termed the Langstroth hive and is a simplified version of similar dimensions as patented by Langstroth.

Larva: Stage in life of bee between egg and pupa; "grub" stage.

Mead: An alcoholic beverage made by fermenting a honey and water solution. Metheglin is a mead with added spices or herbs.

Migratory beekeeping: Movement of apiaries from one area to another to take advantage of honey flows from different crops.

Nectar: A sweet secretion of flowers of various plants, some of which secrete enough to provide excess for the bees to ingest and convert into honey.

Package bees: A quantity of bees (2-5 lb.) with or without a queen shipped in a wire and wood cage to start or boost colonies.

Pheromones: Chemicals secreted by animals to convey information or to affect behavior of other individuals of the same species.

Pollen: Male reproductive cells of flowers collected and used by bees as food for rearing their young. It is the protein part of the diet, which is frequently called bee bread when stored in cells in the colony.

Pollination: Transfer of pollen from the anthers of one flower to the stigma of another flower.

Pollinator: The agent that transfers pollen, e.g., a bee, wasp, or wind.

Propolis: A glue or resin collected from trees or other plants by bees and used to close holes and cover surfaces in the hive; also called bee glue.

Queen: Sexually developed female bee; the mother of all bees in a colony.

Race: A population of bees that has become geographically isolated and adapted to specific regional conditions.

Requeen: To place a queen in a hive; usually to replace an old queen with a young one.

Skep: A dome-shaped beehive, usually of straw, that lacks movable frames.

Smoker: Device used to blow smoke on bees to reduce stinging.

Social insects: Insects that live in a family society, with parents and offspring sharing a common dwelling place and exhibiting some degree of mutual cooperation; e.g., honey bees, ants, termites.

Spermatheca: Small saclike organ in queen's abdomen in which sperm are stored.

Sting: Modified ovipositor, the egg-laying structure of female Hymenoptera developed into an organ of defense.

Super: Any hive body placed above the brood chamber for the storing of surplus honey.

Supersedure: The replacement of a weak or old queen in a colony by a daughter queen – a natural occurrence.

Swarm: Natural division of a colony of bees.

Worker bee: Sexually undeveloped female bee (largest percentage of bees found in a hive).

Selected References

- Anonymous. No date. Africanized bees: Myth or fact? Texas Agricultural Extension Service, Texas A&M University, College Station. 2 pp.
- Anonymous. No date. Bee alert: What is the Africanized bee? Texas Agricultural Extension Service, Texas A&M University, College Station. 2 pp.
- Anonymous. No date. Bee proofing your home. Texas Agricultural Extension Service, Texas A&M University, College Station. 1 p.
- Anonymous. No date. Outdoor recreation and bees. Texas Agricultural Extension Service, Texas A&M University, College Station. 1 p.
- Anonymous. No date. What kids should know. Texas Agricultural Extension Service, Texas A&M University, College Station. 2 pp.
- Anonymous. No date. When honey bees sting. Texas Agricultural Extension Service, Texas A&M University, College Station. 1 p.
- Anonymous. 1987. Screen test identifies Africanized bees. *Pest Cont. Tech.* 15(4): 46.
- Anonymous. 1988. Africanized honey bee tracking goes high tech! *Am. Bee J.* 128(5): 545.
- Bailey, R. & D. Anderson. 1986. How to manage African bees. Reprint Series No. R-61. Peace Corps Information Collection and Exchange, Wash., DC. 60 pp.
- Bailey, B. & R. Rice. 1986. Africanized honey bees arrive in Guatemala; now is the time for U.S. beekeepers to prepare! *Am. Bee J.* 126(11): 739-40.
- Batra, S.W.T. 1983. Potential impact of Africanized bees in the United States. USDA, ARS, Northeast Region, Beltsville, MD. 14 pp.
- Berns, B. 1987. Africanized bees: cause for concern? *Pest Cont. Tech.* 15(4): 42-44, 46.
- Booth, W. 1988. USDA fights to repel African bees' invasion. *Science.* 242(4877): 369-9.

- Boreham, M.M. & D.W. Roubik. 1987. Population change and control of Africanized honey bees (Hymenoptera: Apidae) in the Panama Canal area. *Bull. Entomol. Soc. Am.* 33(1): 34-9.
- Buco, S.M., T.E. Rinderer, H.A. Sylvester, A.M. Collins, V.A. Lancaster & R.M. Crewe. 1987. Morphometric differences between South American Africanized bees and South African (*Apis mellifera scutellata*) honey bees. *Apidologie* 18(3): 217-22.
- Camazine, S. & R.A. Morse. 1988. The Africanized honey bee. *Am. Sci.* 76(5): 465-71.
- Carlson, D.A. 1988. Hydrocarbons for identification and phenetic comparisons: cockroaches, honey bees and tsetse flies. *Fla. Entomol.* 71(3): 333-45.
- Carlson, D.A. & A.B. Bolten. 1984. Identification of Africanized and European honey bees using extracted hydrocarbons. *Bull. Entomol. Soc. Am.* 30(2): 32-5.
- Caron, D. M. (1999.) *Honey Bee Biology and Beekeeping*. Cheshire: Wicwas Press. 355 pp.
- Caron, D.M. 1987. Surviving with Africanized bees. *Am. Bee J.* 127(8): 561-3.
- Caron, D.M. & B.H. Gray. 1984. Panama's Africanized bee commission. *Am. Bee J.* 124(8): 577.
- Cheney, S. 1987. *Killer bees/Africanized bees - 1970-1986*. USDA National Agricultural Library, Beltsville, MD. 21 pp.
- Cobey, S. & T. Lawrence. 1985. Status of the Africanized bee find in California. *Am. Bee J.* 125(9): 607-11.
- Cole, C.L. & M.A. Rowell. 1993. *Bees & wasps resource manual, with emphasis on the Africanized honey bee*. Texas Agricultural Extension Service, Texas A&M University, Bryan. 78 pp.
- Collins, A.M. & T.E. Rinderer. 1986. The defensive behavior of Africanized bees. *Am. Bee J.* 126(9): 623-7.
- Collins, A.M., T.E. Rinderer, J.R. Harbo & A.B. Bolten. 1982. Colony defense by Africanized and European honey bees. *Science* 218(4567): 72-74.
- Danka, R.G., R.L. Hellmich II, A.M. Collins, T.E. Rinderer & V.L. Wright. 1990. Flight characteristics of foraging Africanized and European honey bees (Hymenoptera: Apidae). *Ann. Entomol. Soc. Am.* 83(4): 855-9.

- Danka, R.G., T.E Rinderer, A.M. Collins & R. L. Hellmich II. 1987. Responses of Africanized honey bees (Hymenoptera: Apidae) to pollination-management stress. *J. Econ. Entomol.* 80(3): 621-4.
- Danka, R.G., T.E. Rinderer & R.L. Hellmich II. 1986. Comparative toxicities of four topically applied insecticides to Africanized and European honey bees (Hymenoptera: Apidae). *J. Econ. Entomol.* 79(1): 18-21.
- De Jong, D. 1984. Africanized bees now preferred by Brazilian beekeepers. *Am. Bee J.* 124(2): 116-8.
- De Jong, D. & P.H. De Jong. 1983. Longevity of Africanized honey bees (Hymenoptera: Apidae) infested by *Varroa jacobsoni* (Parasitiformes: Varroidae). *J. Econ. Entomol.* 76(4): 766-8.
- Del Lama, M.A., R.A. Figueiredo, A.E.E. Soares & S.N. Del Lama. 1988. Hexokinase polymorphism in *Apis mellifera* and its use for Africanized honey bee identification. *Rev. Bras. Genet.* 11(2): 287-97.
- Del Lama, M.A., M.A. Mestriner & J.C.A. Paiva. 1985. EST-5 and PGM1: new polymorphisms in *Apis mellifera*. *Rev. Bras. Genet.* 8(1): 17-27.
- Dietz, A., R. Krell & F.A. Eischen. 1985. Preliminary investigation on the distribution of Africanized honey bees in Argentina. *Apidologie* 16(2): 99-108.
- Doane, C.C. & J.C. Shaw. 1987. A commercial trap for detection and capture of honey bee swarms. *Am. Bee J.* 127(10): 712-13.
- Ferracane, M. & F. Ratnieks. 1989. Africanized bees and the good neighbor policy. *Am. Bee J.* 129(2): 117-21.
- Fletcher, D.J.C. 1978. The African bee, *Apis mellifera adansonii*, in Africa. *Annu. Rev. Entomol.* 23: 151-71.
- Foote, L. 1985. Africanized bee, *Apis mellifera scutellata*. *Calif. Dep. Food. Agric.* 4(5/6): 154-63.
- Gary, N.E., H.V. Daly, S. Locke & M. Race. 1985. The Africanized honey bee: ahead of schedule. *Calif. Agric.* 39(11/12): 4-7.
- Gill, R. 1985. Africanized bee, *Apis mellifera scutellata*. *Calif. Plant Pest Dis. Rep.* 4(4): 104-7.
- Goncalves, L.S. 1982. The economic impact of the Africanized honey bee in South America. pp. 134-7 in *The Biology of Social Insects*, M.D. Breed et al., eds. Westview Press, Boulder, CO.

- Graham, J.M. 1992. *The Hive and the Honey Bee*. Dadant & Sons, Hamilton, IL. 1324 pp.
- Guzman-Novoa, E. & R.E. Page Jr. 1993. Backcrossing Africanized honey bee queens to European drones reduces colony defensive behavior. *Ann. Entomol. Soc. Am.* 86(3): 352-5.
- Hall, H.G. 1990. Parental analysis of introgressive hybridization between African and European honey bees using nuclear DNA RFLPs. *Genetics* 125: 611-21.
- Hall, H.G. 1992. DNA studies reveal process involved in the spread of New World African honey bees. *Fla. Entomol.* 75(1): 51-9.
- Hall, H.G. & K. Muralidharan. 1989. Evidence from mitochondrial DNA that African honey bees spread as continuous maternal lineages. *Nature* 339(6221): 211-3.
- Hellmich, R.L. II, A.M. Collins, R.G. Danka & T.E. Rinderer. 1988. Influencing matings of European honey bee queens in areas with Africanized honey bees (Hymenoptera: Apidae). *J. Econ. Entomol.* 81(3): 796-9.
- Hellmich, R. L. II, R.G. Danka, A.M. Collins & T.E. Rinderer. 1986. Laying-worker production of drones in mixed colonies of Africanized and European honey bees (Hymenoptera: Apidae). *Ann. Entomol. Soc. Am.* 79(5): 833-6.
- Hellmich, R. L. II, R.G. Danka, T.E. Rinderer & A.M. Collins. 1986. Comparison of Africanized and European queen-mating colonies in Venezuela. *Apidologie* 17(3): 217-26.
- Hung, A.C.F. 1990. Preliminary evidence for a protein specific to an African honey bee race (*Apis mellifera scutellata*). *Am. Bee J.* 130(1): 49-50.
- Hunter, L.A., J.A. Jackman & E.A. Sugden. 1993. Detection records of Africanized honey bees in Texas during 1990, 1991 and 1992. *Southwest. Entomol.* 18(2): 79-89.
- Kozlowski, J.C. 1990. Insect sting and bite liability: a limited duty for landowners. *Natl. Recreat. Park Assoc.* October: 24-29.
- Krell, R., A. Dietz & F.A. Eischen. 1985. A preliminary study of winter survival of Africanized and European honey bees in Cordoba, Argentina. *Apidologie.* 16(2): 109-18.
- Lavine, B. & D. Carlson. 1987. European bee or Africanized bee? *Anal. Chem.* 59(6): 468-70.

- Lawrence, T. & S. Cobey. 1985. Status of the Africanized bee in California. Part II. An update. *Am. Bee J.* 125(10): 672-5.
- Mc Dowell, R. 1984. The Africanized honey bee in the United States: What will happen to the U.S. beekeeping industry. *Agric. Econ. Rep. No. 519, USDA Econ. Res. Serv., Washington, DC.* 33 pp.
- McIlveen, G. Jr. & P.J. Hamman. No date. Wasps & yellow jackets. Texas Agricultural Extension Service, Texas A&M University, College Station. 6 pp.
- Meise, B. 1989. Africanized honey bees - we have a story of success! *Am. Bee J.* 129(9): 600-2.
- Michener, C.D. 1975. The Brazilian bee problem. *Annu. Rev. Entomol.* 20: 399-416.
- Moffett, J.O. & D.L. Maki. 1988. Venezuela and the Africanized bee. *Am. Bee J.* 128(12): 827-30.
- Morrison, J. 1989. Year of the Africanized bee? *Agric. Res.* 37(1): 4-7, 11.
- Nelson, D.R., A.M. Collins, R.L. Hellmich, R.T. Jones, R.M. Helm, D.L. Squillace & J.W. Yunginger. 1990. Biochemical and immunochemical comparison of Africanized and European honey bee venoms. *J. Allergy Clin. Immunol.* 85(1): 80-5.
- Nunamaker, R.A., W.T. Wilson & B.E. Haley. 1984. Electrophoretic detection of Africanized honey bees (*Apis mellifera scutellata*) in Guatemala and Mexico based on malate dehydrogenase allozyme patterns. *J. Kans. Entomol. Soc.* 57(4): 622-31.
- Owen, M.D. 1983. The venom system and venom hyaluronidase of the African honey bee (*Apis mellifera adansonii*). *Toxicon* 21(1): 174.
- Page, R.E. Jr. 1989. Neotropical African bees. *Nature* 339(6221): 181-2.
- Page, R.E. Jr. 1992. How Africanized honey bees will affect California agriculture. *Calif. Agric.* 46(1): 18-19.
- Page, R.E. Jr. & E.H. Erickson Jr. 1985. Identification and certification of Africanized honey bees. *Ann. Entomol. Soc. Am.* 78(2): 149-58.
- Page, R.E. Jr. & R.A. Metcalf. 1988. A population estimate of MDH allozyme frequencies for the honey bee, *Apis mellifera* L. (Hymenoptera: Apidae). *Pan-Pac. Entomol.* 64(3): 285-9.

- Paxton, R.J., C.M. Echazarreta & M. Garcia. 1991. Africanized honey bees in Yucatan, Mexico: a detailed survey. *Am. Bee J.* 131(10): 646-8.
- Caron, D. M. (1999.) *Honey Bee Biology and Beekeeping*. Cheshire: Wicwas Press. 355 pp.
- Rinderer, T. E., B. P. Oldroyd and W. S. Sheppard. (1993). Africanized bees in the U.S. *Scientific American* 269: 84-90.
- Rinderer, T.E. 1984. Nectar-foraging characteristics of Africanized and European honey bees in the Neotropics. *J. Apic. Res.* 23(2): 70-9.
- Rinderer, T.E. 1986. Africanized bees: the Africanization process and potential range in the United States. *Bull. Entomol. Soc. Am.* 32(4): 222-4.
- Rinderer, T.E. 1988. Computer assisted identification of hybrid strains of western honey bees. *Fla. Entomol.* 78(3): 281-8.
- Rinderer, T.E., A.B. Bolton, J.R. Harbo & A.M. Collins. 1982. Hoarding behavior of European and Africanized honey bees (Hymenoptera: Apidae). *J. Econ. Entomol.* 75(4): 714-15.
- Rinderer, T.E., H.V. Daly, H.A. Sylvester, A.M. Collins, S.M. Bucu, R.L. Hellmich & R.G. Danka. 1990. Morphometric differences among Africanized and European honey bees and their F1 hybrids (Hymenoptera: Apidae). *Ann. Entomol. Soc. Am.* 83(3): 346-51.
- Rinderer, T.E., J.A. Stelzer, B.P. Oldroyd, S.M. Bucu & W.L. Rubink. 1991. Hybridization of European and Africanized honey bees in the Neotropical Yucatan Peninsula. *Science* 253(5017): 309-11.
- Rinderer, T.E., H.A. Sylvester, M.A. Brown, J.D. Villa, D. Pesante & A.M. Collins. 1986. Field and simplified techniques for identifying Africanized and European bees. *Apidologie* 17(1): 33-48.
- Rinderer, T.E., H.A. Sylvester, S.M. Bucu, V.A. Lancaster, E.W. Herbert, A.M. Collins & R.L. Hellmich II. 1987. Improved simple techniques for identifying Africanized and European honey bees. *Apidologie* 18(2): 179-96.
- Rite, R. & B. Bailey. 1985. Guatemalan beekeepers prepare for "Africanization." *Am. Bee J.* 125(7): 488-9.
- Roubik, D.W. & M.M. Boreham. 1990. Learning to live with Africanized honey bees. *Interciencia* 15(3): 146-53.

- Rubink, W.L., W.T. Wilson, J.J. Resendez B. & D.L. Maki. 1990. Pre-Africanized *Apis mellifera* (Hymenoptera: Apidae) swarming dynamics in northeastern Mexico and southern Texas. *J. Kans. Entomol. Soc.* 63(2): 288-97.
- Ruttner, F. 1988. *Biography and Taxonomy of Honey Bees*. Springer-Verlag, Berlin. 284 pp.
- Sames, W.J., IV, W.T. Wilson, J.W. Smith, Jr., and H.D. Petersen. 1991. Effective destruction of honey bee colonies. *Southwestern Entomol.* 16(1): 19-24.
- Schmidt, J.O. 1990. Swarm traps: an example of research and technology transfer. *Am. Bee J.* 130(5): 333-4.
- Schmidt, J.O. & S.C. Thones. 1987. Swarm traps for survey and control of Africanized honey bees. *Bull. Entomol. Soc. Am.* 33(3): 155-8.
- Schneider, S. S., G. DeGrandi-Hoffman, and D. R. Smith. (2004). The African honey bee: factors contributing to a successful biological invasion. *Annual Review of Entomology*, 49: 351-376.
- Schneider, S.S. 1990. Nest characteristics and recruitment behavior of absconding colonies of the African honey bee, *Apis mellifera scutellata*, in Africa. *J. Insect Behav.* 3(2): 225-40.
- Schneider, S.S. 1990. Queen behavior and worker-queen interactions in absconding and swarming colonies of the African honey bee, *Apis mellifera scutellata* (Hymenoptera: Apidae). *J. Kans. Entomol. Soc.* 63(1): 179-86.
- Schneider, S.S. 1990. Spatial foraging patterns of the African honey bee, *Apis mellifera scutellata*. *J. Insect Behav.* 2(4): 505-21.
- Schneider, S.S. 1992. Seasonal patterns of foraging activity in colonies of the African honey bee, *Apis mellifera scutellata* in Africa. *Insectes Sociaux* 39: 181-93.
- Schumacher, M.J., J.O. Schmidt & N.B. Egen. 1989. Lethality of 'killer' bee stings. *Nature* 337(6206): 413.
- Schumacher, M.J., J.O. Schmidt, N.B. Egen & J.E. Lowry. 1990. Quantity, analyses, and lethality of European and Africanized honey bee venoms. *Am. J. Trop. Med. Hyg.* 43(1): 79-86.
- Shipman, W.H. & J.A. Vick. 1977. Studies of Brazilian bee venom. *Cutis* 19(6): 794-7.
- Smith, D.R. 1991. African bees in the Americas: insights from biogeography and genetics. *Trends Ecol. Evolut.* 6(1): 17-21.

- Smith, D.R., O.R. Taylor & W.M. Brown. 1989. Neotropical Africanized honey bees have African mitochondrial DNA. *Nature* 339(6221): 213-5.
- Southwick, E.E. 1990. Living with Africanized honey bees. *Am. Bee J.* 130(2): 91-2.
- Spangler, H.G., J.O. Schmidt, S.C. Thones & E.H. Erickson. 1990. Automated testing of the temperament of Africanized honey bees - a progressive report. *Am. Bee J.* 130(11): 731-33.
- Sparks, A.N. Jr. & P.J. Hammon. No date. Control of honey bees in and around homes. Texas Agricultural Extension Service, Texas A&M University, College Station. 2 pp.
- Spivak, M. & E. Erickson Jr. 1992. Do measurements of worker cell size reliably distinguish Africanized from European honey bees (*Apis mellifera* L.)? *Am. Bee J.* 132(4): 252-5.
- Stanger, W. No date. How to remove bees from buildings. Agricultural Extension, University of California, Davis. 2 pp.
- Sylvester, H.A. & T.E. Rinderer. 1986. Africanized bees: progress in identification procedures. *Am. Bee J.* 126(5): 330-3.
- Sylvester, H.A. & T.E. Rinderer. 1987. Fast Africanized bee identification system (FABIS) manual. *Am. Bee J.* 127(7): 511-6.
- Taber, S. 1986. How the Africanized honey bee is identified. *Am. Bee J.* 126(2): 106-7.
- Taber, S. 1987. Reason and logic in dealing with the Africanized honey bee. *Am. Bee J.* 127(2): 103-5.
- Taylor, O.R. Jr. 1985. African bees: potential impact in the United States. *Bull. Entomol. Soc. Am.* 31(4): 14-24.
- Taylor, O.R. 1985. Let's keep our facts straight about the African bees! *Am. Bee J.* 125(8): 586-7.
- Taylor, O.R. & M.D. Levin. 1978. Observations on Africanized honey bees reported to South and Central American government agencies. *Bull. Entomol. Soc. Am.* 24(4): 412-14.
- Taylor, O.R. & S.A. Rowell. 1985. Feral swarms bees as key to African bee control. *Speedy Bee*. March: 10.

- Tew, J. E. & A.M. Collins. No date. Africanized honey bees. Cooperative Extension Service, USDA; Ohio State University, Wooster; and Agricultural Research Service, USDA, Weslaco, TX. 3 pp.
- Tew, J.E. & A.M. Collins. No date. The Africanized honey bee's ability to tolerate cold conditions. Cooperative Extension Service, USDA; Ohio State University, Wooster; and Agricultural Research Service, USDA, Weslaco, TX. 2 pp.
- Tew, J.E. & A.M. Collins. No date. Attracting Honey Bee Swarms with Bait Hives. Cooperative Extension Service, USDA; Ohio State University, Wooster; and Agricultural Research Service, USDA, Weslaco, TX. 1 p.
- Tew, J.E. & A.M. Collins. No date. Colony reproduction by Africanized honey bees. Cooperative Extension Service, USDA; Ohio State University, Wooster; and Agricultural Research Service, USDA, Weslaco, TX. 2 pp.
- Tew, J.E. & A.M. Collins. No date. Disposing of Africanized swarms or feral colonies. Cooperative Extension Service, USDA; Ohio State University, Wooster; and Agricultural Research Service, USDA, Weslaco, TX. 2 pp.
- Tew, J.E. & A.M. Collins. No date. History of the Africanized honey bee and its range extension. Cooperative Extension Service, USDA Ohio State University, Wooster; and Agricultural Research Service, USDA, Weslaco, TX. 2 pp.
- Tew, J.E. & A.M. Collins. No date. Honey bees and beekeepers: working together for an abundant food supply. Cooperative Extension Service, USDA Ohio State University, Wooster; and Agricultural Research Service, USDA, Weslaco, TX. 2 pp.
- Tew, J.E. & A.M. Collins. No date. Honey bee mating control and stock selection. Cooperative Extension Service, USDA; Ohio State University, Wooster; and Agricultural Research Service, USDA, Weslaco, TX. 2 pp.
- Tew, J.E. & A.M. Collins. No date. Honey production and pollination characteristics of the Africanized honey bee. Cooperative Extension Service, USDA; Ohio State University, Wooster; and Agricultural Research Service, USDA, Weslaco, TX. 1 p.
- Tew, J.E. & A.M. Collins. No date. Important differences between Africanized and European honey bees. Cooperative Extension Service, USDA; Ohio State University, Wooster; and Agricultural Research Service, USDA, Weslaco, TX. 2 pp.
- Tew, J.E. & A.M. Collins. No date. Managing the honey bee queen. Cooperative Extension Service, USDA; Ohio State University, Wooster; and Agricultural Research Service, USDA, Weslaco, TX. 2 pp.

- Thorp, R.W., G.W. Frankie, J. Barthell, D. Gordon, L. Newstrom, T. Griswold, J. Schmidt & S. Thoenes. 1992. Long-term studies to gauge effects of invading bees. *Calif. Agric.* 46(1): 20-3.
- Tunget, C.L. & R.F. Clark. 1993. Invasion of the 'killer' bees: separating fact from fiction. *Postgrad. Med.* 94(2): 92-4.
- Vestal, T.A & B. Batchelor. No date. Bees and me. Texas Agricultural Extension Service, Bexar County Extension Agency. 2 pp.
- Villa, J.D. 1988. Defensive behaviour of Africanized and European honey bees at two elevations in Colombia. *J. Apic. Res.* 27(3): 141-5.
- Villa, J.D., C. Gentry & O.R. Taylor Jr. 1987. Preliminary observations on thermoregulation, clustering and energy utilization in African and European honey bees. *J. Kans. Entomol. Soc.* 60(1): 4-14.
- Villa, J.D., N. Kieniger & T.E. Rinderer. 1991. Overwintering of Africanized, European and hybrid honey bees in Germany. *Environ. Entomol.* 20(1): 39-43.
- Walker, T.W. 1987. After Action Report for the Medical Entomology Section, JTF-Bravo, Preventive Medicine Service, Palmerola Air Base, Honduras. U.S. Army Preventive Medicine Svc., Honduras. 20 pp.
- Williams, J.L., R.G. Danka & T.E. Rinderer. 1989. Baiting systems for selective abatement of undesirable honey bees. *Apidologie* 20(2): 175-9.
- Winston, M. L. (1992). *Killer Bees: The Africanized Honey Bee in the Americas*. Cambridge, Harvard University Press.
- Winston, M.L. 1992. The biology and management of Africanized honey bees. *Annu. Rev. Entomol.* 37: 173-93.
- Winston, M.L. *Killer Bees, the Africanized Honey Bee in the Americas*. Harvard University Press, Cambridge, MA. 162 pp.