Africanized “killer” bees: a problem for North Carolina?

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History

How the AHB got here

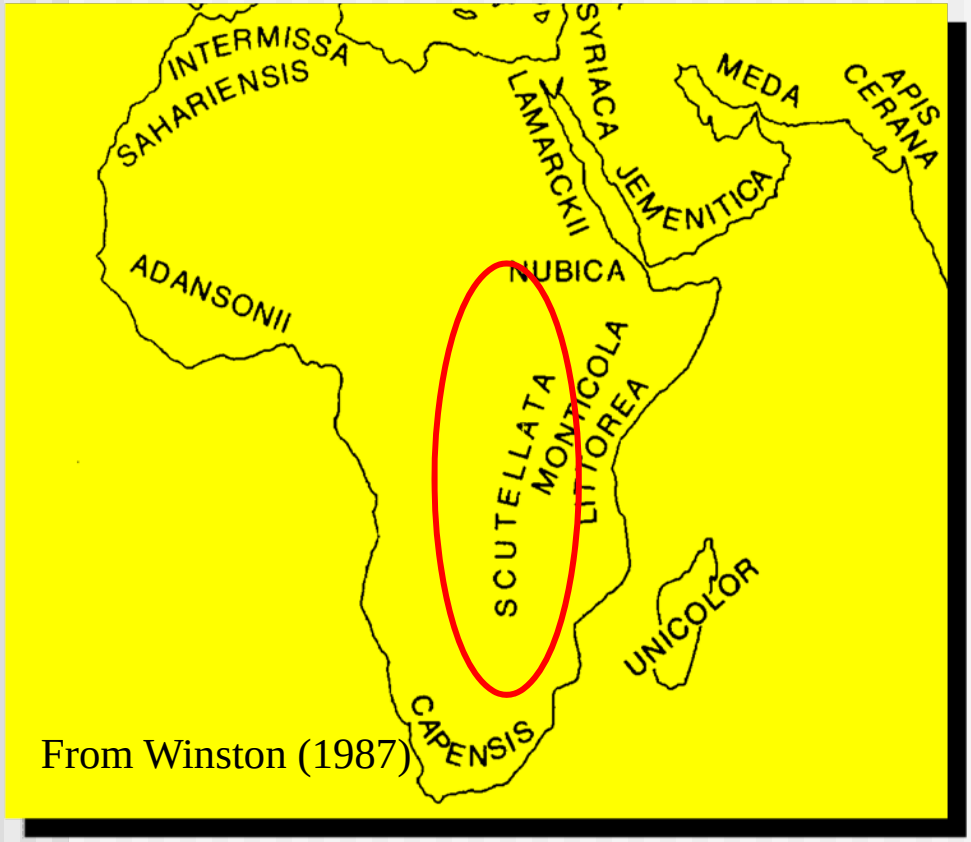
European subspecies

European races

- *A. m. mellifera*
- *A. m. ligustica*
- *A. m. carnica*
- *A. m. caucasica*

The first honey bees to be imported to the new world were European honey bees (EHB).

African subspecies



From Winston (1987)

The subspecies, or race, of honey bees that were introduced to the Americas was *Apis mellifera scutellata*, which evolved in sub-Saharan Africa. They are adapted to tropical habitats, thus they were imported to improve honey production and the apiculture industry in Brazil.

From Caron (1999)

Introductions of *Apis mellifera scutellata* into Brazil began in 1956. Within 50 years, this tropically adapted race of bee colonized most of South America and all of Central America. It entered the U.S. in 1990 through south Texas and is now permanently established throughout the southwestern states and southern California. Throughout its range in the New World, the AHB shows a remarkable ability to displace resident EHB colonies.

Some terminology

- European honey bees (EHB)
  - Behaviorally acceptable stock
- Africanized honey bees (AfHB)
  - Genetic hybrids that may or may not be behaviorally acceptable
  - European queens mated with African drones
- African honey bees (AHB)
  - Behaviorally unacceptable stock
  - African queens mated with African drones

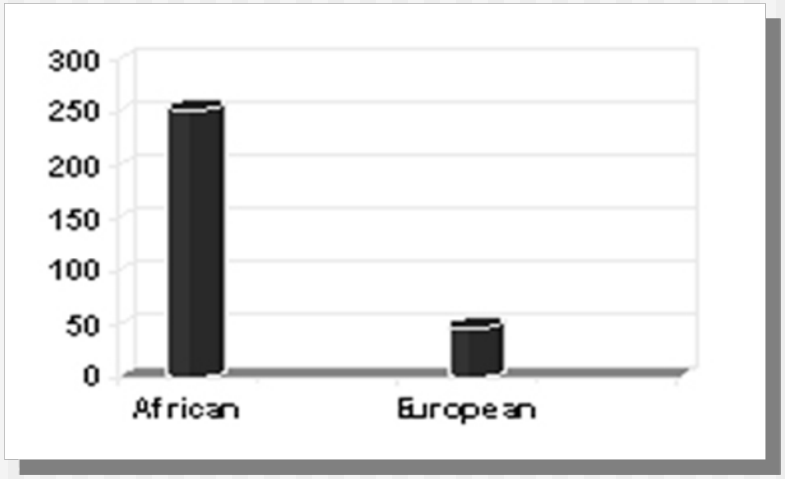
What are Africanized bees?

Some differences in the biology between African and European honey bees

Nesting behaviors

Unlike European bees, which must occupy large, well-insulated nest cavities for winter survival, AHB colonies can occupy smaller cavities and are more likely to build exposed-comb nests.

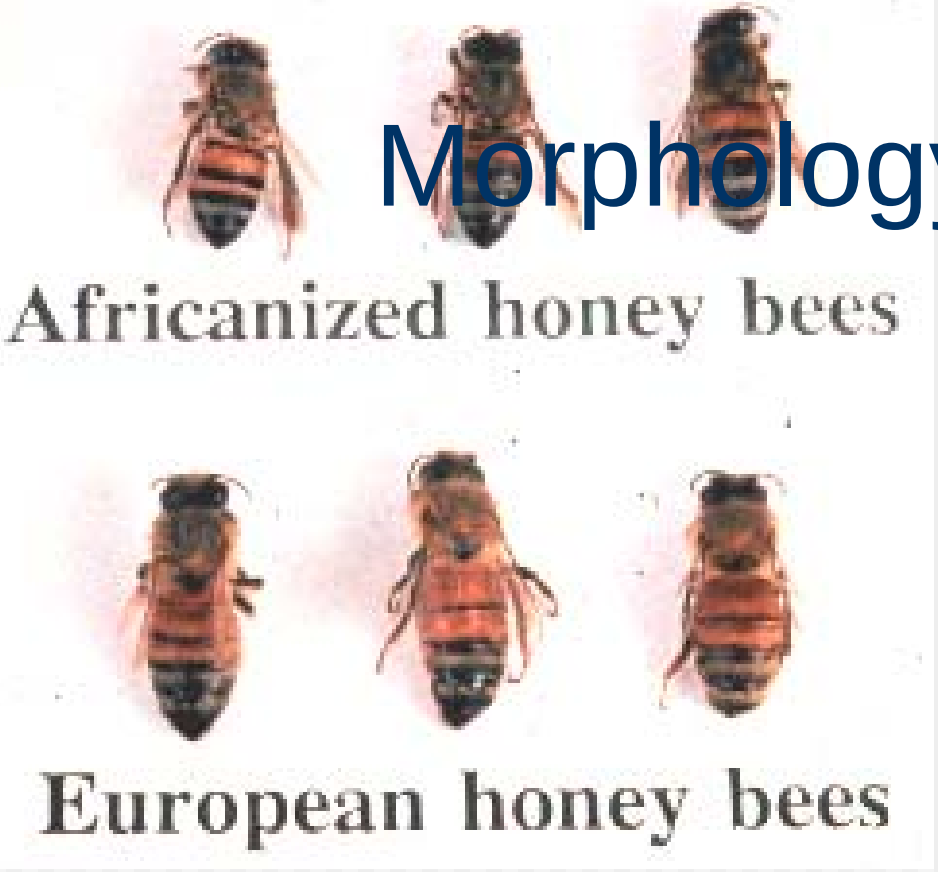
Defensive behavior



The African honey bee race, *Apis mellifera scutellata*, is well known for its high degree of nest defense (left). On the right are data comparing the number of bees captured while defending their colony in the first 30 seconds after a disturbance. About 5 times more African bees leave the colony than European bees in the same time interval. AHB workers also produce more alarm pheromone than EHB workers, which excites other workers to sting, and further contributes to greater colony defensiveness.

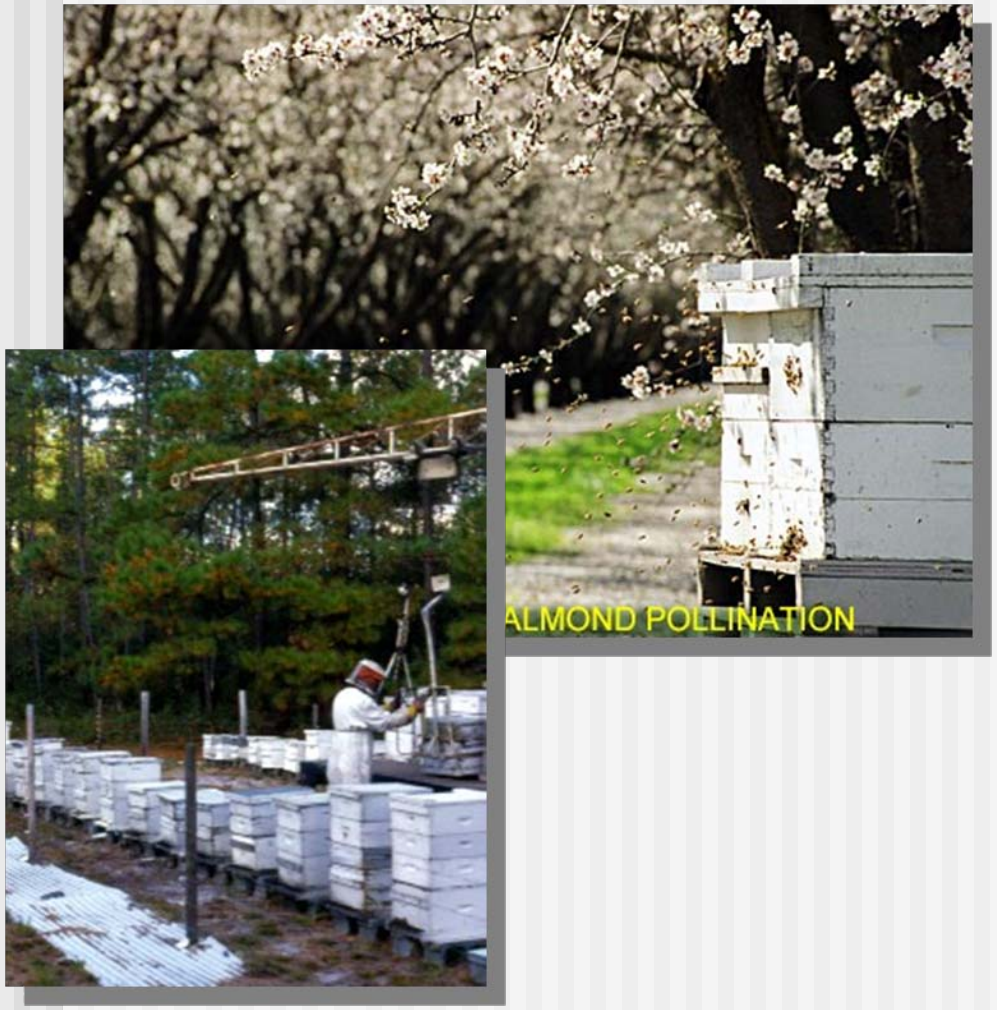
This is what 500 stings per minute can look like…

Morphology



An AHB worker (left) and EHB worker (right). African and European bees look virtually identical, although African workers develop faster in the larval stage. AHBs sometimes have a darker color than EHBs, but color is too variable in both races to be used as a reliable identification mechanism. The two races differ more in how they behave rather than how they look.

Crop pollination



Beehives are often contracted to be placed temporarily into fields and orchards to help pollinate crops. Over 100 different crops reply on honey bee pollination, accounting for $20 billion per year in added agricultural produce. The AHB is much less amenable to transport and movement in agricultural contexts.

Mechanisms of Displacement

How the AHB has supplanted the resident EHB population and remains so ecologically dominant

Swarming

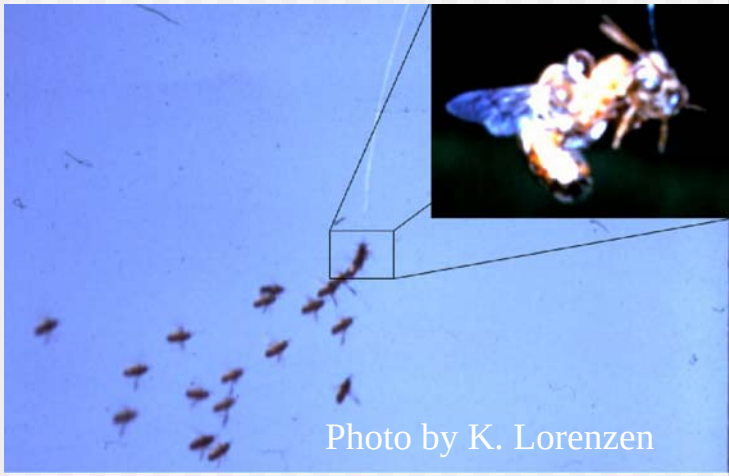
A swarm of African bees. African colonies swarm more often than European colonies and quickly establish large wild populations, which helps them out compete European colonies. African colonies are also much more likely to abscond (abandon a nest site) and migrate during dearth periods. This increased colony mobility further helps to spread the AHB quickly throughout a colonized region.

Negative heterosis

Africanized worker, drone, and queen honey bees (left to right). AfHB workers and queens have lower metabolic rates than African bees. Also, the left and right forewings of EHB/AHB hybrid workers are less symmetrical when compared to one another than are the wings of African workers. This may further reflect incompatibilities between African and European genes that negatively affect larval development. In combination, the physiological and developmental differences might make hybrid bees less competitive and less efficient at foraging, swarming, and mating. As a result, hybrid colonies may not survive well in the wild, which would contribute to the loss of European traits.

Mating advantages

AHB drones may have a mating advantage over EHB drones. African drones are more abundant, take mating flights at times that may increase their chances of mating with European queens, and will drift into EHB colonies and suppress the rearing of European drones. Also, even if queens mate with an equal number of AHB and EHB drones, they may preferentially use African sperm to fertilize their eggs. AHB drone mating advantages result in the rapid spread of African genes and the loss of European genes.



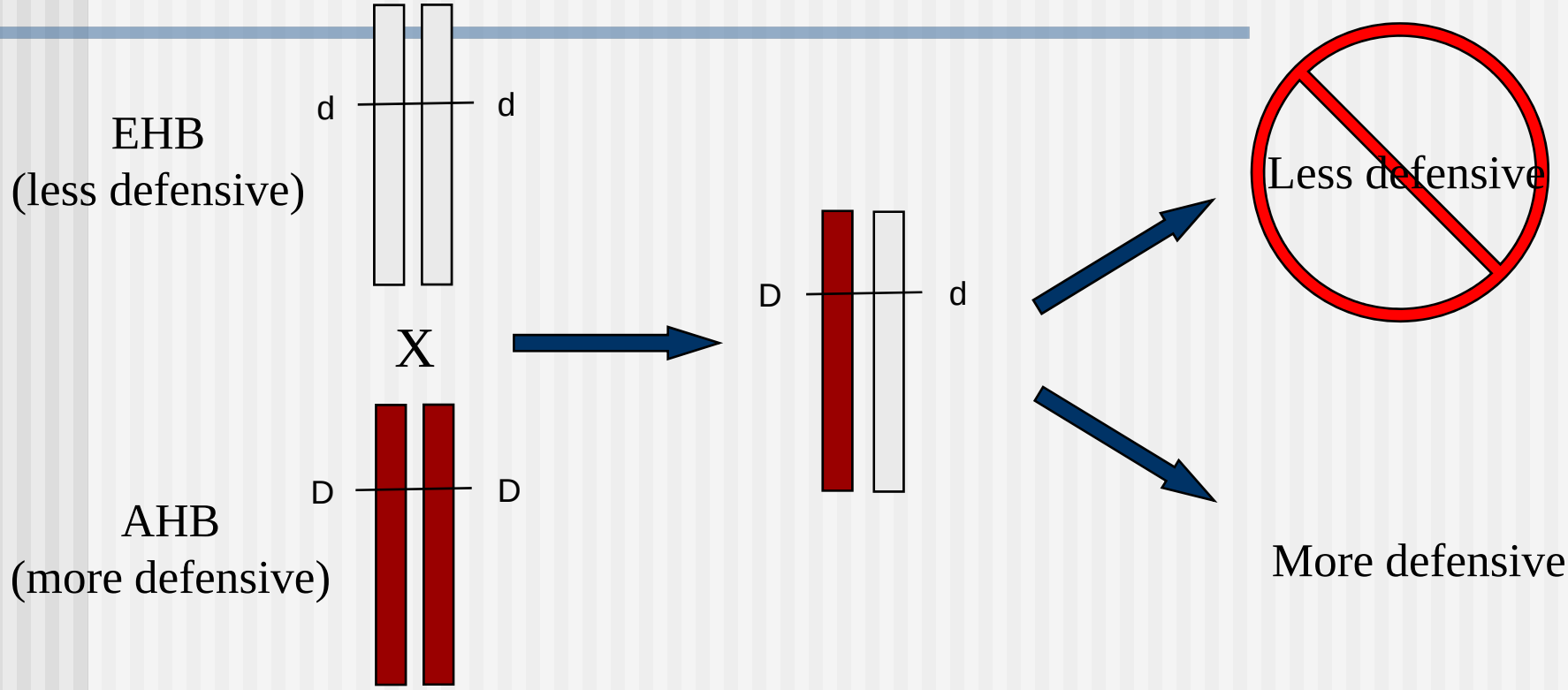
Queen advantages

A virgin queen (VQ) emerging from a queen cell. African-patriline VQs develop faster and emerge sooner than European-patriline VQs. This may give African queens more opportunities to kill their unemerged rivals and become the new laying queen of their colony, thereby contributing to the loss of EHB traits.

Queen advantages (cont.)

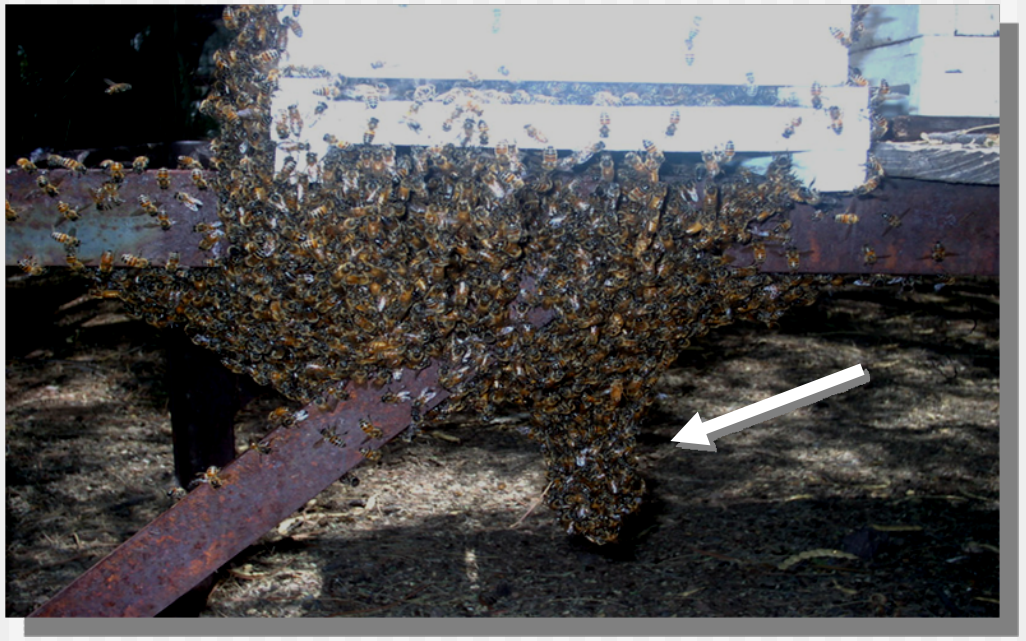
Two virgin queens fighting to the death. When African- and European-paternity VQs are present in the same colony, the African queens kill more of their rivals and produce more bouts of “piping” (a sound signal that may promote fighting success). African VQs also receive more “vibration signals”. Queens can be vibrated hundreds of times an hour, and VQs that receive more signals survive longer and kill more rivals. In combination, the greater fighting ability, piping activity, and vibration signals received results in African-patriline queens winning the rival elimination process and becoming the new laying queens of their colonies. This, in turn, results in the rapid loss of EHB characteristics.

Genetic dominance



For many genes, such as those for defensive behavior, the African genotype is dominant to the European genotype. As a result, heterozygotes (individuals with one allele of each type) behave more like their African parent than their European parent.

Nest usurpation



An African honey bee usurpation swarm actively invading a European honey bee colony. The arrow is pointing to a ball of African bees that are surrounding and protecting the queen.

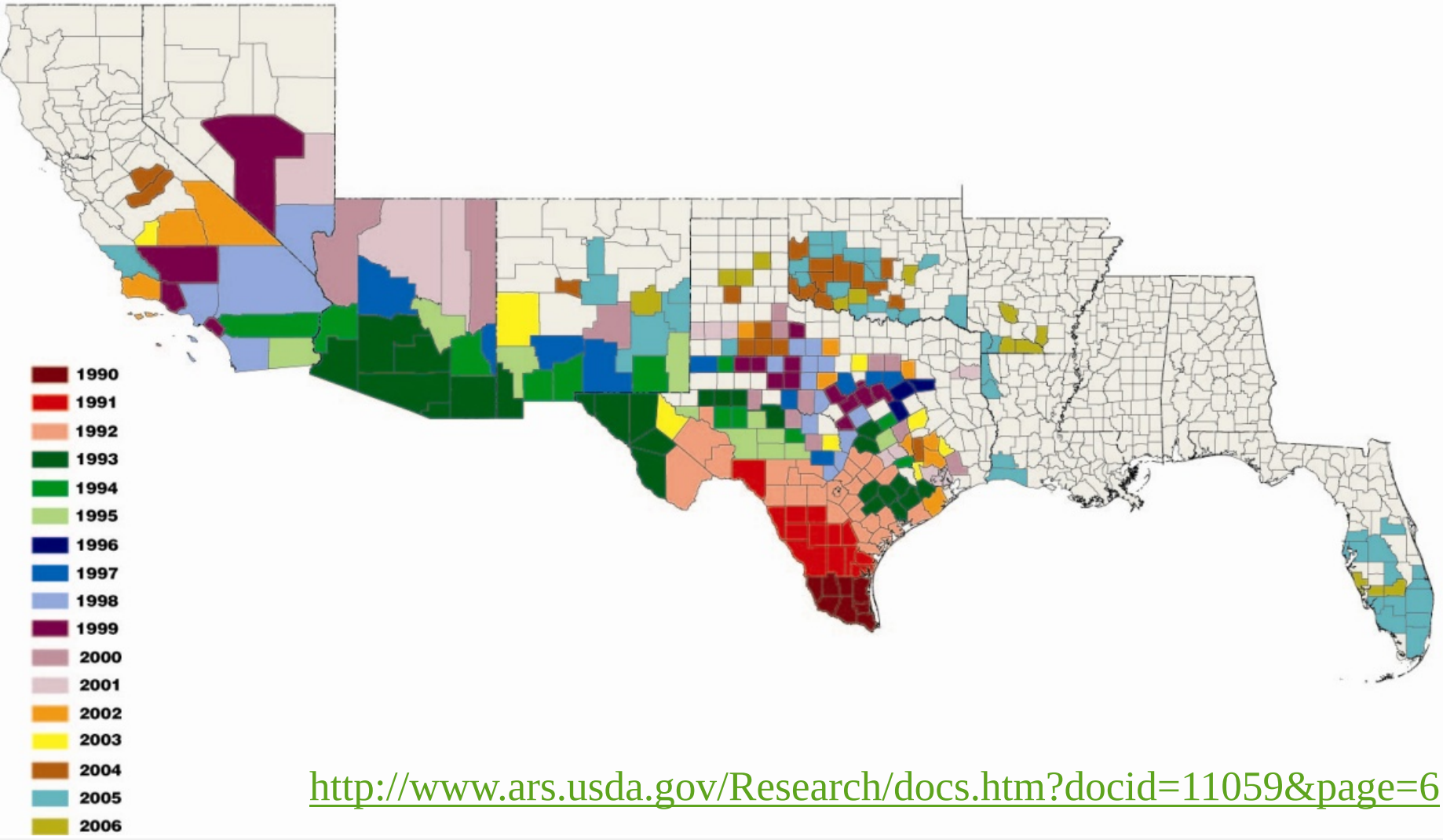
AHB in the US

Where are they now?

Spread of Africanized honey bees by year, by county

Updated January 2007

First found in southern Texas in 1990, Africanized honey bees are now found in much of the South.



http://www.ars.usda.gov/Research/docs.htm?docid=11059&page=6

Symptoms of AfHB

What to look for in your hives to tell that you might have Africanized bees

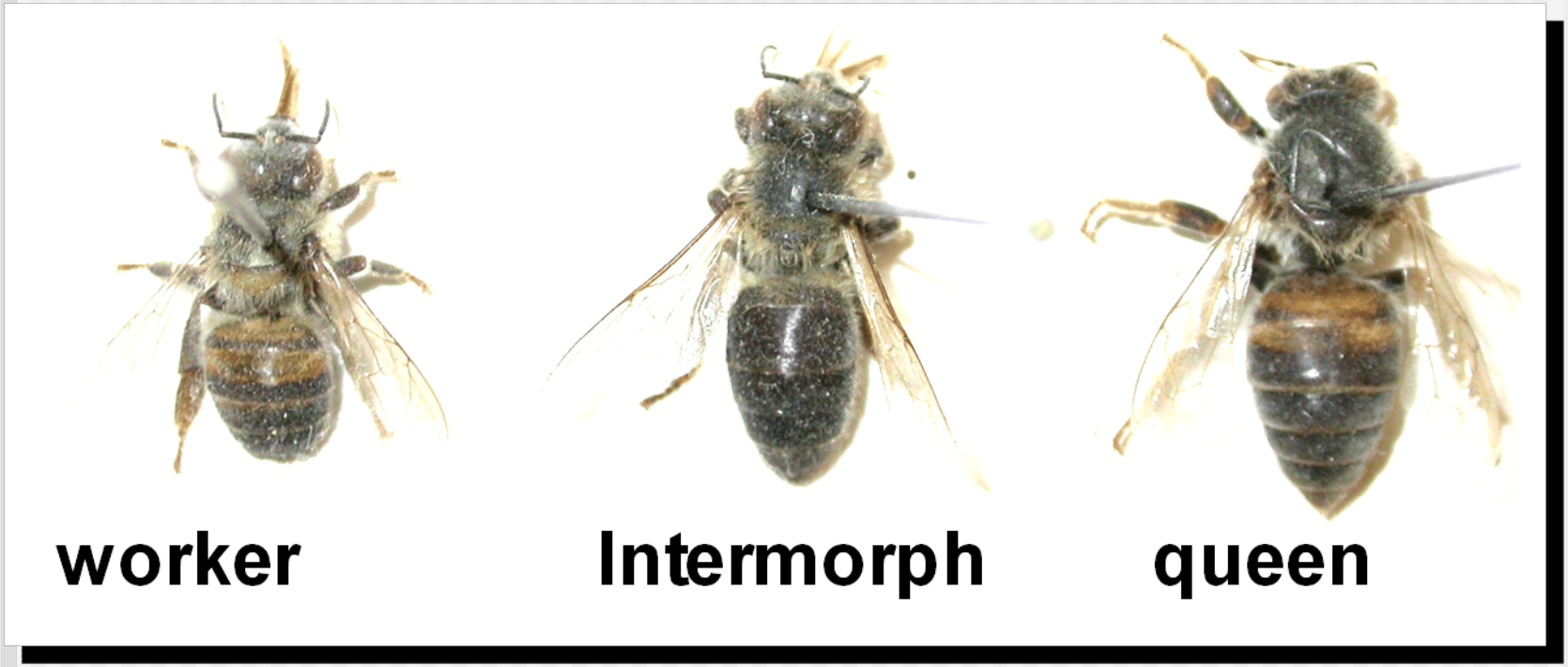
“Runniness”

Comparison of European and African bees on a brood frame. Notice how the European bees cover the brood…

“Runniness” (cont.)

…while the African bees leave it exposed.

Intercastes



Examples of worker bees, intermorphs from African colonies, and an African queen. Note the differences between the abdomens of a European worker and an intermediate morph. Notice the differences in the amount of branched hairs on the worker abdomen, and the absence of them on the intermorph.

Parasitic swarms

An African swarm usurping a European colony. Usurpation swarms are small reproductive or absconding swarms that invade an EHB nest, replace the European queen, and take over the colony. Queenless EHB colonies and those with a caged queen are particularly susceptible to usurpation. In southern Arizona, annual usurpation rates can reach 20-30%, suggesting that usurpation is an important factors in the displacement of European in parts of the southwestern U.S. In southern Arizona, peak usurpation activity occurs from October – December, which corresponds to the absconding season for African bees in the Tucson basin.

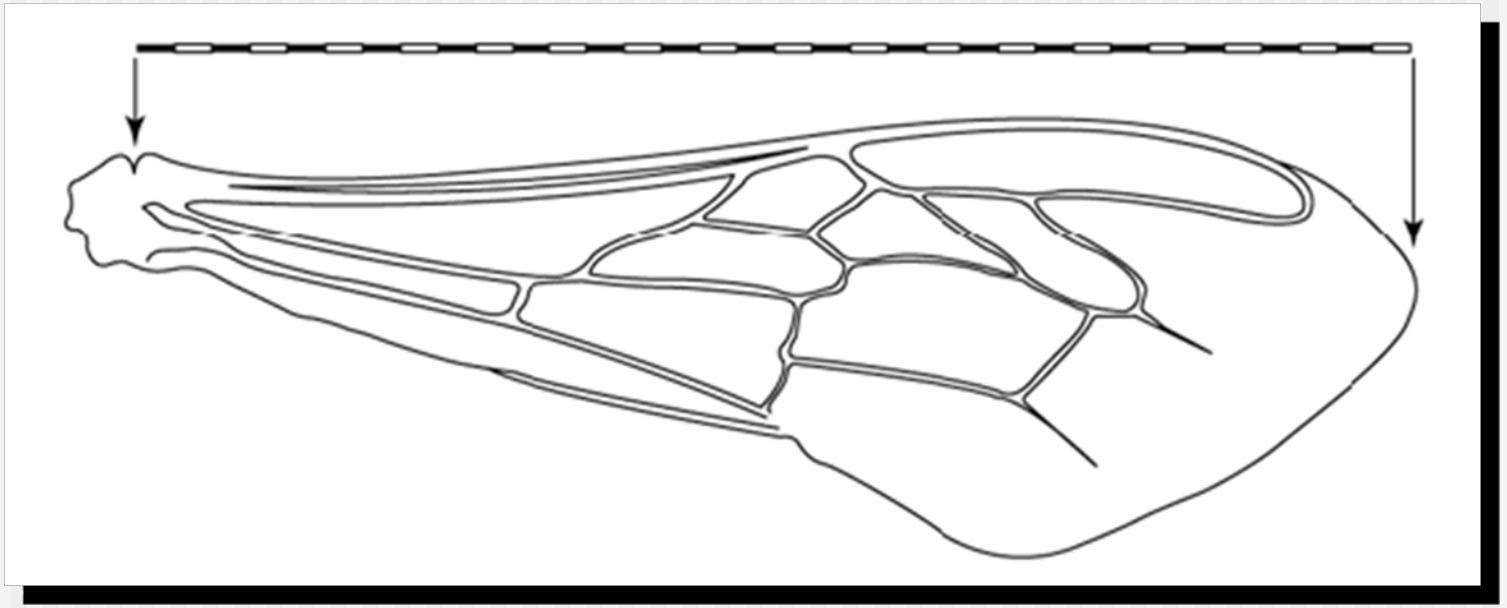
AHB identification

How scientists and officials can distinguish African from European honey bees

Morphometrics

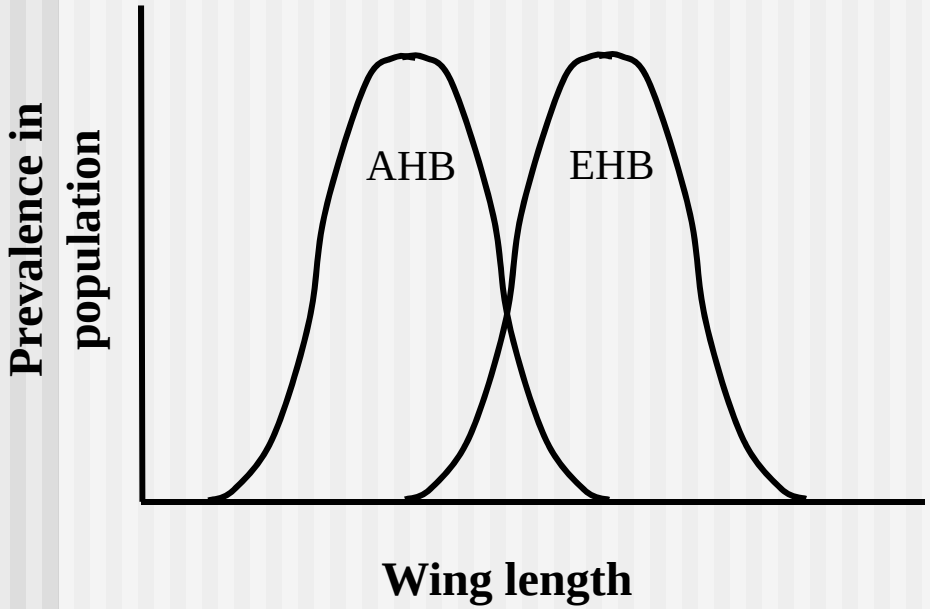
Carefully measuring different body parts to distinguish AHB from EHB, since African bees are smaller, on average.

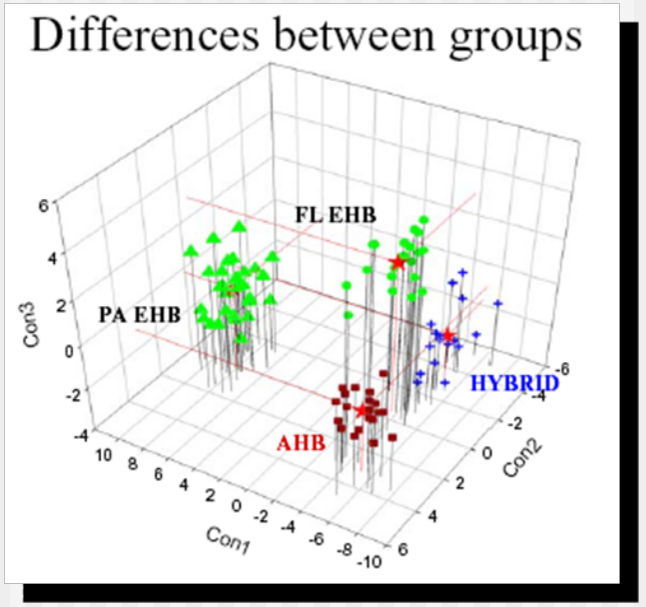
Measurements



- The FABIS method (Fast African Bee Identification System) measures wing lengths of a sample of bees
- The full USDA-ID method measures 23 separate characters and analyzes with principle component analysis

Analysis

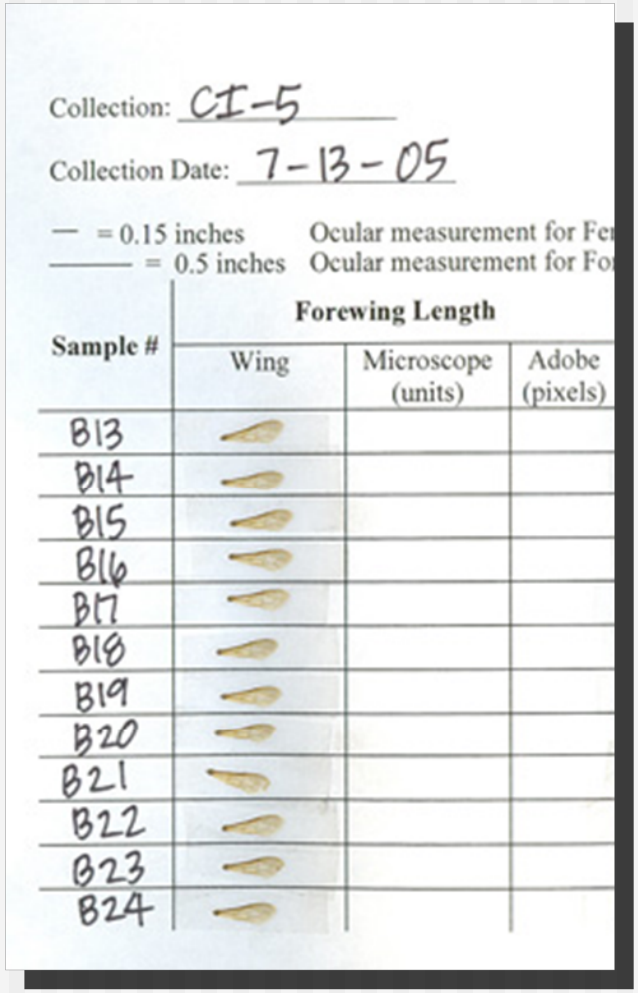




There is much overlap between the AHB and EHB populations, particularly in hybrid zones, making it difficult to readily diagnose a particular sample.

Results from recent survey

A recent survey of bees collected in North Carolina found that two of 19 unknown samples were possible AHB hybrids, and a third sample may have been a positively identified as AHB



Collection: CI-5

Collection Date: 7-13-05

— = 0.15 inches Ocular measurement for Fe

——— = 0.5 inches Ocular measurement for Fo

Sample #	Forewing Length		
	Wing	Microscope (units)	Adobe (pixels)
B13			
B14			
B15			
B16			
B17			
B18			
B19			
B20			
B21			
B22			
B23			
B24			

Morphometrics (overview)

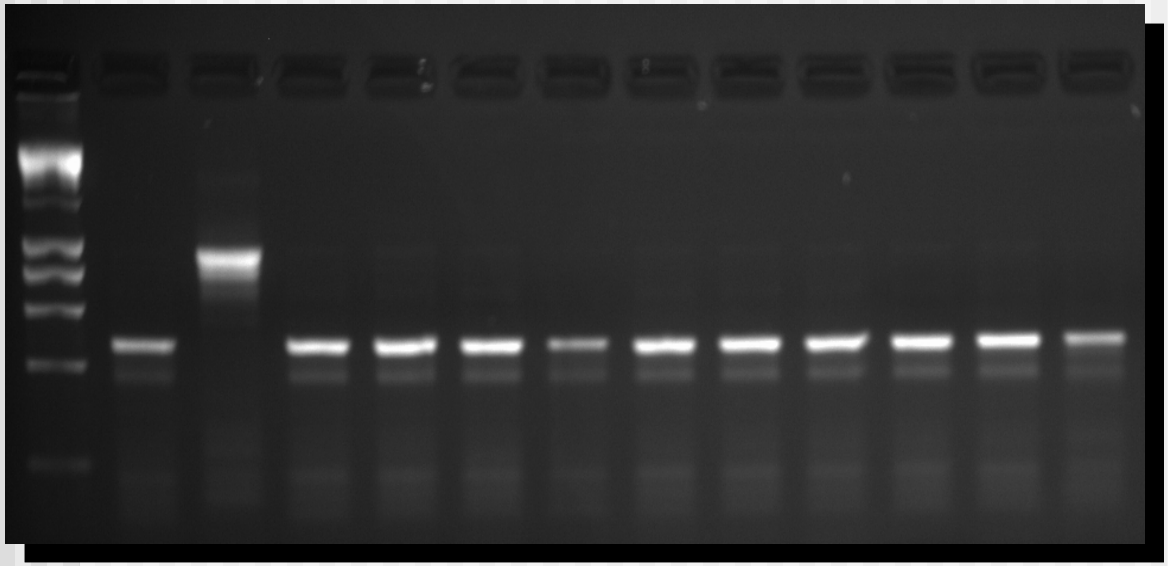
Merits

- Inexpensive
- Measures quantitative traits (with maternal and paternal affects)

Limitations

- Need large samples to minimize sampling error
- Time consuming
- Provides only probabilistic results of AHB vs. EHB
- FABIS alone is inaccurate in hybrid zones

Genetic analyses



Mitotyping (left) analyzes maternally inherited genetic markers to determine the mother’s lineage as either European or African. Other (more expensive) tests can also determine paternity.

Measurements

PCR product (amplified section of mtDNA)

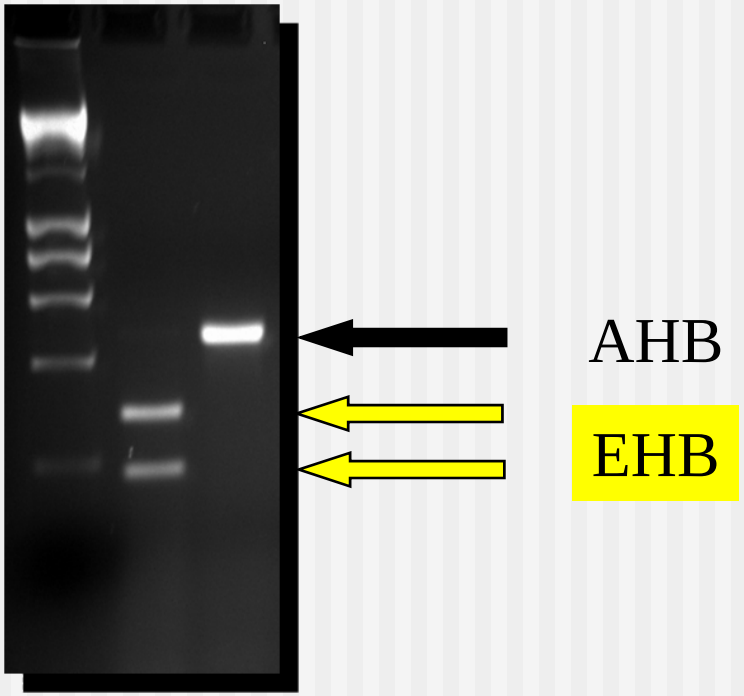
+ restriction enzyme

EHB

AHB

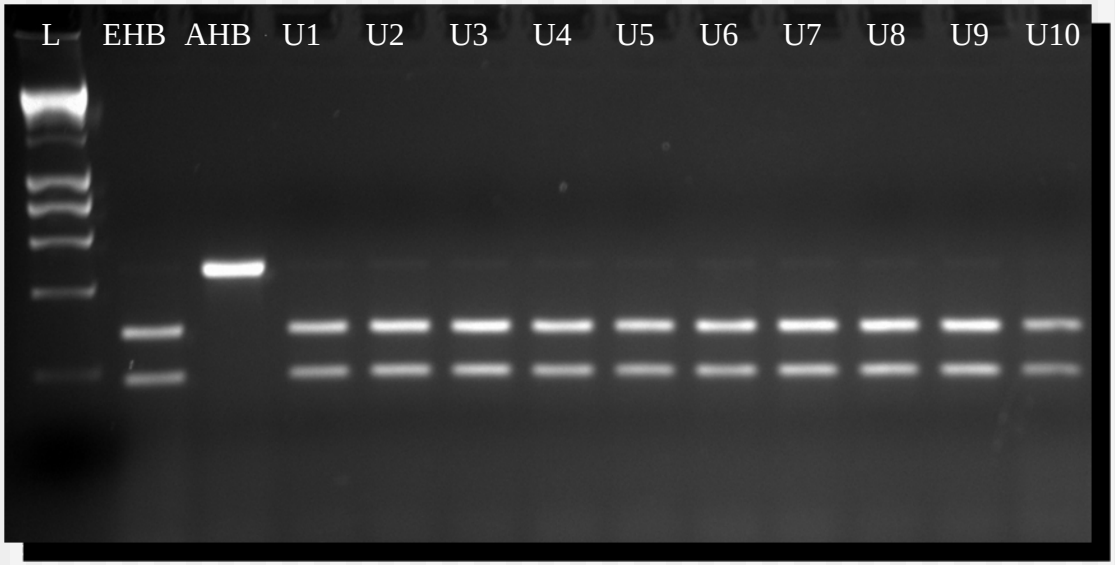
One cut
=
two small bands

No cut
=
one large band



Results from recent survey

A recent survey found that all samples collected in NC were shown to be of European origin (*including* those which were possible AHB as determined by FABIS analysis). **Thus there is no evidence that the AHB is in NC at this time.**



Mitotyping (overview)

Merits

- Precise answer (AHB vs. EHB)
- Rapid analysis
- Does not require large samples

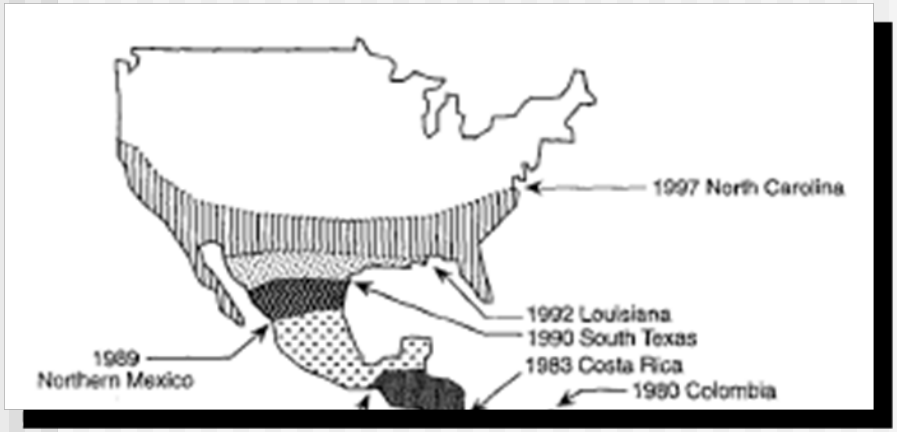
Limitations

- Expensive and equipment is not readily available
- Determines only maternal lineage (thus cannot distinguish hybrids)

Will they ever get to NC?!

It is not a questions of whether or not the AHB will be introduced to NC, as they almost certainly will be, but a question of whether they will become permanently established.

Predicted distribution



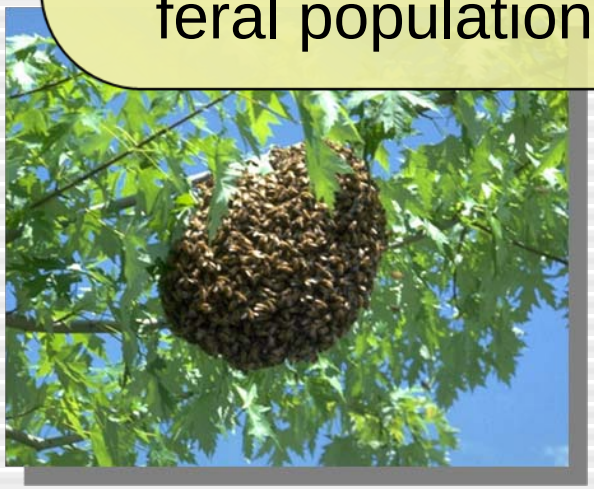
From Winston (1992)

Early predictions were based largely on temperature gradients and the distribution of *A. m. scutellata* in its native Africa. A common assumption is that the AHB cannot survive a prolonged winter, which will slow or prevent its movement into northern states. However, we now know that feral AHB populations are established in areas above 5,000 ft in Arizona and New Mexico and can survive through the winter. Thus, at this point, we do not know the extent to which the AHB will spread in the U.S. or how quickly the invasion process will proceed.

An important distinction…

Method of movement #1:
natural dispersal

An established, permanent feral population of AHB



Method of movement #2:
human-assisted transport

Point introductions but *not* an established population

Ultimate distribution

We cannot predict in which regions the AHB will become permanently established or be a “seasonal visitor,” in which colonies may migrate in during spring and summer but die out during the winter. The ultimate distribution of the African bee in the U.S. will depend on a combination of its inherent ability to spread and survive in new areas and human assisted movements that might transport the bee past barriers that otherwise would halt its progression.

What can I do to help?

Things that *every* beekeeper can do to address the AHB issue

Be vigilant

1. **Mark** all queens; no exceptions.
2. Regularly check hives for unusual external clumping of bees, as these may be parasitic AHB swarms.
3. **Requeen** any colony that is unacceptably defensive or contains an unmarked queen; use only queens from a known EHB source.
4. **Inspect hives** for behavioral signs of AHB, particularly after they are transported in and out of known AHB areas.
5. **Send suspect samples** to authorities for morphometric or genetic testing; place 30 to 50 adult bees in a small container, fill with enough 70% ethyl alcohol to cover the bees, and label with contact information, collection date, and location.
6. In an Africanized area, attempt to make all potential AHB nesting sites “bee tight”; avoid storing empty beehives outdoors.

Be responsive

1. Keep AHB incidents in an appropriate context during media interviews. **DO NOT** include box hives in filming about stinging incidents, as this promotes a negative perception of **all** honey bees. **DO** include managed hives in filming about the benefits of beekeeping.
2. **Avoid speculation** and answer only those questions to which you know the answer. Read articles that provide the background information necessary for explaining the AHB to the media and public.
3. **Don't sensationalize** defensive behavior by using terms like "aggressive" or "vicious."
4. Make clear the **relative risk** of the AHB; the number of deaths each year from stinging incidents are far fewer than dog attacks, food allergies, even lightening strikes.

Be proactive

1. Emphasize that beekeepers are on the front lines of defense—**beekeepers are part of the solution**, not the problem.
2. **Be a good neighbor** and inform anyone who may be in close proximity to your hives; educating them about the benefits of honey bees and the relative risks of AHB should lessen their fears.
3. Establish and **maintain lines of communication** between local beekeepers, first responders, and local officials.
4. Make people aware of the distinction between **yellow jackets and bees**, as many people mistake wasps for honey bees. Increased public awareness of the different types of stinging insects will reduce the number of erroneous AHB reports.

http://entomology.ncsu.edu/apiculture