NORTH CAROLINA AFRICANIZED HONEY BEE ACTION PLAN UPDATED 2016

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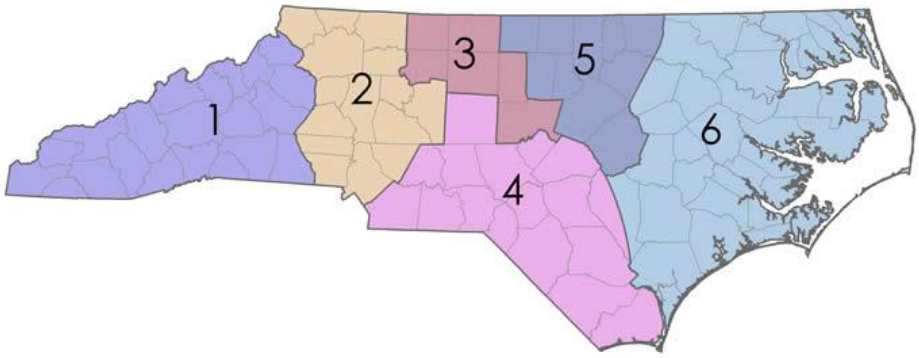
I. QUICK CONTACT INFORMATION

North Carolina Department of Agriculture and Consumer Services, Apiary Inspection
http://www.ncagr.gov/plantindustry/plant/apiary/apiarymp.html

The North Carolina Department of Agriculture and Consumer Services (NCDA&CS) maintains an active Apiary Inspection Program in the state. Six regional inspectors across the state serve as important resources for beekeepers to keep their hives free of diseases and pests.



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State Apiarist	Don Hopkins	Don.Hopkins@ncagr.gov	(919) 218-3310
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Region 5	Adolphus Leonard	Adolphus.Leonard@ncagr.gov	(252) 916-3444
Region 6	Nancy Ruppert	Nancy.Ruppert@ncagr.gov	(910) 690-9555

North Carolina State Beekeepers Association
http://www.ncbeekeepers.org

North Carolina has over 70 county beekeeping associations across the state that are part of the larger North Carolina State Beekeepers Association (NCSBA). Most of these chapters meet monthly with instructional programs, and many clubs offer new beekeeper classes each year. These local associations serve as valuable resources for experienced beekeepers to offer advice and act as mentors to beginning beekeepers.

North Carolina State University Apiculture Program
http://ncsuapiculture.net

The Apiculture Program at NC State University has been a leader in honey bee research, extension, and instruction. Part of their mission is to assist beekeepers by helping to develop and disseminate information about new management techniques to improve colony health and productivity. For further information about the program, contact your local Cooperative Extension Office.

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II. BACKGROUND INFORMATION

The introduction of the Africanized Honey Bee (AHB) into the Americas resulted from a research experiment mishap in Sao Paulo, Brazil in 1956 (Rinderer 1988; Schneider et al. 2004a). African bees were imported into that area to determine if they were superior to European bees in honey production. The African bees escaped and mated with the European honey bees (EHB) in the area, producing "Africanized" bees. The bees have since been moving northward, sometimes at an estimated rate of 300 kilometers per year. The AHB is now permanently established throughout the southwestern U.S and many of the southeastern states, and has recently become established in southern Florida (Fig. 1). Accidental introductions through ships and transport vehicles have been reported for several states, including North Carolina and Tennessee, but the AHB is not known to be permanently established in these regions at this time.

It is currently unclear how far north the AHB will be able to spread in the U.S. Sub-zero temperatures are experienced by the AHB over much of its native range. Perennial colonies exist in Africa at altitudes of almost 2000 meters (6500 feet), where snow lasts for up to a week at a time, and absolute minimum temperatures of less than 0° C (32° F) are found for 6 months of the year (Fletcher 1978). Recent studies have shown the overwintering behavior of the AHB is very similar to the EHB (Dietz et al. 1988).

Given the history of rapid expansion of the AHB, and the recent developments of an established population in the southeastern region of the country, it is very likely that Africanized honey bees will soon arrive in North Carolina. **Although it is difficult to predict if, how, when, and where, it is speculated that the AHB will become established in the state by the end of the decade.**

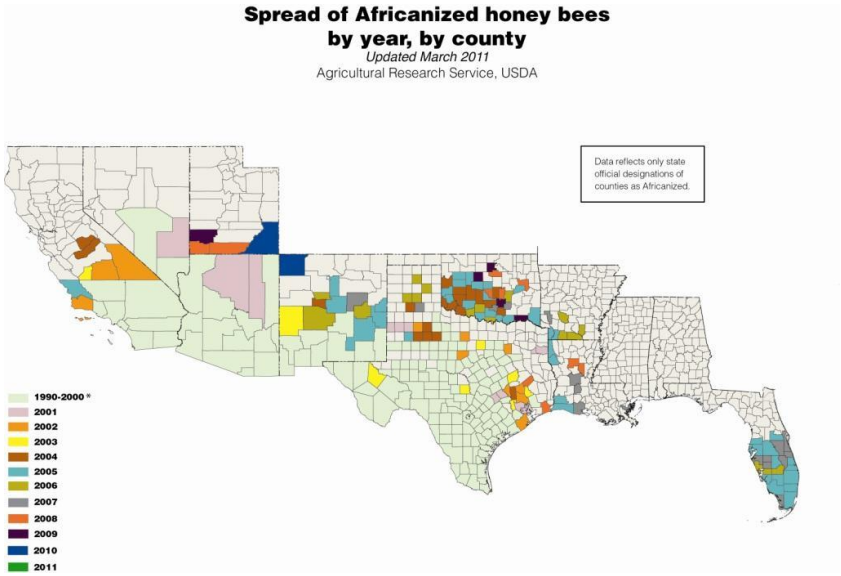

Figure 1. The current distribution of the AHB in the United States (from: https://www.ars.usda.gov/pacific-west-area/tucson-az/honey-bee-research/docs/africanized-honey-bees/page-6/

The North Carolina AHB Action Plan is a joint effort of the North Carolina Department of Agriculture and Consumer Services (NCDA&CS) and North Carolina State University (NCSU). The plan has been developed within a framework established by the United States Department of Agriculture, Animal and Plant Health Inspection Service (USDA-APHIS) and other state plans. The North Carolina Africanized Honey Bee Action Plan takes a five-fold approach to the AHB problem. First, it will utilize the North Carolina Honey Bee Identification Laboratory for accurate and timely analyses of honey bee races. Second, it will initiate a vigorous program to educate the state's beekeepers, the general public, pest control operators, and the medical and public health community. Third, it will establish quarantine initiatives to slow the spread of the AHB into the state and to manage the AHB after it becomes established. Fourth, it calls for scientific investigation into various aspects of AHB biology in an attempt to minimize its impact on beekeepers and the general public. Finally, the plan calls for an organized effort to establish North Carolina as a self sufficient beekeeping community with ample queen and package resources to meet the needs of the state's beekeepers.

In 1987, NCDA&CS & NCSU, in conjunction with the USDA-APHIS, began preparations for the anticipated arrival of the AHB. The first measure taken was the establishment of "bee free zones" around the state's two ports at Morehead City and Wilmington, with managed bees prohibited in this zone. In November 1989, the state's first AHB incident occurred at the Morehead City Port. A feral AHB swarm was discovered in the subflooring of an office trailer that had been shipped from Honduras to North Carolina. The hive was destroyed, and survey procedures were initiated to determine the extent of the infestation. It was quickly determined that this was an isolated incident and that the AHB was not present in the area. The renamed "bee alert zone" encompasses a two-mile radius around each port. If managed bees are not kept in these areas, survey procedures are greatly simplified.

An AHB Advisory Committee was also appointed in 1987. Members of the advisory committee were selected to represent beekeeping interests from across the state. This committee is composed of representatives from the NC State Beekeepers Association (NCSBA), commercial beekeepers, NCDA&CS, NCSU, and the United States Department of Agriculture. The main function of the committee is to act in a planning and advisory role to minimize the potential impact of the AHB on North Carolina Agriculture. The committee is also responsible for developing and approving the final draft of the North Carolina AHB Action Plan. In 2001, the committee's responsibilities were expanded to include all honey bee pests and the committee was renamed the North Carolina Honey Bee Advisory Committee. Current committee members are listed in Appendix A.

III. AFRICANIZED HONEY BEE CHARACTERISTICS

The AHB, *Apis mellifera* subsp. *scutellata* Ruttner, is a subspecies of the Western Honey Bee, *Apis mellifera* L. While the two varieties of *A. mellifera* exhibit many similar biological and behavioral characteristics, there remain some very fundamental differences (Schneider 2015).

AHB are probably most renowned for their defensive behavior. If AHB nests are disturbed, they will retaliate more quickly and in greater numbers than their European relatives (Rinderer 1988; DeGrandi-Hoffman et al. 1998). It has been reported AHB will pursue people or animals as much 600 feet from an apiary. Reports also indicate that the number of stings can be as many as 10 times greater compared to the reaction of EHB during a single encounter (Rinderer 1988). Fortunately, the AHB sting is very similar to that of a EHB in terms of the amount of venom administered and its chemical composition. Swarming AHB are generally no more aggressive than their European counterparts.

The AHB has been observed to be a great deal more difficult to manage than the EHB. This is due in part to their tendency towards frequent swarming and absconding (bees abandon the hive *en masse*). AHB swarms have been documented taking over queenless European colonies and also usurping small EHB colonies by killing the queen (Schneider et al. 2004b). Since the AHB is capable of producing adult bees more quickly than the EHB, the colonies become completely Africanized within a few weeks. Absconding generally occurs when an area's nectar or pollen supply becomes depleted (Winston 1988; Schneider and McNally 1992). The entire colony will abandon its nesting site and may seek out a new nest site some distance from the original. The swarming and absconding biology of the AHB may pose serious management problems for beekeepers who are not accustomed to dealing with such behavior.

The AHB is also noted for its diverse preference of nesting sites (Moffett & Maki 1988). For example, in South and Central America, AHB hives have been found in old rodent burrows, abandoned cars, discarded baskets, and buckets. In Arizona, AHB colonies are often found nesting in water meter boxes in the ground (Baum et al. 2008). Such locations are generally not considered suitable to EHB colonies.

Should the AHB become established in North Carolina, beekeepers will no doubt be forced to learn new management techniques to adjust to a new age in beekeeping. It is a challenge that may discourage some beekeepers; however, many will eagerly meet the obstacles ahead. The AHB has never been in an area where the beekeepers are so well trained and have as many resources available as they do in North Carolina. Beekeepers, with the assistance of the applicable state agencies, should be able to deal with AHB unless they are hindered by unfavorable public reactions (including municipal restrictions towards honey bees and beekeeping).

Throughout the time that the African honey bee has been expanding northward from Brazil, it has interbred with European honey bees, resulting in a hybrid referred to as the Africanized Honey Bee (AHB). Initially it was assumed that the introgression of European genetic material into the expanding AHB population would genetically dilute undesirable African traits. However, despite over 60 years of hybridization, the AHB has largely retained its African genetic and behavioral characteristics (Schneider et al. 2004a). Indeed, throughout much of its range in the Americas, including the southern U.S., the mitochondrial genome of feral AHB colonies has remained African (Pinto et al. 2004). Because mitochondrial DNA is inherited solely from the mother, this means that feral colonies in Africanized areas are descended from African queens; feral colonies descended from European queens are displaced by the AHB. Similarly, the nuclear genome of workers (which is of both maternal and paternal origin) reveals a consistent make-up of about 70% African and 30% European, even after years of interbreeding between AHB and European colonies (Pinto et al. 2005; Whitfield et al. 2006). This suggests that there may be a limit to the extent to which European genes can become incorporated into the AHB population, or that this combination of African and European genes results in a bee that has a competitive advantage in Africanized areas (Wallberg et al. 2014). These colonies are behaviorally African, with respect to stinging behavior, foraging, nest characteristics, growth patterns, swarming and absconding (Schneider et al. 2004a). Nevertheless, the AHB in the Americas is a hybrid bee and is no longer genetically identical to African bees. Hybridization can complicate the identification of the AHB depending on the extent to which AHB and European drones and queens interbreed in invaded areas. Positive verification of the AHB requires a combination of morphometric, genetic and behavioral assays, and reliance on only a single method of verification may result in false positives.

IV. Value of Bees and Beekeeping in North Carolina

It has been estimated that the AHB arrival in the U.S. will be felt most severely by the beekeeping industry. There are approximately 15,000 beekeepers in North Carolina who manage approximately 150,000 colonies

of bees for either honey production, pollination services, or both. Collectively, North Carolina's yields an average of 5.5 million pounds of honey annually, which accounts for approximately $10 million in sales per year.

When compared to the value of crop pollination, honey production makes a minor contribution to the beekeeping industry. According to agricultural statistics released by the NCDA&CS, the NCSU Apiculture program estimates that over the last five years in North Carolina, honey bees have directly accounted for an average of $88 million in annual fruit and vegetable production (67.9% of total value) and approximately $154 million in total annual crop productivity (24.5% of total value; see *Table 1*). Fruit and vegetable crops that rely heavily upon honey bees for pollination include cucumbers, blueberries, watermelons, apples, squash, strawberries, melons, and peaches, while forage crops that benefit from (but not necessarily require) honey bees include alfalfa, cotton, peanuts, and soybeans. Honey bees also benefit wildlife by pollinating their food plants. It would be very difficult to estimate the ecological value of honey bees; however, it can be assumed that this value equals or perhaps surpasses their agricultural value. The financial hardships created by the AHB's arrival will no doubt be passed from the beekeeper to the farmer and, ultimately, to the consumer.

Table 1. The value of NC agriculture directly attributable to honey bee pollination. Table taken from NCSU *Beekeeping Note* **3.14**.

FRUITS AND	Total Value of Production ($1000s of dollars)							Vaule attributable to honey bees ($1000s of dollars)					
VEGATABLES	2000	2001	2002	2003	2004	D	P	2000	2001	2002	2003	2004	5 Year Avg
Apples	12,261.000	11,250.000	22,205.000	17,103.000	16,630.000	100%	90%	11,034.900	10,125.000	19,984.500	15,392.700	14,967.000	14,300.82
Blueberries	18,130.000	18,900.000	22,534.000	34,777.000	32,235.000	100%	90%	16,317.000	17,010.000	20,280.600	31,299.300	29,011.500	22,783.68
Brambles	.	.	583.440	938.250	982.560	80%	90%	.	.	420.077	675.540	707.443	601.02
Cucumbers (fresh)	11,900.000	10,764.000	12,075.000	13,260.000	11,340.000	90%	90%	9,639.000	8,718.840	9,780.750	10,740.600	9,185.400	9,612.91
Cucumbers (pickled)	24,300.000	24,147.000	23,490.000	23,612.000	19,404.000	90%	90%	19,683.000	19,559.070	19,026.900	19,125.720	15,717.240	18,622.38
Grapes	2,661.000	2,532.000	2,934.000	2,989.000	3,366.000	10%	10%	26.610	25.320	29.340	29.890	33.660	28.964
Melons	.	.	20,000.000	20,000.000	20,000.000	80%	90%	.	.	14,400.000	14,400.000	14,400.000	14,400.00
Peaches	4,440.000	1,400.000	3,500.000	2,400.000	2,940.000	60%	80%	2,131.200	672.000	1,680.000	1,152.000	1,411.200	1,409.28
Pumpkins	.	.	2,000.000	2,000.000	2,000.000	90%	10%	.	.	180.000	180.000	180.000	180.00
Squash	9,200.000	9,750.000	10,260.000	8,430.000	9,000.000	90%	10%	828.000	877.500	923.400	758.700	810.000	839.52
Strawberries	17,325.000	16,660.000	19,125.000	15,300.000	15,840.000	20%	10%	346.500	333.200	382.500	306.000	316.800	337.00
Watermelons	8,640.000	7,513.000	9,503.000	6,825.000	6,300.000	70%	90%	5,443.200	4,733.190	5,986.890	4,299.750	3,969.000	4,886.40
Subtotal	***108,857.000***	***102,916.000***	***148,209.440***	***147,634.250***	***140,037.560***			***65,449.410***	***62,054.120***	***93,074.957***	***98,360.200***	***90,709.243***	***88,001.994***
(% of total value)								***60.1%***	***60.3%***	***62.8%***	***66.6%***	***64.8%***	***67.9%***
FORAGE CROPS													
Alfalfa (hay)	5,940.000	7,200.000	5,000.000	5,940.000	3,120.000	100%	60%	3,564.000	4,320.000	3,000.000	3,564.000	1,872.000	3,264.00
Cotton (lint)	363,538.000	254,564.000	163,263.000	322,051.000	253,286.000	20%	80%	58,166.080	40,730.240	26,122.080	51,528.160	40,525.760	43,414.46
Cotton (seed)	44,441.000	25,704.000	25,704.000	37,692.000	41,795.000	20%	80%	7,110.560	4,112.640	4,112.640	6,030.720	6,687.200	5,610.75
Peanuts	.	.	45,990.000	73,280.000	77,112.000	10%	20%	.	.	919.800	1,465.600	1,542.240	1,309.21
Soybeans	.	.	174,305.000	306,180.000	257,550.000	10%	50%	.	.	8,715.250	15,309.000	12,877.500	12,300.58
Subtotal	***413,919.000***	***287,468.000***	***414,262.000***	***745,143.000***	***632,863.000***			***68,840.640***	***49,162.880***	***42,869.770***	***77,897.480***	***63,504.700***	***65,899.013***
(% of total value)								***16.6%***	***17.1%***	***10.3%***	***10.5%***	***10.0%***	***13.2%***
TOTAL	***522,776.000***	***390,384.000***	***562,471.440***	***892,777.250***	***772,900.560***			***134,290.050***	***111,217.000***	***135,944.727***	***176,257.680***	***154,213.943***	***153,901.007***
(% of total value)								***25.7%***	***28.5%***	***24.2%***	***19.7%***	***20.0%***	***24.5%***

D = Dependency of crop on insect pollination for fruit set
P = Proportion of insect pollinators that are honey bees

Resources: National Agricultural Statistics Service
Morse, R. A. & N. W. Calderone. (2000) The value of honey bees as pollinators of U.S. crops in 2000. *Bee Culture* **128**: 1-15.
McGregor, S. E. (1976). *Insect Pollination Of Cultivated Crop Plants* . Agriculture Handbook No. 496, USDA-ARS, U.S. Gov. Prnt. Office, Washington, DC.

V. POTENTIAL IMPACT OF THE AHB IN NORTH CAROLINA.

Given the importance of honey bees and beekeepers to the state's agricultural economy, it is vital to ascertain the possible consequences of the AHB becoming establish in North Carolina. The following is a list of potential problems and concerns that could occur once the AHB is present in the state.

A. Over dramatization of the AHB's defensive behavior by the press may lead to public prejudice against the beekeeping industry.
B. Public fear of the AHB in some municipalities will mandate unrealistic bee regulation over common sense and sound logic. In doing so, some municipalities may pass restrictive ordinances against keeping bees.
C. Quarantines will restrict the movement of bees into agricultural crop pollination locations.
D. In crop pollination locations, the defensive nature of AHB may hinder the operation of farm

machinery and prevent workers from entering fields.

E. Due to the reproductive biology (swarming and absconding) and nesting behavior of the AHB, the public may be more likely to encounter AHB swarms and colonies in cities, parks, forests, and neighborhoods.
F. The tendency of the AHB to abscond when their hives are transported for pollination will increase the cost and difficulty of crop pollination.
G. The AHB could interfere with timber harvest, fire control, and recreation in National or State Forests.
H. Concern over accidents/injuries associated with keeping AHB may cause commercial beekeepers to go out of business. Moreover, the swarming, absconding, and stinging behavior of the AHB may cause hobby beekeepers to lose interest and quit keeping bees.
I. Maintenance of EHB hives could increase due to the necessity of requeening hives yearly.
J. The costs to inform the medical and public health community of possible precautions and potential problems with AHB sting encounters may rise.
K. The beekeeping industry is already suffering from the impact of several bee pests, and their problems will likely be compounded by the arrival of AHB.

These negative consequences are clear and of tremendous concern. It should be noted, however, that since the feral EHB population has been almost entirely decimated (largely from exotic pests), the AHB will likely fill that ecological void and thus may be environmentally beneficial in certain ways.

VI. RECOMMENDED ACTIONS

A. Educational Initiatives

1. **Beekeepers** - The primary means of educating beekeepers concerning Africanized Honey Bees will be the Apiary Inspectors of NCDA&CS. Moreover, the NC State Beekeepers' Association (NCSBA) will conduct annual AHB workshops at their summer conventions. This training will emphasize dealing with all honey bees (especially AHB) to reduce the chance that the bees will become a nuisance or a problem, particularly in urban and suburban areas.

2. **Growers** - The N.C. Cooperative Extension Service (NCCES) and NCSBA will make a concerted effort to work with commodity groups, state grower associations, the Farm Bureau, and other interested parties to educate farmers about the potential hazards and impacts of the AHB.

3. **Medical and Public Health Community** - Beekeepers who are also physicians have cooperated for the last several years to provide training to beekeepers on the use of emergency treatment of bee and insect stings, including the administering of epinephrine. These training programs will be continued and work will be initiated on providing information sessions to the state's medical and public health community concerning the aggressive stinging activities of the AHB.

4. **Pest Control Operators** - There are many environmental problems that could stem from inadequately trained groups attempting to control the AHB. These problems could include the destruction of certain beneficial insects, and the possibility of food, water, and structural contamination resulting from pesticide misuse.

   Historically, beekeepers have dealt with elimination of honey bees from areas where they were considered a nuisance. They did this as a public service without the use of pesticides. Because

of its biology, the AHB may present a more visible problem in some locations than European bees. Without proper training, many beekeepers may not be equipped to deal with the new problem in a safe and effective way.

The N.C. Pesticide Licensing and Certification Program provides a groundwork for environmental protection. Training for a new group of bee handler/pest management technicians may be needed. The purpose of such a program would be to minimize the public health and environmental problems that may be associated with the entry of AHB into North Carolina.

A cooperative effort should be established between the NCDA&CS Pesticide Division and the NCSU Extension Service. The Extension Service should instruct potential bee handlers/pest management technicians in bee removal and structural pesticide application. The NCDA&CS should add a licensing category to its public applicators licensing program to certify professionals passing the test. The two major goals are to: (1) reduce accident/injury associated with swarm control; and (2) minimize environmental hazards associated with pesticide use.

5. **Emergency Response Agencies** - The spread of AHB throughout the U.S. has often resulted in Emergency Response agencies such as local fire and police departments being called upon to deal with the arrival of the bees. The agencies are often called upon for the first response to an emergency or assumed emergency situation and this will probably also occur in North Carolina if AHB spreads into the state.

   It is essential that these agencies know how to obtain "expert" assistance to deal with AHB or any other stinging insect situation, and also that their personnel have some basic knowledge regarding the insects. In cooperation with the Emergency Programs Division of NCDA&CS, contact information for the Apiary Inspectors and others experts will be distributed

6. **Public** - The N.C. Cooperative Extension Service (NCCES) and NCDA&CS will educate the public about the AHB by four general methods:

   a. NCCES and NCDA&CS will maintain an online resource about the AHB in North Carolina and the greater southeast region.

   b. NCCES personnel will give presentations to school, commodity, and civic groups on the AHB.

   c. Bulletins, slide sets, and videos on the AHB will be produced for distribution throughout the state. This will also include working through the print and television media.

   d. Beekeepers will be trained and used to act as resources for providing local information on the AHB.

   e. Public Affairs/Media Divisions of NCCES and NCDA&CS will serve as media liaisons, preparing press releases and other public information.

B. Quarantine Actions

The mission of the North Carolina Department of Agriculture and Consumer Services (NCDA&CS) Apiary Program is to promote and protect the state's beekeeping industry. The Apiary Program provides disease and disorder inspections and fumigation services in an effort to control diseases and pests of the beekeeping industry. Additionally, the Apiary Program provides educational workshops to educate the state's beekeepers on the biology and treatment of mite and disease pests of honey bees and Africanized bees. Promotional efforts are achieved through lectures to county and state beekeeping organizations or any groups interested in apiculture or related topics.

The Apiary Program in cooperation with the Food and Drug Protection Division of the NCDA&CS also provides honey house sanitation inspections.

1. Action Plan for Spot AHB Infestation in North Carolina

a. Managed Bee Colonies

Detection Protocol

If the AHB is detected or suspected in managed bee colonies in advance of a general infestation, then the following plan will be implemented:

i. Install drone and queen traps on all hives located in the suspect apiary to prevent the spread of reproductives.
ii. Weigh a sample of workers, measure the diameter of comb cells (which are smaller in AHB nests), and observe feral colonies for AHB behavioral traits in order to select colonies that should be sampled for full morphometric analysis.
iii. Sample all suspect colonies in the apiary to determine the extent of the AHB infestation.
iv. Submit all samples to the NCDA&CS Honey Bee Identification Lab for AHB determination. FABIS (Fast Africanized Bee Identification System) testing will be conducted by NCDA&CS; mitochondrial DNA samples (mDNA) will be processed at NCSU.
v. If AHB is confirmed, then the survey procedure will begin.

Survey Procedure

The objective is to locate all feral or managed bees within a 3-mile radius of the suspected AHB detection (the maximum estimated distance that AHB swarms typically travel; Schneider 1995).

i. Contact local beekeepers, including N.C. Master Beekeepers, through county and state beekeeping organizations, and the County and State Cooperative Extension Service.
ii. Interview persons knowledgeable about the area of AHB infestation. Firemen, policemen, foresters, and game wardens may be able to provide information on feral and managed bee locations.
iii. Interview local residents door to door using personal communication.
iv. Monitor any movement of honeybees in a 3-mile radius of the suspected AHB find.
v. Plot all feral and managed bee locations using GPS.

Eradication or Control

At the discretion of the State Apiarist, any or all of the following may be executed:

i. Enact quarantine, under the authority of the Commissioner of Agriculture to prevent further spread of the AHB. The quarantine will minimally encompass a 3-mile radius

with the suspect yard at the epicenter. Additional quarantine areas will be initiated if needed. Movement of bees in the quarantine zone will be regulated.

ii. Sample managed bee hives within the 3-mile radius. Mandatory requeening of these colonies with certified EHB queens may be required.

iii. Require depopulation or mandatory requeening of all hives in the suspect apiary, using queens of known European descent.

iv. Monitor bees in requeened hives for AHB traits until the state apiarist is satisfied that AHB is no longer present.

v. Implement methods and tactics to locate feral colonies (e.g., beelining and placement of poison bait stations). Identified feral colonies will be destroyed as necessary.

b.Feral bee colonies

Detection Procedure

If colonies of non-managed (feral) honey bees are found in areas considered at high risk for AHB, then the following plan will be implemented. Examples of high risk areas in North Carolina include the state ports in Wilmington and Morehead City.

i.Destroy the suspect colony immediately immediately, typically by spraying with a soap solution.

ii. Make every effort to collect a sample of >200 adult bees. Mail a sample of 100 bees in 70% EtOH to a USDA-certified lab for AHB determination. The remaining bees that are preserved in EtOH will be tested at the NCDA&CS Honeybee Diagnostic Lab, 950 E. Chatham St., Cary, NC 27511.

iii. If AHB is confirmed, then the survey procedures will be initiated.

Survey Procedure

Using the suspect find as the epicenter, a survey will be initiated encompassing a 3-mile radius. The objective of the survey is to locate all managed and feral bees within a 3-mile radius. The following methods may be employed in the survey if deemed necessary by the state apiarist.

i. Contact county and state beekeeping organizations and NC Master Beekeepers.

ii. Contact county and state cooperative extension service.

iii. Contact the news media through the NCDA&CS public affairs office.

iv. Interview persons knowledgeable about the area. Firemen, policemen, foresters, and game wardens should be useful resources.

v. Employ the placement and monitoring of pheromone baited hives in the area of AHB detection.

vi. Establish honey bee bait stations with attractant pheromones. Monitor stations and use beelining techniques to determine the feral bee distribution in the area.

vii. Sample managed bees in the area and remove or requeen as appropriate.

viii. Regulate any movement of bees into or out of the area.

Eradication or control

At the discretion of the State Apiarist, any or all of the following may be executed:

i. Enact quarantine, under the authority of the Commissioner of Agriculture to prevent further spread of the AHB. The quarantine will minimally encompass a 3-mile radius with the suspect yard at the epicenter. Additional quarantine areas will be initiated if needed. Movement of bees in the quarantine zone will be regulated.

ii. Sample managed bee hives within the 3-mile radius. Mandatory requeening of these

colonies with certified EHB queens may be required.

iii. Depopulation or mandatory requeening of all hives in the suspect apiary, using queens of known European descent.

iv. Monitor bees in requeened hives for AHB traits until the state apiarist is satisfied that AHB is no longer present.

v. Implement methods and tactics to locate feral colonies (e.g., beelining and placement of poison bait stations). Identified feral colonies will be destroyed as necessary.

2. Action plan for a general Africanized Honey Bee infestation in North Carolina

a. Destroy all Africanized bee colonies when encountered using an approved pesticide.

b. Requeen all honey bee colonies on an annual basis (or more frequently if necessary).

i. Use marked certified queens of European descent.

ii. Destroy and replace unmarked queens, or mark and monitor such.

iii. Requeen or destroy all unacceptably defensive colonies.

iv. Maintain requeening records and sales receipts to be shown to NCDA&CS Apiary Inspectors upon request.

c. Conduct a vigorous program for controlling wild bee (feral) populations around apiaries.

i. Maintain swarm boxes in the immediate vicinity of all apiaries. Replace pheromone lures every six months or as needed.

ii. Inspect traps on a weekly basis and destroy all feral swarms encountered.

d. Drone management

i. Manage at least 10% of all colonies in an apiary for EHB drone production.

C. Research Priorities

Queen acceptance and queen biology – Maintaining an acceptable stock within beehives is of primary importance in addressing the AHB in North Carolina. However, the experience of beekeepers in Africanized areas has demonstrated difficulty in requeening colonies once they have become Africanized. This phenomenon is supported by empirical evidence, but the mechanisms by which queen acceptance is governed remains largely unknown. Thus understanding the pheromone biology of queens in particular and nestmate recognition in general will help address the need for stock maintenance. Moreover, various other aspects of queen biology—such as mating behavior, development, queen-queen competition, and fecundity—have all shown to be important factors in the Africanization process. Since queen honey bees are the key to all genetic aspects of colonies, priority for research must be placed on queen biology.

Swarm biology - The AHB reproduces more rapidly than its European counterpart and thus it exhibits a strong tendency towards frequent swarming. Swarming is usually counter-productive to a good beekeeping management system, and methods of alleviating this condition will be examined. Moreover, parasitic swarms are an important mechanism of the Africanization process, thus investigating how small clusters of AHB usurp an established EHB colony will provide great insights into how to slow their introgression.

Effect of human activity on the spread of AHB – One of the greatest attributes of the Western honey bee (*Apis mellifera*) is their amenability for manipulation and transport, a trait that has enabled beekeepers to move hives from site to site. This process is manifest in the extreme by migratory beekeepers, who transport their hives across the state and all over the country. To date, however, there has been little empirical research into the effect of human-assisted transport on the distribution and eventual establishment of the AHB. Understanding the connection between humans and AHB

movement might provide insights into management practices that could be altered to mitigate their spread.

Disease research – One approach to minimizing the impact of the AHB is to reduce their ecological success over their European counterparts. Another complimentary approach is to improve the health and productivity of the EHB. Thus investigations into disease control for non-AHB stock will help keep the EHB population strong and productive. The most infamous parasite of honey bees is the mite *Varroa destructor*. This pest has shifted hosts from the Eastern honey bee, *Apis cerana*, to the Western honey bee, *A. mellifera*, and entire feral populations have been decimated as a result. Another parasitic mite, the tracheal mite *Acarapis woodi*, lives in the airway passages of adult bees. These small arachnids can kill entire colonies by themselves or by creating secondary infections after compromising the immunodefenses of workers. Other notable pests are the protozoans *Nosema apis* and *N. ceranae* which infect the gastrointestinal tract of adults. American foulbrood (AFB), caused by *Paenibacillus larvae*, is the most serious brood disease of honey bee colonies. *P. larvae* spores are extremely difficult to eradicate from honey, wax, and hive equipment once they have been contaminated. This persistence is the main reason why historically it is the costliest disease for beekeepers. Another disease, similar in symptoms to AFB, is European foulbrood (EFB) caused by the bacterium *Melissococcus plutonius* and other opportunistic pathogens. Several viruses also infect honey bees, causing diseases such as sacbrood and acute bee paralysis, and are often associated with parasitic infestations. One important fungal disease known as chalkbrood, caused by *Ascosphaera apis*, attacks developing larvae in a manner similar to AFB, although it is significantly less devastating. Research into mitigating all of these parasites and pathogens would promote colony health which, in turn, may help minimize the impact of the AHB.

Bee breeding and AHB genetics - If the AHB become established in North Carolina, then it will be essential to have stocks of known (certified) European honey bees that can be used to provide queens to requeen Africanized honey bee colonies. Investigations into closed breeding programs, population and quantitative genetics, and Mendelian genetics are needed to make sure the EHB stocks will remain viable and phenotypically acceptable. Moreover, basic research into how the AHB appears to be genetically dominant over the EHB will help determine how they seem to displace (rather than integrate with) the resident EHB population.

D. Encouragement of a Self-Sufficient Queen and Package Industry

Nurture existing queen and package producers currently operating in the state.

a. Work with these businesses to obtain funding (grants, government loans) for expansion.
b. Provide technical assistance to improve product quality.
c. Encourage the development of new queen and package producers in the state.
d. Provide short clinics in the procedure of instrumental insemination to educate beekeepers and bee breeders in how to maintain control over the genetics of their stock.

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