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APRIL 1999

CRB Note, Vol. 6, No.2

CALIFORNIA RESEARCH BUREAU

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The Africanized Honeybee (AHB) is a highly defensive and aggressive cross between the familiar European honeybee and an African variety imported into Brazil for experimental purposes. This "Africanized" variety was accidentally released into the wild in 1957 and has been progressing northward from Brazil ever since, as much as 300 miles per year. After an unexpected slowing along the southern border of the United States several years ago, Africanized honeybees have become established in California.

Entomologists and agricultural officials now consider AHB to be present, if not fully established, in Imperial, Kern, Orange, Los Angeles, Riverside, San Bernardino, and San Diego counties. Isolated swarms – hitchhikers on vehicles – have appeared from time to time elsewhere in the state. Experts now believe it is highly likely, if not inevitable, that AHB will spread up the coast and to the Central Valley, advancing as far as climate permits.

Although the agricultural impacts can be managed, at a cost, risks to people and animals will remain and will require ongoing education, preparation, and action.

This paper reviews the situation and outlines some policy options to help cope with the arrival of AHB in California.

Introduction

The sting of an Africanized honeybee (AHB) is no more dangerous than the sting of a familiar European honeybee. The Africanized variety (sometimes called “killer bee”) is simply the result of experimental crossbreeding an African variety with the familiar European honeybee (EHB), an experiment that turned out to have been very ill-advised. The two varieties differ significantly in behavior, but not in appearance. From appearance alone, it is virtually impossible to tell which is which. However, when it feels threatened – which happens easily and quickly – an AHB swarm attacks in far larger numbers than EHB, inflicting hundreds or thousands of stings. An AHB swarm chases the object of the attack – human or animal – much farther. That many stings may be fatal, especially if prompt medical aid is not provided. Even if the stings are not fatal immediately, if not treated the toxins can cause kidney failure and death days later, even after a seeming recovery in the meantime.

Not only is AHB aroused to action much more easily than the familiar European honeybee, it remains aroused much longer. Approaching a hive or even making loud noises, as with a lawnmower or edger, at a distance of up to hundreds of feet may draw an attack.

No amount of further crossbreeding appears to reduce the aggressive and defensive extremes of AHB, despite early hopes to the contrary.

Where are Africanized Honeybees Now?

The Africanized honeybee is well established throughout much of South and Central America and Mexico, having initially been accidentally released in Brazil in 1957 and migrating since then at an average of 200 to 300 miles per year.[1] The northward migration slowed suddenly along the southern U.S. in the early 1990s, possibly as a result of parasitic mites that decimated all honeybee populations, inhospitable weather, and physical barriers (mountains and deserts). The migration has resumed recently, with the aid of the El Niño weather phenomenon (heavy, widespread rains) of 1997-98.

Colonies of Africanized honeybees have been found in Texas, New Mexico, Arizona, and Nevada. AHB is now clearly established in those states, although more recently in Nevada than in the rest. In California, Africanized honeybees have been found in Imperial County and in eastern San Bernardino, Riverside, and San Diego counties.[2] An August 5, 1998, news release from the County of San Diego described an AHB finding in Jacumba, a town about 40 miles east of Chula Vista and immediately north of the Mexican border. A more recent news report cites AHB findings in the Riverside County cities of Corona and Norco, the San Bernardino County city of Fontana, and the Los Angeles County city of Lawndale.[3] As of January 1999, the Los Angeles County Agricultural Commissioner has determined that AHB has colonized most of that county.[4] As of late March, 1999, AHB has been found in Fallbrook and Tierrasanta (San Diego County), as well as in several communities in Orange County.[5] On April 9, 1999, it was reported that AHB has been found in Kern County and is believed to have colonized at least part of the county.[6]

On the basis of experience elsewhere, it appears that AHB could spread to all areas of California where climate permits overwintering – that is, where temperatures do not become too cold for AHB to survive the winter. AHB's range is restricted in comparison to that of the European honeybee, as AHB is poorly adapted to cold temperatures. This suggests that the entire coastal region may be at risk of eventual permanent colonization and the conversion of all feral (wild, unmanaged) honeybee populations in those areas to the Africanized variety. The Central Valley is an uncertain habitat for AHB, as temperatures can fall below freezing throughout much of the Valley, although colonization has been confirmed in part of Kern County, the southernmost part of the valley, as of April 1999. Mountain areas are likely never to be colonized, although they may have warm-weather incursions.

Despite early hopes to the contrary, the aggressive and extremely defensive characteristics of the Africanized honeybee are not reduced by crossbreeding with the familiar native varieties. Some entomologists believe that the aggressive and defensive extremes are actually increased through crossbreeding.

Hazards to the General Public

AHB attacks have not yet been frequent in the United States, but have sometimes been deadly. As AHB moves into heavily populated areas of California it is likely that such attacks will become more common, especially until the public knows how to prevent and avoid them. There will probably be some severe incidents before the general population of any colonized area understands the hazard and learns how to prevent and avoid danger and to respond to attacks. It should be noted that local agencies (counties, vector control districts) are already carrying out educational efforts in anticipation of the increasing presence of AHB.

People who are allergic to bee stings are at the greatest danger, as multiple stings are most likely to be fatal to them. Severely allergic individuals are of course also at risk from stings by native honeybees. The danger of multiple stinging incidents comes from established nests, which bees – especially AHB – aggressively defend, not from swarming or foraging bees.

People who work or travel in infested areas and those who use lawnmowers and other power equipment anywhere near AHB nests are at special risk. Africanized bees respond to the sound of lawn mowers, for example, even at distance.

An additional type of risk is that of public misunderstanding of AHB. Unscrupulous businesses could take advantage of unwary, ill-informed, and anxious consumers through sales of unnecessary or fraudulent AHB-related services. Further, inappropriate AHB-related inquiries to emergency services could interfere with legitimate emergency calls if people jump to report every stray wasp or other flying insect.

Hazards to Agriculture

Agricultural issues related to AHB include:

- Increased cost for providing bees for pollination resulting from higher management costs[7]
- Risks to agricultural workers from feral colonies[8]
- Costs of preventing stinging incidents, education about AHB risk, training in AHB risk prevention, and preventive actions in agricultural areas

AHB may also pose a risk to animals, although not on a scale likely to be significant from a cost perspective.

Although AHB is expected to raise some costs for agriculture in California, its potential cost impact is far less than the potential cost impact of the Mediterranean fruit fly (medfly) and the Mexican fruit fly. The latter are capable, if unchecked, of causing

massive damage to crops. Medfly and Mexican fruit fly incursions require prompt, costly responses to eradicate them. In contrast, AHB's agricultural damage is relatively limited, consisting primarily of increased costs for pollination services and death of some farm animals caused by mass stinging. Fruit flies, in contrast to AHB, pose no *direct* threat to humans or animals.

Of related concern is the loss of feral (wild) bee populations and of their pollination role. Feral bee populations have fallen sharply in recent years as a result of bee diseases (mite infestations) not associated with AHB. Even if the mite problem recedes, the danger of AHB will require eradication of feral bee populations to reduce risk to people and animals. As areas become colonized by AHB, sensible prevention programs may include precautionary destruction of wild swarms and unmanaged hives.

Law and Regulation

Bees as such are unregulated, in contrast to ferrets, for example, which are prohibited in California as a threat to wildlife. Commercial beekeeping is a business, subject to business regulations and falling under provisions of law in connection with agriculture. Bee removal and eradication services are regulated under pest control laws.

In response to Senate and Assembly resolutions, California established a task force on AHB that reported on the issue in 1989. A Steering Committee was then established to monitor the issue and to assist state and local agencies to prepare for AHB. The Steering Committee draws from a wide range of departments and public agencies within California.

Chapter 298, Statutes of 1994 (SB 250, Kelley):

> [P]ermit[s] an applicant for licensing or certification as a qualified applicator to elect to be trained in the handling, control, and techniques of removal of Africanized honey bees. The bill would authorize the Director of Pesticide Regulation to develop or approve a program to train applicants in this specialty. The bill would also permit an applicant for a Branch 2 license from the Structural Pest Control Board to be certified in the handling, control, and techniques of removal of Africanized honey bees, and would require the board to develop or approve such a program.

The licensing provision is in §8565.6 of the *Business and Professions Code*.

Among other provisions, the bill also provided “that any hive or comparable apparatus that is not occupied by a live bee colony, and that is accessible to bees, is a public nuisance.”[9] Such hives are “subject to abatement” in accordance with law. See §29321 of the *Food and Agricultural Code*.

Local Programs

Local agencies are training emergency response personnel, coordinating with pest control operators, and providing educational materials to schools and to the general public. There was much activity of this sort in the early 1990's, when the arrival of AHB was believed imminent. Although those steps came in advance of AHB's arrival, they left local agencies prepared. The educational needs are unchanged and materials and plans prepared at that time are still valid, or at most in need of relatively minor updating. Some members of the public may have become skeptical of warnings about Africanized bees as a result of their failure to arrive when originally expected, but as local incidents occur and are reported that skepticism should wane.[10]

Policy Options

The State of California cannot prevent the migration of AHB into the state, nor is any way known to eradicate Africanized honeybees once they are established in an area . However, some steps might help to minimize AHB's impact and to mitigate risks to public safety. The options outlined below might contribute to those ends.

Agricultural Impacts

- The Legislature might direct county agricultural commissioners to include AHB status and impact information in their annual reports. As those offices have entomologists on staff and already extensively monitor local conditions, this would draw upon people with direct knowledge of local conditions. The Department of Food and Agriculture could be requested to forward to the Legislature a summary of findings from the counties. Of specific interest would be data on costs of pollination, stinging incidents involving agricultural workers, stinging incidents involving livestock, and costs of mitigation measures undertaken by farmers.

- The Legislature might alternatively request county agricultural commissioners to prepare periodic special reports on AHB infestations and impacts, separate from the required annual report, to facilitate analysis of whether new legislation or other state action is needed. Such reports could be directed to the Legislature by way of the Department of Food and Agriculture or another agency selected for the purpose. Periodic reports of serious bee-related incidents might also be requested from public safety agencies in order to help the Legislature monitor the impact of AHB.[11]

Public Education

- The Legislature might direct that all school districts make appropriate AHB-related information available to students and their families and to teachers and administrators. Such information, available from such sources as vector control agencies, offices of county agricultural commissioners, the California Department of

Food and Agriculture, and the California Department of Health Services, could include specific guidance on the need to report swarms and on methods of avoiding injury from AHB.[12]

Hazard Reduction

In considering ways to reduce the hazards presented by AHB, it should be borne in mind that California has not adopted formal measures for reducing hazards presented by other potentially lethal pests found in the state, including black widow and brown recluse spiders, scorpions, and rattlesnakes. Any response to Africanized honeybees should reflect the actual threat they pose, both in absolute terms and in comparative terms, avoiding reliance on worst-case projections.

Some actions to reduce hazards belong to individuals (homeowners, for example) and others belong to public agencies (municipalities, park and recreation districts, vector control agencies, and others). The keys to these kinds of actions will be communication and public education, which can reasonably be accommodated within existing resources, especially with the cooperation of news media.

Specific potential steps to reduce hazards might include:

- Bee-proofing of homes and yards. This is primarily the responsibility of homeowners, with assistance as appropriate from pest control services.

- Precautions around schools and other public places. This is primarily the responsibility of building and grounds managers.

- Emergency hotlines. The current 9-1-1 system can accommodate emergency calls related to AHB, although local officials must assure that the necessary information is provided to operators in order to screen and refer calls.

- Regular checking of water meters for bee infestation. Water meters are very attractive to AHB. Training of meter readers to watch for signs of infestation, to take appropriate precautions, and to report sightings is a responsibility of utility services.

- Local regulation or prohibition of hobby beekeeping. This is an issue that municipal officials might wish to revisit in the light of the arrival of AHB, in consultation with agriculture officials, entomologists, and vector control agencies.

- Educating hospitals, physicians, and emergency response personnel regarding treatment of massive stinging incidents. For example, dialysis soon after a serious stinging incident can prevent kidney damage and death that otherwise can occur days later from toxin in the system.

- Using 1/8" wire mesh in building construction anywhere it might prevent access from the outside. The current standard 1/4" allows bees in, but 1/8" excludes them. For

the long term, a change in the standard (whether voluntary or mandatory) could reduce the opportunity for bees of any type to colonize within walls of buildings. It would take many years of new and replacement construction before such a change could have an impact, and it is not clear that the change would have a significant impact on the AHB threat even in the long run.

AHB-related positions in State government

In view of the areas of risk and in view of the inevitability of AHB's spread into much of California, the Legislature might consider funding one or more full-time positions to cope with planning, analysis, and information needs.

To this point, AHB-related activities have been handled informally and from existing budgeted funds. A growing need for information and response is likely to make such informal means insufficient for the long run. Such positions could be considered for the Department of Food and Agriculture and the Department of Health Services, both of which have significant roles in coping with the impact of AHB colonization of California. Formal positions of this type would strengthen California's ability to draw from the experience of other states through extensive discussions and site visits.

Similarly, the Legislature could consider earmarking funds for local agencies (counties, vector control districts, or others as may be appropriate) as part of a long-term program of preparation, analysis, observation, and response to the permanent situation of AHB colonization.

Sources and Further Reading

Sources of the above information include conversations with entomologists in Arizona and California and with representatives of county agricultural commissioner's offices in San Diego, Imperial, Riverside, San Bernardino, and Santa Clara counties, along with numerous newspaper articles and other reports. I have also spoken with personnel of the California Department of Food and Agriculture. There was wide agreement on many points, especially on the current extent of AHB colonization and on reasonable expectations for impact on agriculture and the public in California. On other issues, including specific potential mitigation measures, there was agreement on fundamental points but not necessarily on specific tactics.

There is a great deal of published material on AHB, as its progress and impacts have been closely monitored for 40 years and its arrival in California was anticipated well before the fact. Much of the material is, of course, technical in nature. Some nontechnical documents are described below.

- For an overview of AHB’s entry into the United States, see "The progress of Africanized Bees in the United States (1990-1995)," by entomologists at UC Riverside and the Arizona Department of Agriculture. The document has been posted

on the Internet at http://entmuseum9.ucr.edu/bees/AHB.html. That overview stops at the time when AHB inroads had sharply slowed. AHB movement has since resumed, at least into California and Nevada, including into heavily urbanized portions of Southern California.

- An example of a local plan is provided by "Africanized Honey Bee Response Guide for Santa Clara County," September 23, 1996, prepared by the Africanized Honey Bee Working Group for Santa Clara County.

- The official manual on AHB is "Africanized Honey Bee Action Plan for State of California," revised July 1991 (originally published November 1989), prepared by Governor's Task Force for Africanized Honey Bee. This manual has department-by-department information on tasks and responsibilities.

Notes

[1] An African strain of bee was imported to Brazil for breeding experiments, in hopes of producing a bee that would thrive in the tropics and be a good producer of honey. The experiment succeeded in part, as the crossbreed does thrive in the tropics. Managing AHB for honey production, however, is difficult at best.

[2] In mid-December, there was a report of an AHB incident in the city of San Bernardino, although the identification had not been verified at the time of the report. Behavior of the bees did suggest that the hive was Africanized.

[3] Tom Gorman, "Africanized Bees' Presence Grows in Region," *Los Angeles Times*, 12-17-1998, B-8, as posted online at Electric Library (http://www.elibrary.com).

[4] "Africanized Bees Have Colonized Most of County," *Los Angeles Times*, January 13, 1999, as posted at http://www.latimes.com.

[5] "Killer bees spreading in S. California," AP report posted online at *San Jose Mercury News* site, March 26, 1999 (http://www.sjmercury.com/breaking/docs/003470.htm).

[6] "Killer Bees found in Kern County," *Sacramento Bee*, April 9, 1999, p. A4.

[7] These costs include frequent re-queening of hives and frequent inspections to find signs of AHB as early as possible. According to Aurelio Posadas, of the California Department of Food and Agriculture, recent reports from beekeepers in Imperial County do not suggest that management costs have increased substantially at this time in order to cope with AHB. (Personal communication, January 22, 1999.)

[8] Appropriately managed commercial hives do not pose any unusual risk, as proper management will assure that the hives are free of AHB.

[9] The quoted passages are from the Legislative Counsel's digest of SB 250.

[10] The obverse of this skepticism is an occasional overreaction to the sight of any bee (or any insect of similar appearance, such as wasps) following sensationalized news reports about AHB.

[11] Stinging incidents might be rare enough not to require special actions or reporting, but this is a question that will remain unsettled for a few years, until the ultimate extent of AHB's penetration into the state is determined and a picture may be known of the frequency and severity of encounters.

[12] There is much information available on the Internet. The California Department of Food and Agriculture provides a summary at http://www.cdfa.ca.gov/pests/honeybee/honeybee.html. Many other sites provide information. Lesson plans for schools (customized by grade level) provided by the University of Arizona Africanized Honeybee Project are available via http://Ag.Arizona.Edu/pubs/insects/ahb.