WHITE BOX,

UF bee researchers try to sort out what happens when bees already threatened by colony collapse disorder meet a growing population of Africanized cousins

By Stu Hutson

BLACK BOX

Rock paintings from 15,000 years ago show humans smoking bees out of their hives to get to the honey. Two thousand years ago, bee venom was considered the best remedy for Egyptian pharaohs' arthritis. And today, there are 2.4 million bee colonies producing honey in the United States and bees pollinate about $5.7 billion in crops annually.

But despite great advances in our understanding of bee biology — from mapping the insect's genome to understanding the chemical makeup of bee pheromones — the future of the bee industry has never been more uncertain.

A phenomenon called colony collapse disorder, or CCD, is wiping out whole hives in record numbers and researchers worldwide are baffled.

"We've come a long way toward figuring out the secret life of bees … of what goes on inside those white boxes," says Jamie Ellis, an apiary expert at the University of Florida's Institute of Food and Agricultural Sciences. "In a lot of ways, though, what goes on is still a big black box of questions."

Ellis says the die-off is most likely the result of several factors including, but not limited to, genetic weaknesses inadvertently bred into bees over time, parasite-spread pathogens, side effects of pesticides, and environmental pollutants.

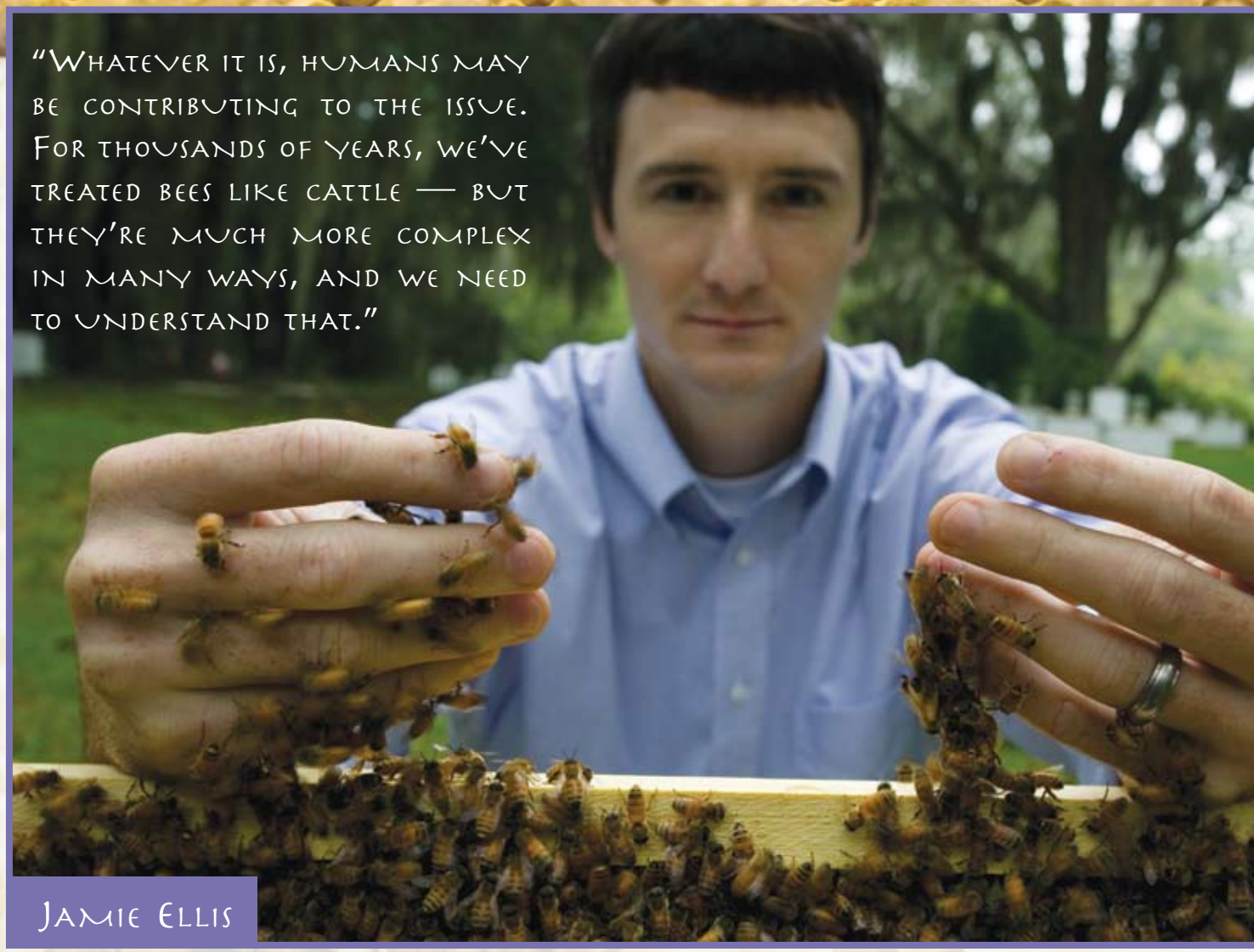
"It's possible that it's not just a problem with the bees," Ellis says. "It may be an environmental issue as well — the bees could be the tip of the iceberg."

With its temperate climate and year-round agricultural industry, Florida has long been the winter home to the nation's beekeeping industry, but as beekeepers already spooked by CCD return to Florida this year, they have an additional worry: the threat of Africanized, or "killer," bees.

The Swarm?

The 1970s were rife with fictionalized accounts of Africanized "killer" bees invading North America. From the truly disturbing motion picture "The Swarm" to the hokey made-for-TV "Terror Out of the Sky," the nation was primed for a full-fledged attack of the insect kind.

Photography by Eric Zamora



Africanized bees are a hybrid of European and African bees first developed in the 1950s by Brazilian scientists seeking a strain that could better withstand the heat of Central and South America.

The bees were tougher, but little of the European genetics survived past early test generations, leaving the bees to revert to their more hostile form. And it is widely believed that, in true science-fiction style, a few of the test subjects escaped.

Those first fugitives quickly dominated local hives, and by the early 1990s, African bees were knocking on the United States' door. Despite best efforts, they swept into Texas, then into parts of New Mexico, Arizona and lower California. They began swarming eastward — and then, stopped.

"These bees are adapted to hot, dry conditions," says Glenn Hall, a UF specialist in bee genetics. Many scientists think that the insects' spread was halted near Houston by a steady stream of warm, moist air flowing inland from the Gulf of Mexico.

When climate discouraged the bees' eastward migration, they came to Florida by a different route.

"They did not come by land … so it turns out that, over two decades, they've come by sea," Hall says, explaining how the bees hitchhiked on boats bringing goods from Central and South America.

Although isolated bee swarms have been found on ships since the late 1980s, it wasn't until 1999 that established colonies were found on land near the ports. By 2005, about 40 percent of wild bees in Florida were Africanized. This year, that number could be as high as 90 percent.

"There's no doubt they're spreading," says Jerry Hayes, chief apiary inspector for the state Department of Agriculture, who monitors the population of African bees in Florida through a series of nearly 500 traps throughout the state.

Bee Movie

In a far cry from the horror films of the '70s, Disney recently released "Bee Movie" — a big budget, computer-animated film starring a lovable, well-coiffed bee voiced by Jerry Seinfield.

In an ironic foreshadowing of what could happen in real

life, the main character inadvertently shuts down many of the country's hives, nearly leading to widespread plant die-offs and bee "lay offs."

In the movie this all comes about as the result of a lawsuit. In real life, CCD is mysteriously devastating the world's honey bee population, already killing thousands of U.S. honeybee colonies.

For undetermined reasons, beekeepers have been witnessing colony after colony dwindle in population until one day they find their hives empty of bees — living or dead.

That threatens not only the honey industry but also the nation's $16 billion industry of crops that the bees pollinate: two thirds of citrus, watermelons, blueberries, strawberries, pecans, beans, apples, almonds and pretty much anything that grows on a vine.

"We've been trying to figure out what is going on, but it's like nothing you see anywhere else in nature with bees," says Ellis, one of UF's leading CCD researchers and co-founder of the African Honey Bee Extension and Education Program.

Guesses at what may lie at the root of the culling range from new viruses to radiation from cell phone towers. But Ellis says the die-offs are most likely a culmination of man-made effects and usual culprits bees have been battling for a long time.

"Whatever it is, humans may be contributing to the issue," Ellis says. "For thousands of years, we've treated bees like cattle — but they're much more complex in many ways, and we need to understand that."

He says the genetic diversity of queen bees in the U.S. is poor, almost to the point that managed honey bees can be viewed as a monoculture that doesn't have the genetic bag of tricks to respond to harmful outside influences.

"So what you get is a bunch of the same kind of bees that all have the same Achilles' heels," Ellis says. "Whether that's a virus or a mite."

In addition, beekeepers often overuse pesticides to keep hives clear of parasitic mites. And bees may be further stressed by being placed in the middle of crops that offer low-quality pollen and nectar for bee food.

"People often forget that bees don't just go from the flower to the hive," he says. "They cover whole areas and pick up traces of everything around them — paint chips, pesticides, other debris. If their environment isn't healthy, neither are they."

Bee Battles

Domesticated bees are pacifists compared to the African bees, so when the latter move in and overthrow the queen, there typically isn't much of a battle. That could be especially true if the colony is already under threat from CCD. Soon, the new Africanized queen is producing offspring.

"African honey bees are just tougher," Ellis says. "They don't succumb to mites — and from what we can tell, they don't succumb to CCD."

Matings between African honey bees and domesticated European bees produce offspring that may be weaker than either original group. Hall and colleagues found that hybrids commonly have lower metabolisms, with may reduce their ability to survive.

Josh Wickham

Glenn Hall

"There have been people who have said, 'Why don't we just keep working on mixing the two and come up with a domesticated African honey bee?' Even playing devil's advocate, that just doesn't work."

— Glenn Hall

In addition, studies have shown that after infiltration, African hive members even go so far as to single out and eliminate fellow bees that lack a certain level of African-born genetic purity.

"Once they get established, we're really talking about African bees, not Africanized bees," Ellis says.

"There have been people who have said, 'Why don't we just keep working on mixing the two and come up with a domesticated African honey bee?'" Hall adds. "Even playing devil's advocate, that just doesn't work."

He points to Central America as evidence. Even after half a century of intermingling with native bees in the tropics, the Africanized bees have uncannily retained almost all of their original characteristics.

That genetic doggedness also means that their infiltration of domesticated bees devastated honey and other agricultural industries throughout the American tropics.

European bees originate from colder areas where they have to gather a lot of food to carry them through rough times. African bees never had to "think ahead" in this fashion, so they spend a lot less time storing reserves.

In a modern setting, this means less honey for the beekeeper, less pollination for the farmer — and more stings for everyone.

Evil Twins

Hall, a bee geneticist who discovered DNA markers to identify African honeybees, says that — to the untrained eye — they look the same as resident European honeybees.

But they don't act the same.

African bees more aggressively defend their nests than European bees. African bees may swarm as many as six times a year while European bees swarm about one or two times a year, he says.

"With Africanized and European bees, most people can't tell the difference until they can count whether they have one stinger in them or a hundred," says Elmore Herman, president of the Florida State Beekeepers Association.

Although colony collapse disorder makes hives more open to attack, it also makes beekeepers more willing to allow the would-be attackers in, thinking the wild bees will supplement their diminished stock.

As a result, Africanized bees could get a free ride to territories where they wouldn't naturally be able to spread — if they don't attack the bee keeper first. Ultimately, the colonies will just die off from the cold environments, but not before spreading to other hives.

"Some people just don't get it, bad bees are bad bees. You can't turn them good," says Herman.

"There are better ways to keep your hives healthy," Ellis adds. "Many of those ways will work against both CCD and Africanized honey bees."

Just like in chess, the most powerful piece in the beekeeper's arsenal is the queen. "Requeening" hives on a regular basis ensures that African genetics are weeded out while a variety of strong domestic traits are distributed. Beekeepers throughout the state can obtain genetically typed queens from a bank developed in a joint effort between UF and the Florida Department of Agriculture and Consumer Services.

The collaboration has developed a set of best management practices for Florida beekeepers that address both CCD and African bees. The researchers have also developed "The Florida African Bee Action Plan," which includes preparedness plans for local firefighters, police and other emergency personnel who might have African bee encounters.

Ellis and Hall also are collaborating on what most experts believe is the most tangible cause of bee die-offs in Florida — parasitic mites.

The state has lost 35 percent of its colonies to die-offs — a percentage that can be attributed largely to parasitic mites. This is a relatively small amount given that most bee-breeding areas have sustained losses from 50 to 70 percent of their colonies.

Still, the effects of the recent bloom in Africanized honey bees have yet to reveal themselves. The most recent economic data show no net impact that can be separated from the effects of CCD or mites. However, the data for 2007 — which won't be finished until near the end of 2008 — may reveal an entirely different story.

"Neither of these problems is going to go away any time soon," Ellis says. "We're still going to have to work pretty hard if we don't want to be stung … um, pardon the pun."

Scott Bauer

Africanized honey bees surround a European queen honey bee, marked with a pink dot for identification. Africanized bees tend to replace European bees, partly because European queens mate disproportionately with African drones.

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