Hives stayin’ alive

Dancing bees’ ‘stop signal’ warns of peril, UCSD research says

By Scott LaFee, UNION-TRIBUNE STAFF WRITER

Friday, February 12, 2010 at 12:04 a.m.

Eduardo Contreras / Union-Tribune

UCSD professor James Nieh has had new research about bee communication published in the journal Current Biology. Bees are known to dance to communicate. Nieh has discovered how bees deliver warnings by stopping the dancing.

Photo by Eduardo Contreras - Union-Tribune

These bees with yellow paint markings are former subjects that were released after professor James Nieh studied them.

Online: To watch a UCSD video of honeybees waggle-dancing and getting a stop signal, go to uniontrib.com/waggle

SAN DIEGO — Scientists have spent decades studying waggling bees, individuals in every colony that dance and vibrate to tell others where food can be found.

As it turns out, the bees butting heads with the wagglers to make them stop dancing may be just as important. The interruption is a “stop signal” — a warning to steer clear of a place with predators or competing bees.

Why is this significant?

Studies of bee waggling have led to profound discoveries about the complex communication patterns of some highly social insects, helped beekeepers improve their operations and earned an Austrian zoologist a 1973 Nobel Prize.

The anti-waggling discovery, by UCSD professor James Nieh, also may be historic: It's only the second known example of a sophisticated insect society using "negative feedback" — signals that tell others to stop a behavior.

"People hadn't given too much thought about the role of negative feedback in superorganisms like beehives," said Nieh, whose research was published yesterday in the journal Current Biology. "This makes one wonder what else is possible, and not just among bees."

Perhaps nothing gets a hive buzzing more than news of a rich new source of nectar and pollen. Incoming worker bees describe their discovery by performing a waggle dance, a series of choreographed movements intended to recruit and direct other bees to the fruitful site.

Scientists were perplexed by other bees that would interrupt the performance, seemingly to beg for a sample of the food.

Nieh, who teaches biology at the University of California San Diego, came up with a different explanation. The interruptions aren't food requests, he said, but a warning that the promise of nectar and pollen at a particular site comes with the danger of predators or too many competitors.

"The honeybee's system of collective foraging, already unbelievably complex for a creature with a brain the size of a grass seed, is even more complex than was previously realized," said Gene Robinson, a professor of entomology at the University of Illinois at Urbana-Champaign.

Negative feedback makes sense, Nieh said. "If a bee visits a location where she's attacked by other bees or where there are predators like spiders, she's not going to want her nest mates to go to that same location and confront the same risks," he added.

The stop signals in a superorganism — a biological collection of individuals that behave as a unit, such as bees, ants and termites — are significant and surprising, experts said.

"The only other known example is of an ant species that puts down a chemical signal at the beginning of an old trail to indicate it no longer leads to a food source," Nieh said.

The UCSD study was conducted in 2007, with Nieh and colleagues meticulously monitoring a research hive on campus. The researchers marked some worker bees with dabs of paint or tiny stickers. Then they exposed them to simulated dangers at feeding sites away from the hive, such as "alarm" pheromones that are produced when bees from other hives are nearby, or mechanical pricks to their legs to simulate spider bites.

When these worker bees returned to the hive, the researchers recorded their visual and acoustic behaviors. The bees targeted other waggle-dancing bees that had visited the same site and were now recruiting nest mates to go there.

The alarmed bees generated a vibrating signal lasting just a 10th of a second, while their bodies vibrated roughly 380 times per second. The stop signal, Nieh said, "is frequently delivered by a sender butting her head into a recipient, although the sender may also climb on top of the receiver."

The greater the perceived danger, the more insistent the stop signal, Nieh said. Bees exposed to an alarm pheromone increased their stop-signaling by an average of 14 times. Those whose legs were pricked repeated their stop signals an average of 88 times.

After enough warning, most waggling bees stopped dancing and recruiting.

Scott LaFee: (619) 293-1259; scott.lafee@uniontrib.com