**SCIENCE**

# Scouts, streakers and swarms

## Researchers peek inside a colony to see how honeybees locate a new home, communicate their find and fly as one in an exodus to the site

Tuesday, October 28, 2008 3:01 AM

**BY SPENCER HUNT**

THE COLUMBUS DISPATCH

It's a riveting sight: a swarm of 10,000 honeybees hanging in a huge, buzzing mass, protecting their queen while a team of scouts hunts for a new hive.

Within 24 hours, a new home is found, and a staggering exodus occurs.

But this is no simple rite of survival. Ecologists want to know how this huge group gets from point A to point B.

"You stand in the middle of a swarm, you have bees flying in every direction, banging into your head," said Kevin Passino, an Ohio State University computer and electrical engineering researcher. "It seems like complete chaos."

With the help of a high-definition video camera and a lot of patience, Passino, OSU graduate student Kevin Schultz and Tom Seeley, a Cornell University biologist, think they've found the answer: streaker bees.

Streakers are individuals that fly quickly along the top of swarms in the direction of a new hive, serving as guides that the others follow.

"There is order" in the swarm, Passino said. "It's just very hard to see."

TOM SEELEY/KEVIN PASSINO PHOTO

**Researchers isolated a colony of bees on Appledore Island, Maine, and took hours of high-definition video to study how bees travel in a swarm.**

Their discovery offers new insight into bee society and decision-making. It might also help create more efficient computer and Internet systems and, maybe one day, smarter robots.

Swarming occurs whenever a hive gets crowded. A colony produces a new queen, splits the available workers and moves to a new location.

The new queen stays in the old hive while the old queen leaves, often accompanied by as many as 10,000 loyalists.

The swarm will pick a nearby spot, typically a tree branch, where the bees cling to each other to conserve energy while scout bees look for the new spot, usually within 2 miles.

The ideal home is a big, hollow tree with a small, south-facing opening at the base to allow easy access.

Previous research by Passino and Seeley, who has studied bees for more than 30 years, found that scouts play key roles.

The scouts -- typically no more than 5 percent of a colony -- investigate potential sites and then fly back to the swarm. They sell their finds (and give directions) by crawling over their fellow scouts and performing a "waggle dance" in which they shake their abdomens.

The more waggle, the more a scout likes a new home.

"The scouts are dancing for each other. They are a little bit like representatives in a government," Seeley said. "The remaining 95 percent of the bees, they are saying, 'OK, you make the decision for us, and we'll follow you.' "

Longer, more waggled dances encourage other scouts to stop selling mediocre sites and investigate the better ones. When the scouts return, they share their opinions about the site. When they agree on a spot, they tell the swarm.

Scouts wriggle through the masses and vibrate against the bodies of their fellow bees to warm up their muscles for flying. The process makes the swarm emit a noise like an engine revving.

Swarms typically travel in a loosely formed mass that's more than 32 feet wide and 10 feet tall. Within this mass, bees appear to be flying in every direction.

That is why researchers have had such a hard time figuring out how a swarm ends up in the right place.

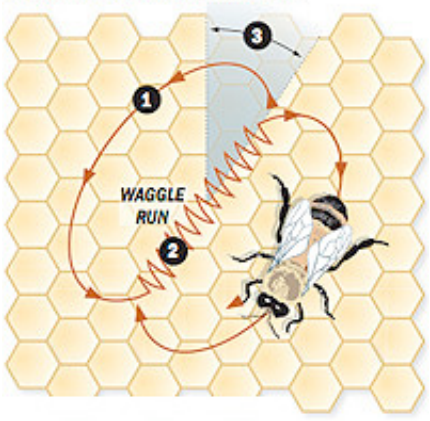
TOM SEELEY/KEVIN PASSINO PHOTO

FRED SQUILLANTE I DISPATCH

**OSU researchers Kevin Passino, left, and Kevin Schultz noticed that "streaker" bees flew higher and faster than the rest.**

**Decoding the waggle dance**

Honeybees employ a waggle dance to inform others about food sources and nesting sites.




**1.** The bee starts in a **figure-eight pattern** across the honeycomb or on the surface of the swarm.

**2.** As the bee passes through the center part of the dance, she performs the "waggle

Seeley and Passino cracked this problem by taking a colony of bees to Appledore Island off the coast of southern Maine. Because the island has few natural shelters for bees to swarm, the researchers knew they could create their own sanctuary to study.

They knew the path the swarms would take to get to the hive box and were able to position a high-speed, high-definition video camera to record the insects in flight.

Previous theories about swarm flights suggested that the bees might track a chemical trail in the air. So Seeley sealed the bees' pheromone glands and watched them travel straight to the box.

That left two theories to test.

The first involves "informed bees": individuals that know the destination and guide the rest by nudging them in the right direction.

The other involves "streakers."

By analyzing the high-definition video frame by frame at Ohio State over six months, Passino and Schultz found their streakers sprinting along the top of the swarm.

While most bees in the lower part of the swarm flew at about 10 feet per second, a smaller number of bees in the top were flying at 32 feet per second in streaks that pointed toward the new hive site.

Seeley said bees flying below the streakers could keep an eye on them against the backdrop of the sky and change direction if necessary to stay on course.

Passino said, at one point, a seagull flew through one swarm and confused some of the bees, which altered their course to follow the bird.

she performs the **waggle run,"** vibrating her body side to side. The **time** it takes tells the other bees the **distance** of the food source or nest site from the current hive.

**3.** The **angle** of the waggle run tells the other bees the **direction** of the food source or new nest.


## ON THE WEB

**Click here to watch some of the bee research videos.**

"When they realized they were no longer seeing other bees, they reversed course and came back" to the swarm, Passino said.

Although the video clearly shows streakers, it doesn't show what the fast-flying bees do once they reach the leading edge of a swarm.

Seeley said more research is needed to determine whether these streakers slow down and wait for slower bees to pass them, or fly around the edges of the swarm before they speed off again.

Schultz said the video did not get a good look at the periphery of the swarm. "There are some interesting things happening on the edges that we didn't see," he said.

It's also not clear whether scouts turn into streakers.

Seeley said it might be possible to mark scout bees in a way that would show up on camera, to see whether they become the guides.

Passino thinks they do. "It must be the scout bees," he said.

Passino and Schultz said their research into bee behavior could help reshape computer circuitry and software through something called "bio-inspiration."

"Nature has some of the most fantastic examples of autonomous systems that really work," Passino said.

Ants, for example, find the shortest distance between their nest and food sources.

Examining how bees make decisions could help create new Internet search engines, Passino said: Programmers would program Internet "scouts" to look for the best Web sites to match a query.

The examination of bee flight also could help technicians design robotic, autonomous vehicles that scout out the best targets, communicate their finds and then work as a team to reach them, Passino said.

For Seeley and other biologists, including James Tew, Ohio State's beekeeping specialist, the research offers a greater understanding of how bees work together to survive.

"We have always had significant problems keeping up with bees once they leave a hive," Tew said.

"They've tackled a very fundamental question."

Why is that important? Honeybees pollinate $14.6 billion in fruit and vegetable crops in the U.S. each year.

shunt@dispatch.com

---