# CENTRAL COAST BEEKEEPERS NEWSLETTER

July, 2025

NEXT MEETING July 17 2025

**Important Notice: Our meetings are now the third Thursday of the month at the Newport OSU Extension Office. Please see the schedule on page 3 for dates and locations.**

## PRESIDENT'S MESSAGE

### By Jeremy Egolf

A few weeks after solstice, the sun is tracking lower in the sky and the blackberries are in full bloom and swarming with nectar-seeking bees. Speaking of which, from July 4th to July 11, I received word from various folks of six swarms that had been seen in the Lincoln City area and needed homes. Speaking of which, we should all be checking our hives and (unless we want to encourage our colonies to throw off swarms) add another super when the top most box is about 70% full.

And don't forget the varroa mites. With their population likely peaking in the next couple months or so, it's a good idea to knock them back. Those of us leaving the honey stores for the overwintering colonies have more flexibility. Some beekeepers have had issues with formic acid, generally rated as acceptable for harvestable honey, so it's really a matter of

weighing the risks within the venerable treatment guidelines offered by the Honeybee Health Coalition. A refresher on options is always appropriate, whatever the season.

And speaking of the season, a mighty shout out and thanks to the intrepid volunteers who staffed our booth at the Lincoln County fair over the 4th of July weekend. Their determination got us through challenging circumstances at the Chinook Winds Casino, this year's venue. But we did it, so thank you!

Back in the national news, I checked with our local Congresswoman Val Hoyle's office -- she sits on the House Committee on Natural Resources -- regarding the status of the Ecosystems Mission Area in the current funding climate. (In the last newsletter, we had a piece on the US Geological Survey's native bee collection.) The function still exists - the recent budget reconciliation bill did not go into this particular specific, but it will be considered as part of the annual funding process in the actual Interior and Environment appropriations bill, which is in committee. We'll provide updates as possible.

We'll have an opportunity to ask Ramesh Sagili, director of the OSU bee lab, regarding bee research funding when he speaks to us at our June 17 meeting. We again urge you to read Ramesh and Andony Melathopoulos' statement on conflicts between native bees and the honeybees. We again direct your attention to this important piece: https://extension.oregonstate.edu/catalog/em-9524-impact-beekeeping-native-bees-urban-settings

Following up the June talk by Lincoln County Master Gardeners on planting for pollinators, we have herein a piece on plants popular with the bees but also visually appealing for humans.

Always ready to learn something new, we have this from Wikipedia: "**Abiotic stress** is the negative impact of non-living factors on the living organisms in a specific environment. The non-living variable must influence the environment beyond its normal range of variation to adversely affect the population performance or individual physiology of the organism in a significant way." If you guessed that this is by way of introducing an item on the subject, you are correct - see the abstract of a relevant article in this newsletter.

Again, HELP WANTED: We always want and need to expand the core of volunteers doing the work of Central Coast Beekeepers. We urge members to consider running for office in our autumn elections, and, also, we're looking for a volunteer to pick up the job of newsletter editor.

We look forward to seeing you this Thursday, July 17.

## The Year's Program -

**Meetings are 1:30 p.m. Thursdays, normally at the OSU Extension office in Newport.**

**July 17 - Ramesh Sagili (DIrector of the OSU Bee Lab), "Current Research"**

**August - Summer break, no meeting**

**Sept 18 - Charlie Vanden Heuvel, "Hive Inspections."**

**Oct 16 - Rick Olsen, "Raising Queens"**

**November 20 - Officer Elections, Plans for 2026**

# What a bumble bee chooses to eat may not match ideal diet

## Bees may under- or over-consume necessary nutrients, researchers find

The findings challenge previous beliefs that scientists can make assumptions about bees' nutritional needs based on what they choose to consume, according to the researchers.

July 2, 2025

By Katie Bohn

UNIVERSITY PARK, Pa. — Humans may not be the only species that struggles to eat the right amounts of the ideal foods. A new study led by researchers at Penn State suggests that what bumble bees choose to eat may not line up with their ideal nutritional needs. The study — published in the Journal of Insect Physiology — examined whether giving bumble bees diets of pollen and nectar enriched with different amounts of proteins, fats and carbohydrates had an effect on how much they ate, as well as a variety of physical characteristics.

The researchers found that bumble bees consumed different amounts depending on which diet they were assigned, but these amounts didn't translate to better physical fitness. For example, bees over-consumed the protein-enriched pollen and under-consumed the fatty, or lipid-enriched, pollen, even though neither of these choices enhanced fitness.

Etya Amsalem, associate professor of entomology in the College of Agricultural Sciences and lead author on the study, said the findings challenge previous beliefs that scientists can make assumptions about bees' nutritional needs based on what they choose to consume. "Bee preferences are unlikely to reflect true needs and more likely result from evolutionary constraints," she said. "For instance, bees may under-consume lipids not because high-lipid diets are harmful, but because their physiology is not well-suited for digesting or storing large amounts of lipids." Similarly, Amsalem added, bees may over-consume proteins because they have evolved to seek them out whenever they're available, even though excess protein can be detrimental because it affects how efficiently bees can eliminate nitrogen from their bodies.

As bee populations decline around the globe, the researchers said, more studies are pointing toward nutritional stress as a contributing factor, making diet an important factor to understand. Habitat loss and agricultural development have reduced the numbers of flowers, forcing bees to rely on suboptimal food sources.

While bumble bees have been shown to regulate their food intake, Amsalem said, scientists don't know if bee preferences necessarily align with what benefits them the most. "It's an odd assumption when you think about it — my toddler prefers chocolate over broccoli, but I wouldn't conclude from that that chocolate is healthier for her," she said. "So, why do we assume bees are different? Understanding potential mismatches between consumption and fitness outcomes is important, as most conservation and management strategies assume bees can self-regulate their diets for optimal health."

For the study, the researchers split the bees into groups and provided them with different diets manipulated by enriching the pollen or modifying the sugar solution — which mimicked nectar — with different macronutrients in different concentrations. They then measured consumption and several indicators of fitness — mass gain, ovary activation and number of eggs laid by workers — for 10 days. All worker bees were the same age, and all tests were conducted in microcolonies containing three workers, which Amsalem said enabled the researchers to directly test if consumption aligned with improved fitness. These groups were compared with a separate control group of bumble bees, which were allowed to feed freely from wild pollen and a 60 percent sugar solution.

The researchers found that increasing protein levels in pollen resulted in bees consuming more pollen, while increasing lipid levels led to bees eating less. Additionally, worker bees over-consumed sucrose when it was offered at lower concentrations. However, despite bees choosing these eating patterns, these choices ended up negatively affecting their fitness compared to the control. In all cases, egg-laying decreased and body mass either declined or remained unchanged.

Amsalem said the findings suggest that conservation and agricultural management strategies may want to consider diet composition impacts on fitness, not just preference or intake. "Future research could investigate why bees fail to optimize diet — for example, metabolic limitations, gustatory biases or ecological tradeoffs — and may explore nonmacronutrient components like vitamins and minerals that may explain fitness discrepancies," Amsalem said.

Anna Cressman, who earned a master of science in entomology from Penn State, and Seyed Ali Modarres Hasani, postdoctoral scholar at Penn State, also co-authored this paper.

The Agricultural Resource Center program of the Pennsylvania Department of Agriculture helped support this research.

# Scientists' top 10 bee-magnet blooms—turn any lawn into a pollinator paradise

## Botanists from the University of Copenhagen and the UK set out to find the best flower combinations for bees and hoverflies.

July 7, 2025 University of Copenhagen - Faculty of Science

Summary:

Danish and Welsh botanists sifted through 400 studies, field-tested seed mixes, and uncovered a lineup of native and exotic blooms that both thrill human eyes and lure bees and hoverflies in droves, offering ready-made recipes for transforming lawns, parks, and patios into vibrant pollinator hotspots.

FULL STORY

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A modest strip of the study's top ten blooms can turn any urban nook into a pollinator magnet. Credit: Shutterstock

Botanists from the University of Copenhagen and the UK set out to find the best flower combinations for bees and hoverflies. The results make it easier for garden owners and

municipalities, among others, to plant the perfect pantries for insects, which also delight the human eye. Flower strips, seed mixtures, and wild by design. We want to help bees and other vital pollinators, which are in decline all over the world. But which flowers are actually the best?

This question prompted botanists from the Natural History Museum of Denmark at the University of Copenhagen and botanists from the National Botanic Garden of Wales to conduct a scientific study of which flower mixtures attract the most pollinators.

"Much of our knowledge in this area is anecdotal. So, there was a need for a scientific approach, where we systematically test different flowers to be sure how we can best help pollinators, which are extremely important to our ecosystems," says professor and botanist Natasha de Vere from the Natural History Museum of Denmark.

**Yarrow, Garden cosmos, and cornflower are a treat**

The researchers reviewed over 400 previous research articles on flowers and insects and investigated how much bees and hoverflies like the finished flower mixtures that are currently sold commercially. Based on the study, the researchers developed two new seed mixtures, which they evaluated both on the number of insects that visited them and on their aesthetic appeal to humans. "We can see that seed mixtures containing both non-native and native flowering plants establish themselves better in the soil, bloom for longer, and have more visits from pollinators. And they are also most attractive to the human eye," says Natasha de Vere.

Based on the study, the researchers recommend choosing seed mixtures with these species if you want to attract bees and hoverflies and are also interested in the aesthetic value of the flowers:

- Yarrow (*Achillea millefolium*)
- Corn chamomile (*Anthemis arvensis*)
- Cornflower (*Centaurea cyan*us)
- Purple viper's bugloss (*Echium plantagineum*)
- Corn marigold (*Glebionis segetum*)
- Common poppy (*Papaer rhoeas*)
- Field mustard (*Sinapis arvensis*)
- Scentless chamomile (*Tripleurospermum inordorum*)
- Garden cosmos (*Cosmos bipinnatus*)
- Moroccan toadflax (*Linaria maroccana*)
- Common phacelia (*Phacelia tanacetifolia*)

**If everyone does a little, we can help the bees**

The reason why the researchers have also included the aesthetic dimension of flower mixtures in their study is, of course, that appearance also has a significant impact on what we choose to plant in our gardens and green spaces. "It has become quite popular to plant strips of flowers in urban areas and in gardens where there may have been only grass lawns before. This is because flowers are good for bees, but also for our mental health," says Natasha de Vere.

According to the professor, who has conducted in-depth research into the interaction between plants and pollinators for a number of years, even small areas of flowers are of great importance to our buzzing friends. Her research shows that gardens and urban areas can be very good for pollinators.

"It is important that everyone does something to help - and even small changes can really make a difference. I myself only have a small backyard, which I have filled with the best plants for pollinators, and it is now full of bees and hoverflies," she says, adding: "I hope our new research results can be used to provide evidence-based guidance on how to select plant species - whether you are a garden owner, a municipal gardener, or otherwise involved in producing seed mixtures."

**Story Source:**

Materials provided by **University of Copenhagen - Faculty of Science**. *Note: Content may be edited for style and length.*

**Journal Reference**:

1. Lucy Witter, Laura Jones, Abigail Lowe, Will Ritchie, Peter Dennis, Gemma Beatty, Natasha de Vere. **The pick of the plot: An evidence-based approach for selecting and testing suitable plants to use in annual seed mixes to attract insect pollinators**. *PLANTS, PEOPLE, PLANET*, 2025; DOI: 10.1002/ppp3.70041

# Breakthrough research on reinsemination of bee queens with imaging of reproductive system elements

Piotr Dziechciarz, Marcin Domaciuk, Renata Pyz-Łukasik, Krzysztof Olszewski & Grzegorz Borsuk

*Scientific Reports* **volume 15**, Article number: 20810 (2025) Cite this article Published: 01 July 2025

## Abstract

The sperm reservoir in the spermatheca of bee queens with desirable genotypes may be depleted. In order to recreate a breeding line, instrumental reinsemination can be performed although beekeepers are generally convinced that ovipositing queens cannot be reinseminated due to the hardening of their valve fold. The beekeeping literature does not provide macroscopic-scale anatomical images of the valve fold. In this two-year study, in total 28 bee queens laying fertilized and unfertilized eggs were subjected to reinsemination with drone semen and ten-fold diluted hematoxylin. The reproductive system was dissected from 24 queens, and the valve fold was subjected to anatomical and histological analysis. The reinseminated queens were aged three months and three years. This study has confirmed that it is possible to carry out instrumental reinsemination in bee queens laying only unfertilized eggs. Afterwards, such queens begin to lay fertilized eggs from which fully developed workers hatch. The mean number of fertilized eggs laid by such queens was 514. The reinsemination of the queens with 2 µl of ten-fold diluted hematoxylin and the histological analyses performed with the use of a stereomicroscope in the macro scale and a light microscope have revealed the actual structure of the stained valve fold, whose shape resembles a “rose flower”. The valve fold consists of one main structure supported by two smaller ones on the sides. In terms of histology, the structure of the valve fold in three-month-old queens is composed of a thick cuticle covering the secretion of epithelial secretory cells and muscles. This structure is responsible for the flexibility of the valve fold. In turn, the valve fold in three-year-old bee queens has an altered histological structure, as its cuticle is lost, leaving only the secretory cells of the epithelium.

The full article is available here:

https://www.nature.com/articles/s41598-025-03278-z

# 2024 was worst year for British bumblebees: Report

Kristine Sabillo, 12 Mar 2025

Bumblebee numbers in Great Britain declined by almost a quarter in 2024 compared with the 2010-23 average, making it the worst year for the genus *Bombus* since records began, according to the latest "BeeWalk" report.

BeeWalk, run by the Bumblebee Conservation Trust, is an annual standardized monitoring program, in which volunteers and partner organizations record the abundance of different bumblebee species across Great Britain between March and October.

In 2024, BeeWalk records showed that only about nine bumblebees on average were seen per kilometer (0.6 miles) walked as opposed to some 12 in 2023 and a peak of around 14 in 2015.

The report cited wet and cold weather from April to June as one of the factors impacting many iconic British bumblebee species, which are important pollinators of crops and wildflowers. The late spring to early summer period is critical for the colony establishment stage, when queen bumblebees create new nests.

Richard Comont, Bumblebee Conservation Trust's science manager, told Mongabay by email that queens at this stage act as "single parents" that forage to feed the whole nest.

However, in cold, wet weather, many flowers close, fall off or don't produce as much nectar or pollen, Comont said. Flying in rain is also much harder for the queen and takes up more energy, while the brood needs more incubation so the larvae don't die of cold, he added.

"When there is cold, wet weather while the queen is a single parent to the developing brood, it increases the chance of nests failing in the same way that it does for birds," Comont said.

While weather has a role to play, it's difficult to pinpoint climate change as a main driver or "smoking gun" of bumblebee population trends in the past 15 years because of its complexity, Comont said. "But it's pretty clear that the effects of climate change — increased flooding, more & hotter heatwaves, more unstable weather patterns, etc — will be increasing the pressure on bumblebee populations."

Although overall bumblebee numbers were lower in 2024, the report noted the situation was nuanced for each bumblebee species, depending on the season.

Species that recorded the biggest decline in England, Scotland and Wales during June or July, when their colony size should be at their peak, were the white-tailed (*Bombus lucorum s.l.*) and red-tailed (*B. lapidarius*) bumblebees, with declines of 60% and 74%, respectively.

For late-peaking species in August, trends were mixed: The heath bumblebee (*B. jonellus*) saw a 63% increase but both the common carder bumblebee (*B. pascuorum)* and the moss carder bumblebee (*B. muscorum*) recorded declines.

The rarest bumblebee in England and Wales, the shrill carder bumblebee (*B. sylvarum*), was up by 74%, although the species was not recorded in two of its five remaining populations.

Comont said it's important to improve the resilience of existing populations through ensuring enough nesting sites and flowering plants.

# On Remote Kent Island, Bowdoin Scientists Uncover Clues to Pollinator Intelligence

By Rebecca Goldfine

The unique ecology of the island has made it possible for a team of Bowdoin researchers to develop new insights into how different bees and wasps learn, and how this ability impacts their foraging behavior.

Kent Island bumblebee.

Eric Diaz, one of the study's coauthors, in the field on Kent Island.

Assistant Professor of Biology Patricia Jones and five Bowdoin students recently published their findings on bee and wasp cognition in The Royal Society's *Biology Letters.*

Their paper, "Pollinator cognition in a plant network" is based on research they conducted over three summers on the island. The students—Eric Diaz ’23, Neena Goldthwaite ’24, Hannah Scotch ’22, Sejal Prachand ’24, and Eva R. Ahn ’26—were supported by Kent Island summer fellowships.

The team first set out in 2019 to determine the ability of six pollinator species—four kinds of bees and two varieties of wasps—to learn plant colors and what effect this had on their nectar-seeking habits. All pollinating insects are “under similar pressures to forage efficiently in a mixed floral community,” the paper notes.

After conducting lab experiments on more than 200 pollinators and making more than 3,000 fieldwork observations, the researchers discovered that the more specialist pollinators that visit a select group of flowers are better at learning colors than the more generalist insects, which visit a broader range of flowers. Both behaviors are equally good but represent different foraging strategies.

In the paper, the researchers propose that being adept at color learning helps specialist insects forage more efficiently and be more selective, so they don't waste energy visiting the wrong flowers. “If [their preferred] plants are of distinct colors, this may...strengthen selection for color learning abilities,” they write.

In contrast, insects that aren’t as good at color learning stick to flowers with similar colors, reducing their need for advanced cognitive skills.

Building on this knowledge, scientists can continue to hone their understanding of what drives pollinator behavior. With insects in decline around the world, including the pollinators that ensure our food supply, studies like this one of plant-pollinator networks are critical. **“Any dataset on which pollinators are visiting which plants is really useful for bee conservation work,” Jones said.**

Each summer, Jones and her husband, Ian Kyle ’06, bring a group of Bowdoin fellows to Kent Island to pursue science, art, or education projects.

## The special nature of Kent Island

The research team took advantage of Kent Island's unique site in the Bay of Fundy to undertake their study. “Islands are so useful for biology and ecology because of their isolation and containment,” Jones said. Especially for pollinator research, she added. “The island provides us the opportunity to nail down the plant-pollinator network because we’re surrounded by cold ocean on all sides.” “There is a knowable, manageable diversity here, so we can look at who are the insects and who are the plants with a level of confidence that is hard to do in mainland sites,” Jones said.

The island is also a productive place for students to learn fieldwork skills. Eva Ahn ’26, a coauthor of the pollinator paper and the artist who created its illustrations, said her summer on the island “opened my eyes to what research could be. Before it was a very mysterious thing.” As an environmental studies and biology major, Ahn is interested in a career in ecology or marine biology. Her summer on Kent Island was special, she said, because she was able to spend lots of time outside and observe the natural world more closely. “It was a great opportunity to incorporate my interest in art into research, which helped me understand more deeply.”

### What do bees know?

To gather data for their recently published study on color learning, the Kent Island researchers first had to discern how their pollinators perceive color. Bee and wasp vision, and their perception of color, differs greatly from humans.


Eva Ahn's poster of Kent Island wildflowers commonly visited by its pollinators (based on how we, humans, see them!).

Ahn said this aspect of the study was particularly important, both for the research and for conservation. “In the whole scheme of conservation and protecting these insect species, it's important to understand how they perceive the world. It's very different from us,” she said. **“It's important to take into account their sensory perspectives when we’re trying to inform policies and methods of conserving these very important species that provide a lot of ecological benefits.”**

To get a better sense of what the pollinators see, the team used Bowdoin's spectrometer to measure light wavelengths reflected by flower petals. “We took these objective measurements of colors and then we plotted them subjectively into the way a bee sees them, to think about flower colors from a bee’s perspective,” Jones said. “Combining that with color learning hasn’t been done before.” After making observations of pollinator behavior in the field, the students and Jones tested their ability to learn color in the lab by tempting them with either sucrose- and water-dipped paper strips of different colors.

This summer, and for summers to come, Jones is continuing this work with Kent Island students to better understand the complex dynamics of a pollinator-plant community. She hopes to one day be able to look at the totality of flower traits—their color, scent, size, amount of nectar, and nectar chemistry—and deduce how bees decide which blossoms to visit. “The nice thing about this project in particular is it generates lots of data and a huge amount of questions,” Jones said. “I challenge each student to come up with their own question to ask.”

Don't Forget the Petrels!

In addition to the pollinator publication, Jones is the senior author of another recently published paper on Leach's storm-petrels, “Adult survival in a small seabird, Hydrobates leucorhous, covaries with the Atlantic Multidecadal Oscillation over the past six decades.” The small, endangered seabird nests each summer on Kent Island, in underground burrows. The paper's researchers took advantage of a multidecade dataset on the island's petrel population started in the 1950s by Charles Huntington (1919-2017), a Bowdoin biology professor and Kent Island director from 1953 to 1986. “Long-term biological datasets are rare because of how labor- and resource-expensive they are to sustain, but they are critical to understanding the impact of global climate change on population demographics,” the paper explains.

Published July 07, 2025

# Ecological thresholds and transformations due to climate change: The role of abiotic stress

Michael J. Osland, John B. Bradford, Lauren T. Toth, Matthew J. Germino, James B. Grace, Judith Z. Drexler, Camille L. Stagg, Eric R. Grossman, Karen M. Thorne, Stephanie S. Romañach, Davina L. Passeri, Gregory B. Noe, Jessica R. Lacy, Ken W. Krauss, Kurt P. Kowalski, Glenn R. Guntenspergen, Neil K. Ganju, Nicholas M. Enwright, Joel A. Carr, Kristin B. Byrd, Kevin J. Buffington

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## Abstract

An ecological threshold is the point at which a comparatively small environmental change triggers an abrupt and disproportionately large ecological response. In the face of accelerating climate change, there is concern that abrupt ecosystem transformations will become more widespread as critical ecological thresholds are crossed. There has been ongoing debate, however, regarding the prevalence of ecological thresholds across the natural world. While ecological thresholds are ubiquitous in some ecosystems, thresholds have been difficult to detect in others. Some studies have even concluded that threshold responses are uncommon in the natural world and overly emphasized in the ecological literature. As ecologists who work in ecosystems chronically exposed to high abiotic stress, we consider ecological thresholds and ecosystem transformations to be critical concepts that can greatly advance understanding of ecological responses to climate change and inform ecosystem management. But quantifying ecological thresholds can be challenging, if not impossible, without data that are strategically collected for that purpose. Here, we present a conceptual framework built upon linkages between abiotic stress, climate-driven ecological threshold responses, and the risk of ecosystem transformation. We also present a simple approach for quantifying ecological thresholds across abiotic stress gradients. We hypothesize that climate-driven threshold responses are especially influential in ecosystems chronically exposed to high abiotic stress, where autotroph diversity is low and foundation species play a prominent ecological role. Abiotic conditions in these environments are often near physiological tolerance limits of foundation species, which means that small abiotic changes can trigger landscape-level ecological transformations. Conversely, the alleviation of stress near thresholds can allow foundation species to thrive and spread into previously inhospitable locations. We provide examples of this climate-driven threshold behavior from four high-stress environments: coastal wetlands, coral reefs, drylands, and alpine ecosystems. Our overarching aim in this review is to clarify the strong relationships between abiotic stress, climate-driven ecological thresholds, and the risk of ecosystem transformation under climate change.

For the full article, see:
https://esajournals.onlinelibrary.wiley.com/doi/10.1002/ecs2.70229

# Chinese scientists create first cyborg bee with world's lightest brain controller

## Chinese-made device can command the movements of bees, making them ideal to help search for survivors in earthquake ruins, scientists say

Stephen Chenin Beijing Published: 2:00pm, 10 Jul 2025

[From South China Morning Press]

Worker bees carry nectar sacks weighing 80 per cent of their body mass. When airborne, they tuck their hind legs like landing gear to cut wind drag.

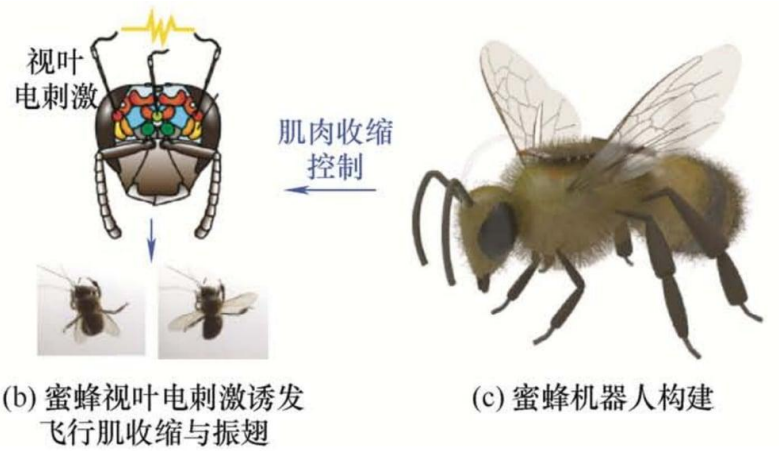
And they can fly 5km (3 miles) with no need for rest, an example of how nature's genius shames human machinery.

Until now.

At Beijing Institute of Technology, Professor Zhao Jieliang's team has built the world's lightest insect brain controller. At 74 milligrams, it is lighter than a sack of nectar. Strapped to the bee's back, the device pierces its brain with three needles. It creates illusions with electronic pulses to command flight: turn left, turn right, advance, retreat.

Nine out of 10 times, the bee obeyed.

The cyborg bee could serve as military scouts or search for survivors in the ruins of an earthquake, according to a peer-reviewed paper published on June 11, in the Chinese Journal of Mechanical Engineering. "Insect-based robots inherit the superior mobility, camouflage capabilities and environmental adaptability of their biological hosts," wrote Zhao and his colleagues.




Chinese scientists command a bee's flight with the world's lightest brain control device. Photo: Beijing Institute of Technology

"Compared to synthetic alternatives, they demonstrate enhanced stealth and extended operational endurance, making them invaluable for covert reconnaissance in scenarios such as urban combat, counterterrorism and narcotics interdiction, as well as critical disaster relief operations," they added.

Before this, the lightest cyborg controller came from Singapore and was triple the weight. It could command beetles and roaches but they crawled at relatively slow speeds in short ranges and fatigued quickly. Zhao's team printed circuits on polymer film. While flexible and as thin as insect wings, it hosts numerous chips including an infrared remote.

Tests were done in nine pulse settings. The researchers studied bee wings and cockroach turns. They mapped signals to motion, made bees bank and made roaches trace long straight paths with little deviation.

But some flaws remain. Bees need wired power and roaches tire after 10 zaps. One signal stirs different moves in different bugs, according to the researchers. A long-lasting battery weighs 600mg – far too heavy for a bee. Their legs and bellies also refuse commands.

"In future research, precision and repeatability of insect behaviour control will be enhanced by optimising stimulation signals and control techniques," wrote Zhao's team. "Concurrently expanding functional modules of the control backpack will improve environmental perception capabilities of insect-based robots, advancing their deployment in complex operational settings such as reconnaissance and detection missions," they added.

Nations have engaged in an intense race on cyborg tech. The US Defence Advanced Research Projects Agency (DARPA) used to take the lead, with Japan trailing closely. But now China is smashing records in this field, thanks to ample government funding and a booming electronics industry.

## Club Information and Contacts

Visit our website at: https://www.ccbaor.org/

Address: POB 1916 Newport, OR 97365

Email: centralcoastbeekeepers@gmail.com

facebook: CCBA meta