CENTRAL COAST BEEKEEPERS NEWSLETTER

June 2024

NEXT MEETING June 26, 2024

Important Notice: In the second half of the year, WE WILL MEET ON SATURDAYS, in the hope that more of our members with Monday to Friday commitments will be able to attend. Please see updated schedule, p. 2

PRESIDENT'S MESSAGE

By Jeremy Egolf

This is National Pollinator Week, June 17-23. Appropriately, our own Becca Fain is setting up our CBBA display at the Waldport Public Library this Saturday, June 22, as we head into summer and the blackberry nectar flow. In recognition of this special week, the *Oregonian* online has a nice article featuring pollinator-attractive plants:
https://www.oregonlive.com/hg/2024/06/25-plants-to-draw-native-bees-to-oregon-gardens-in-honor-of-national-pollinator-week.html
The article quotes, amongst others, Andony Melathopoulos, the speaker for our June meeting, and Gail Langellotto, entomologist and professor in the OSU College of Agricultural Sciences, who collected native bees in Portland-area gardens for the Oregon Bee Project.

This May, OSU Bee Lab Director Ramesh Sagili spoke to us on pollen patties and varroa treatments. A few takeaways:
- Mite drift is more pronounced in areas of high bee density (e.g., commercial apiaries vs. a handful of backyard colonies)
- Reproductive vs. phoretic mite proportions may be as high as 80:20 depending on time of year, but 56:44 is more typical.
- Varoxsan, a slow release oxalic acid treatment applied similarly as Hopguard, is coming to market (more on the product website is here: https://www.vita-europe.com/beehealth/products/varroxsan-varroa-control/)
- OSU is performing experiments with glass hives to study flow of sublimated oxalic acid; frames will be analyzed to determine where the acid is deposited. It has been found that treatments of four grams of oxalic acid per brood box injures larvae, but three grams do not harm them
- Ramesh reminded us to treat not according to a calendar, but per need based on regular sampling
- The OSU lab found a 30% drop in mites after three hours exposure to Apivar. A follow up will be performed this year, including an efficacy comparison to some Florida bee lab hives which have had no amitraz for thirty years.
- On nutrition, there has been little research since the 1990s. Larvae pheromone stimulates pollen foraging. Older (foraging) bees have lower protein requirements, but 7-14 day old nurse bees need pollen protein.
- Larvae molt as they grow, with hormones that control molting vs. growing. The hormones require steroids, which pollen substitutes do not contain. Therefore, pollen supplements (containing several percent natural pollen) should be fed to them. OSU is studying improved supplements. The Keith Jarrett supplement had relatively low consumption by caged bees, but OSU will study it in the field.
- It is possible that supplements can contribute to immunity.
- USDA, Xerces Society, etc., lists of flowers attractive to pollinators do not include nutritional data. OSU is collecting pollen to analyze for nutrients, and has pollen vacuums available to lend to "citizen scientists." OSU will study bee feces to determine which pollen varieties are being digested fully rather than just being passed through. Also, OSU is studying supplements' relation to diutinus ("winter") bee survival -- see also the link to *The Apiarist* in this newsletter.
- For apiaries placed among hybrid crops (e.g., carrots) which produce little pollen, growers are urged to plant pollen-rich plants (a point mostly relevant to Oregon east of the coast range, but still relevant to the coast's forest land)

The weekend of May 19th, we distributed our bulk order of packages and nucs and are optimistic they are taking hold. We hope their keepers have made an initial mite treatment. We had an outreach event in May at the Florence Garden Club sale and will also be at the Waldport library pollinator event June 22 and then three full days at the Lincoln County Fair over the July 4th weekend.

The Year's Program

All meetings 1:30 p.m. at the Newport Public Library, except for the June meeting, which is at the OSU Extension office in Newport.

Wed., June 26: Dr. Andony Melathopoulos (OSU Extension Service Master Melittologist): "Take a walk on the wild side: the weird and wonderful world of native bees (for beekeepers)." Note: meeting at the OSU Extension Office, 1211 SE Bay Blvd., Newport.

> Before Dr. Melathopoulos's presentation, we suggest you look into the identifying keys at https://ir.library.oregonstate.edu/concern/technical_reports/xg94hz59f
>
> Better still, print them out and have them available when the bees come bumbling! Learn to distinguish the boys from the girls!
>
> For the federal project sequencing native bee genomes, see https://www.beenome100.org/home

Saturday, July 27: Annie Marion (USDA Natural Resources Conservation Service, Waldport Field Office): "Coastal Pollinator Habitat."

August: Summer party hosted by Pat Wackford (to whom we are grateful!) (date TBD)

Saturday, September 25: Randy Oliver

Saturday, October 19: Dr. Dewey Caron (Emeritus Professor of Entomology and Wildlife Ecology, University of Delaware, and Affiliate Professor, Department of Horticulture, OSU): "Winter Hive Preparations"

Saturday, November 16: Annual Meeting (Election of Officers, Plans for Next Year)

2024 Bulk Package and Nuc Order

The bees were distributed over the weekend of May 19 - please keep us posted on the quality of the bees you receive – this feedback is very important to us as we make plans for next year's bulk order.

Diutinus Bees

At our May meeting, Dr. Sagili touched on the role of nutrition in producing diutinus (long lived, or "winter" bees). This sent us scurrying off to learn more; we turned up a fine web page on the subject (courtesy of *The Apiarist*) here:

https://theapiarist.org/diutinus-bees/

It's too long to extract at length for this newsletter, but the piece contains fascinating data on bee cohorts through the autumn during the gradual transition to the diutinus bees. The four key physiological factors to be considered are the levels of **juvenile hormone**, **vitellogenin** and **hemolymph proteins** and the size of the **hypopharyngeal gland**. A useful schematic presents a proposed system model for how the production of winter bees is regulated. Possible epigenetic factors in diurnal bee production are discussed.

Project Apis m. Links

Last month's newsletter featured Jan Lohman's message regarding Project Apis m. It's worth glancing at their website for visibility into the research they're funding:

https://www.projectapism.org/research

And a plethora of guides and links are available here:

https://www.projectapism.org/resources

And here is their Seeds for Bees program; resources include a handy list of concerns for cover crop seed mixes:

https://www.projectapism.org/sfb-home

Testing Honey Bee Colonies for Hygienic Behavior

[Editor's note: This is extracted from https://www.sare.org/publications/a-sustainable-approach-to-controlling-honey-bee-diseases-and-varroa-mites/testing-honey-bee-colonies-for-hygienic-behavior/ The online article also describes a method for freezing brood using liquid nitrogen, which involves significant safety issues (as does, for example, treating colonies with oxalic acid). Hence, the liquid nitrogen method is not included here.]

It is relatively easy to determine if a colony of bees displays hygienic behavior. If you are curious whether your bees express the behavior, you can test them using this method. (Also see Spivak and Downey, 1998; Spivak and Reuter, 1998b). They involve presenting bees with freeze-killed or pin-killed brood and determining the colony's rate of removal of the dead brood.

The ability of a colony to quickly remove freeze-killed or pin-killed brood corresponds generally with how quickly the colony detects and removes diseased or mite-infested brood. These methods are used as an initial screen to find colonies with hygienic tendencies. This initial assay should be followed by more detailed tests of a colony's ability to detect and remove actual diseased or mite-infested brood.

Recommended Method to Test for Hygienic Behavior

THE FREEZE KILLED BROOD ASSAY

In this assay, a comb section of sealed brood containing approximately 100 cells on each side (2 inches by 2.5 inches, or 5 centimeters by 6 centimeters) is cut from a frame and frozen for 24 hours at -10°F (-20°C). The frozen comb section is inserted into a frame of sealed brood in the colony being tested (Figure 2).

Tests have shown that it does not matter if the frozen section comes from the same colony from which it was removed or from a different colony. The frame with the freeze-killed brood insert is placed in the center of the brood nest. One day (24 hours) later the frame is removed and the number of sealed cells remaining is recorded. A hygienic colony will have uncapped and removed over 95% of the frozen brood within 24 hours. A non-hygienic colony will take over six days to completely remove the frozen brood.

Important note: This test should be repeated on the same colony, and you may notice that the results may vary between tests. For example, a colony may remove 95% of the frozen brood on the first test, but only 50% on the second. This colony is not hygienic! It is very important that colonies be considered hygienic ***only if they remove more than 95% of the brood on two consecutive tests.***

UN WORLD BEE DAY—20 May 2024 "Bee Engaged with Youth" to Safeguard Bees and Other Pollinators

By Dr. Ronnie Brathwaite iSenior Agriculture Officer, Plant Production and Protection Division (NSP), Food and Agriculture Organization of the United Nations (FAO). **19 May 2024**

[Editor's Note: This article is from https://www.un.org/en/%E2%80%9Cbee-engaged-youth%E2%80%9D-safeguard-bees-and-other-pollinators. Although the contents offer little that is new to beekeepers, it is interesting that the UN Food and Agriculture Organization is making an effort to foster youthful interest in bees.]

Pollination is a fundamental process that is necessary for the survival of our ecosystems. It plays a crucial role in food security and agrobiodiversity. Pollinators support vital ecosystem functions for nature, agriculture and human well-being, acting as the invisible cornerstone of functioning and sustainable agrifood systems. The Food and Agriculture Organization of the United Nations (FAO) estimates that about three quarters of the food we eat depends, at least in part, on pollinators and that around 10 per cent of the total economic value of agricultural output for human food is dependent on insect pollination. This is no small feat considering that the total value of agriculture's contribution to human food globally can be measured in trillions of dollars per year.

Unfortunately, pollinators are facing multiple challenges that put their capacity to provide ecosystem services at risk. Human activity, such as intensive monoculture production, poses serious threats to bees and other pollinators by limiting their access to food, such as wildflowers, and to their natural habitats and nesting sites. Additionally, detrimental agricultural practices, such as chemical treatments and overuse or improper use of pesticides, including insecticides, acaricides, fungicides and herbicides, can be very harmful to bees and other pollinators, affecting their cognitive abilities, impairing their performance and even killing them.

In addition to greatly contributing to the production of our food supply, pollinators serve critical functions in safeguarding our ecosystems by enhancing soil health and guaranteeing working fauna-flora interactions. Protecting pollinators and preserving their precious ecosystem functions are paramount to bolstering global food and nutrition security and thus supporting our very existence. Whether it is the Himalayan bumblebee, which pollinates flowers at altitudes above 4,000 m, or the ground-dwelling digger bees in Texas, all pollinators need our support.

By promoting nature-positive and agroecological approaches that protect pollinators and their habitats, such as diversifying agricultural landscapes, minimizing pesticide use, and establishing pollinator-friendly habitats within and around crop production areas, we can actively support bees and other pollinators in playing their critical role in the ecosystem and our food systems.

Over 200,000 animal species function as pollinators, including more than 20,000 species of wild bees. Pollinators include bumblebees, bats, wasps, butterflies and certain birds and mammals. Domesticated bees are likely the best-known pollinators, but it is important to underline that most pollinator species are wild. Therefore, it is imperative for us to pay particular attention to human activities that continue to encroach on and threaten the natural habitats of pollinators.

Bees and other pollinators are so crucial that, in 2017, the United Nations General Assembly proclaimed 20 May as World Bee Day, to be celebrated by United Nations agencies, Member States and stakeholders around the globe. However, dedicating just one day each year is insufficient to raise awareness about the importance of pollinators and pollination services. This heterogenous group of animals that pollinates our crops and ensures our food security deserves more recognition and praise.

Beekeepers of Yeruu soum (Selenge aimag) in Mongolia, members of the Supreme Council of Mongolian Beekeepers Association. Pierre Ferrand

The future of food security and sustainable food systems depends on the decisions we make today. As temporary inhabitants and custodians of our planet, we must recognize that countless plants and animals, including humans, will continue to inhabit this space long after we are gone. Our young people are the focus of our hopes that, we humans have already learned from our missteps over the past decades and that future generations will be supported in making better choices. These choices should entail the restoration of degraded habitats for pollinators, the practice of pollinator-friendly agriculture, reduction of environmental pollution, and halting or reversing climate change. It is through the co-creation of knowledge and capacity-sharing today that we lay the groundwork to guide the informed actions of tomorrow.

We are betting on the fact that young people have the vigour and vision to continue to advocate for pollinators and provide innovative and technological solutions that will catalyze the efforts initiated by FAO and partners. Such work is aimed at fostering pollinator conservation and sustainable production and consumption, valuing ecosystem services, and promoting ecosystem-friendly agriculture such as agroecology.

A quick scan of social media platforms will reveal that millions of young people are engaging in discussions about apiculture (beekeeping) and pollinators' protection. Those of us who are old enough to remember when social media was invented in the 1990s never anticipated this level of uptake. In 2024, these platforms serve as powerful tools to amplify the voices of young advocates and activists who are creating a sense of solidarity while spreading the message of bee conservation to their peers and communities. They are also motivating and influencing decision makers to prioritize protecting bees and other pollinators. Young people don't just talk about pollinators; they also take concrete action by planting pollinator-friendly gardens, setting up "bee hotels", and participating in citizen science projects to monitor the populations of bees and other pollinators. Such activities not only directly benefit bees but also promote a sense of environmental stewardship among youth.

These actions are not solely altruistic—there is collective interest in bees and other pollinators. Social media influencers can attract annual revenue in the millions of dollars if they can keep their followers engaged, but the business of apiculture itself can also be a lucrative endeavour. There is high demand for natural and organic honey products, creating a tangible financial incentive to invest in sustainable beekeeping and honey production. With proper training and equipment, this can become a genuine business opportunity for young entrepreneurs.

To make the creation of sustainable bee-related businesses a real possibility for young people, we need a dedicated, global, peer-to-peer youth educational programme centred on the importance of bees and other pollinators, and on the ways in which they can be integrated into farming systems and in various landscapes. There are numerous success stories of youth in "bee-businesses", especially from the global South, that can serve to attract more young people and inform them about the importance of pollinators' protection and existing business opportunities.

Domesticated bees are likely the best-known pollinators, but it is important to underline that most pollinator species are wild. © FAO/Tofik Babatev

The power and potential of youth as agents of change are reemphasized by the fact that the events of World Bee Day 2024 are centred on the theme "Bee engaged with youth" to highlight the importance of youth involvement, recognizing that they are the future beekeepers and stewards of the environment. The theme focuses on attracting the attention of younger generations and sharing fascinating facts about bees, beekeeping and pollination ecosystem services.

This year's events will demonstrate that beekeeping—a profession that embraces the use of locally available materials, limited resources and home-grown innovation—can offer employment and income opportunities to those in extreme poverty, landless individuals, women and young people. It will emphasize the need to provide an opportunity for young people to engage with beekeepers and experts in the field, and to learn about the latest technology used in beekeeping.

FAO is mandated to organize World Bee Day to serve as an annual reminder to the world about the importance of bees and other pollinators for food security and biodiversity. It's the right occasion to increase awareness among all stakeholders, Governments, United Nations system entities, other international and regional organizations, civil society, the private sector and the wider public about the importance of protecting bees and other pollinators.

FAO is also supporting the development of its Global Action on Pollination Services for Sustainable Agriculture to promote sustainable agrifood systems through pollinators' protection, ecosystem services resilience and agroecology mainstreaming. Building on past FAO interventions, this renewed action aims to provide evidence-based entry points for initiatives in support of pollinators' protection and agroecology enhancement, and will demonstrate how pollinators' protection can enhance sustainable and resilient agrifood systems and create business opportunities. The Global Action will also contribute to greater knowledge-sharing and scaled-up, pollinator-friendly agricultural practices globally.

As we celebrate World Bee Day, let us remember how crucial it is to prioritize efforts to protect bees and other pollinators. FAO is committed to supporting youth, who have a key role to play in fostering the transformative changes as well as future initiatives and activities needed to save our bees and other pollinators.

Further reading

Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (IPBES), *The Assessment Report of the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services on Pollinators, Pollination and Food Production*, S.G. Potts, V. L. Imperatriz-Fonseca and H. T. Ngo, eds. (Bonn, Germany, IPBES Secretariat, 2016). Available at https://doi.org/10.5281/zenodo.3402857.

Matthew R. Smith and others, "Pollinator Deficits, Food Consumption, and Consequences for Human Health: A Modeling Study", in *Environmental Health Perspectives*, vol. 130, No. 12 (December 2022). Available at https://ehp.niehs.nih.gov/doi/epdf/10.1289/EHP10947.

Papua New Guineans, genetically isolated for 50,000 years, carry Denisovan genes that help their immune system, study suggests

Emily Cooke

[Editor's Note: Although not specific to bees, this article caught my eye due to its description of a case of human genetic diversity within a relatively small geographic area, reminiscent of reports on natural selection of bee characteristics we carried in previous editions of the newsletter. A practical question to have on our minds is the value to us on the central coast of queens that have been raised and mated from several generations of colonies from the Coast Range to the Pacific, as distinct from those with Willamette Valley or California or even further afield heritage.]

189

Nine members of a family are pictured sitting on a wooden platform with clothes hanging on a washing line above.

Papua New Guineans, who have been genetically isolated for millennia, carry unique genes that helped them fight off infection — and some of those genes come from our extinct human cousins, the Denisovans.

The research also found that highlanders and lowlanders evolved different mutations to help them adapt to their wildly different environments.

"New Guineans are unique as they have been isolated since they settled in New Guinea more than 50,000 years ago," co-senior study author François-Xavier Ricaut, a biological anthropologist at the French National Center for Scientific Research (CNRS), told Live Science in an email.

Not only is the predominantly mountainous terrain of the island country particularly challenging, but infectious diseases are also responsible for more than 40% of deaths.

Locals therefore had to find a biological and cultural strategy to adapt, which means that the population of Papua New Guinea is a "fantastic cocktail" to study genetic adaptation, Ricaut said.

Modern humans first arrived in Papua New Guinea from Africa around 50,000 years ago. There, they interbred with Denisovans who'd been living in Asia for tens of thousands of years. As a result of this ancient interbreeding, Papua New Guineans carry up to 5% Denisovan DNA in their genomes.

In the new study, published April 30 in the journal Nature Communications, scientists analyzed the genomes of 54 highlanders from Mount Wilhelm who lived between 7,500 and 8,900 feet (2,300 and 2,700 meters) above sea level, and 74 lowlanders from Daru Island, who lived less than 330 feet (100 m) above sea level.

They found that mutations lowlanders probably inherited from Denisovans boosted the number of immune cells in their blood. The highlanders, meanwhile, evolved mutations that raised their red blood cell count, which helps reduce hypoxia at altitude. That's not unusual, as people from several other high-altitude environments have evolved different mutations to combat hypoxia.

The Denisovan gene variants may affect the function of a protein called GBP2 that helps the body fight pathogens that are only found at lower altitudes, such as the parasites that cause malaria. These genes may therefore have been selected during evolution to help people fight off infection at lower altitudes where pathogens are rife, the team said.

Going forward, the team wants to uncover how these mutations bring about changes in the blood of Papua New Guineans, Ricault said. To decipher this, they'll need to investigate how these mutations impact the activity of the genes in which they are found.

Slovenia's Beautiful Beehives

Beautiful Beehives Turn Apiaries Into Art

(from *Bee Culture* 12/13/23)

Dating back to the 18th century, AŽ hive panels depict stories of marriage, damnation, and daily life.

BY REBECCA L. RHOADES

"SLOVENIA HAS A STRONG connection with beekeeping," says Peter Kozmus, one of the country's—and the world's—leading experts on bees. "Historically, every village had at least one beekeeper who produced honey for himself, his relatives, and neighbors." This tradition continues today, with approximately one in every 200 Slovenians keeping and tending to bee colonies.

Kozmus has been a beekeeper since he was 14 years old. Today, he runs a honey farm in Pilštanj in eastern Slovenia, where he tends to more than 100 bee colonies. He also heads the breeding program for the 8,000-member Slovenian Beekeepers' Association, a nearly 150-year-old education, research, and training organization.

Drive through the verdant countryside, and you'll notice hobbit-sized huts, similar in appearance to garden outbuildings or she-sheds. But these small structures aren't filled with landscaping tools or craft supplies. Instead, they're apiaries that house unique hives, known as Alberti-Žnideršič (or AŽ) hives. Invented at the turn of the 20th century by beekeeper Anton Žnideršič, the hives—*kranjichi* in Slovenian—take their name from their inventor whose design was inspired by a leaf hive system by German teacher and beekeeper Adolf Alberti.

Unlike their American counterpart, the Langstroth hive, with its vertical box shape and hanging honeycomb frames, AŽ beehives are smaller and open from the back instead of the top. They also can be stacked together. Their structural design and small size allow them to be incorporated into the walls of the apiaries, providing protection from the elements and making it easier for beekeepers to inspect and manage their colonies. More than 90 percent of beekeepers in Slovenia use AŽ hives.

Kozmus in front of one of his beehouses. COURTESY PETER KOZMUS

Like everyone else in Slovenia, Kozmus oversees colonies of native Carniolan honey bees, the only species the country allows beekeepers to tend. Kozmus's bees are divided between four apiaries outfitted with AŽ hives. A large one near his house serves as the main source of honey production and is used for tourism purposes. Two mobile apiaries can be moved around the property "to find better pastures," Kozmus explains. And a small house is reserved for nucleus colonies—developing colonies with breeding queens. But there is no standard design for an AŽ hive house. It can be as small or as large as the beekeeper desires and can hold dozens of hives, stacked two or three high.

Typically, the hives are built into the south side of a bee house to capture the sun, while the opposite wall blocks the cold north winds. The eaves should extend about three feet to protect from rain and snow, while the entire house should be raised about four feet off the ground in order to keep the hives dry. Many bee houses are built on wheels, allowing them to be moved around the property as the seasons change.

Inside, the apiaries are a mix of workspace and living room. Depending on their location, they can include heat or air conditioning. Some are large enough to hold the extractor and other machinery needed to process the honey, as well as space for the beekeeper to hang out. "You'll see a lot of bee houses that have beds or a table and chairs in them," says Suzanne Brouillette, the owner of Slovenian Beekeeping. Brouillette, a New Hampshire resident, organizes beekeeping-themed trips to Slovenia and is one of the few providers of AŽ hives in the United States. "You'll go out and take care of the bees, have some bread and wine and cheese, and take a nap," she says.

A small hole or slit on the front of the hive allows the bees to enter and exit, while the beekeeper accesses the combs from the rear of the hive, which is located inside the apiary. The hives themselves are divided into two chambers. "They're basically two-story bee apartments," says Wesley Brittenham, director of horticulture for Los Poblanos, a historic inn and lavender farm in Albuquerque, New Mexico. The property recently built a Slovenian apiary as part of its beekeeping program. "The queen does all the brood rearing and egg laying in the downstairs portion, while upstairs, all the bees can build pure, clean honeycomb," he explains.

Each weighing about eight pounds, AŽ bee house frames are easy to remove, simply sliding out one at a time like books off a bookshelf. Langstroth hive frames can weigh as much as 40 to 90 pounds and must be lifted up out of the hive. "There are so many benefits to this style of beekeeping," Brouillette says. "Number one, anyone can do it—children, the elderly, if you're in a wheelchair. It really opens up beekeeping to everyone."

But the most memorable aspect of Slovenian bee houses is their colorful appearance. The hives often are painted in bold primary hues and adorned with artistic panels, known as *panjske končnice*.

Brouillette says there are 600 known panel motifs from the 1800s, ranging from the religious to the political to the quotidian. "It was a way of being a little bit more prestigious than your neighbor if you had them," she says.

About half of the motifs tell stories from the Bible. "The panels were like frescoes in a church," Brouillette adds. The oldest-known bee panel is from 1758 and depicts the Madonna and Child. There's Adam and Eve in the Garden of Eden, images of patron saints, and scenes of sinners in Hell.

Secular subject matter includes animals and hunting scenes, caricatures of important figures, and social commentary. There are themes of marriage and funerals, moral tales of drinking and infidelity, important events from history, and amusing looks at daily life.

While the art of hand-painting bee panels faded away after World War I, many beekeepers still use reproduction panels or ones with their own designs. “Beekeepers still paint the fronts of their hives because it’s our tradition and because we want to have beautiful hives,” Kozmus says. “Some apiaries still have such beautifully painted beehive headboards that visitors can watch them like they’re watching TV, because each headboard tells a story.”

When it comes to the story of beekeeping, the future looks uncertain. The prospect of a world without bees is dark: The Beekeepers’ Association warns that “Without bees, there is no life, no diversity, and almost one-third less food production. Which means no future.” But there is hope, as more Slovenian beekeepers continue the historic tradition. Thanks to the group’s educational efforts, the average beekeeper age has decreased from 65 to 59 over the past 15 years in Slovenia.

“In our country, we have mostly small hobby beekeepers for whom beekeeping is a way of life,” Kozmus explains. For Slovenians, he says, tending bees is not viewed as work, but something “that makes their lives better.”

Culture gathers and shares articles published by outside sources. For more information about this specific article, please visit the original publish source: https://www.atlasobscura.com/articles/what-are-slovenian-beehouses

The wasps that tamed viruses: Some insects have transformed wild viruses into tiny biological weapons.

Nala Rogers, Knowable Magazine - 5/10/2024, 6:52 AM

Xorides praecatorius is a parasitoid wasp. TorriPhoto via Getty

If you puncture the ovary of a wasp called *Microplitis demolitor*, viruses squirt out in vast quantities, shimmering like iridescent blue toothpaste. “It’s very beautiful, and just amazing that there’s so much virus made in there,” says Gaelen Burke, an entomologist at the University of Georgia.

M. demolitor is a parasite that lays its eggs in caterpillars, and the particles in its ovaries are “domesticated” viruses that have been tuned to persist harmlessly in wasps and serve their purposes. The virus particles are injected into the caterpillar through the wasp’s stinger, along with the wasp’s own eggs. The viruses then dump their contents into the caterpillar’s cells, delivering genes that are unlike those in a normal virus. Those genes suppress the caterpillar’s immune system and control its development, turning it into a harmless nursery for the wasp’s young.

The insect world is full of species of parasitic wasps that spend their infancy eating other insects alive. And for reasons that scientists don’t fully understand, they have repeatedly adopted and tamed wild, disease-causing viruses and turned them into biological weapons. Half a dozen examples already are described, and new research hints at many more.

By studying viruses at different stages of domestication, researchers today are untangling how the process unfolds.

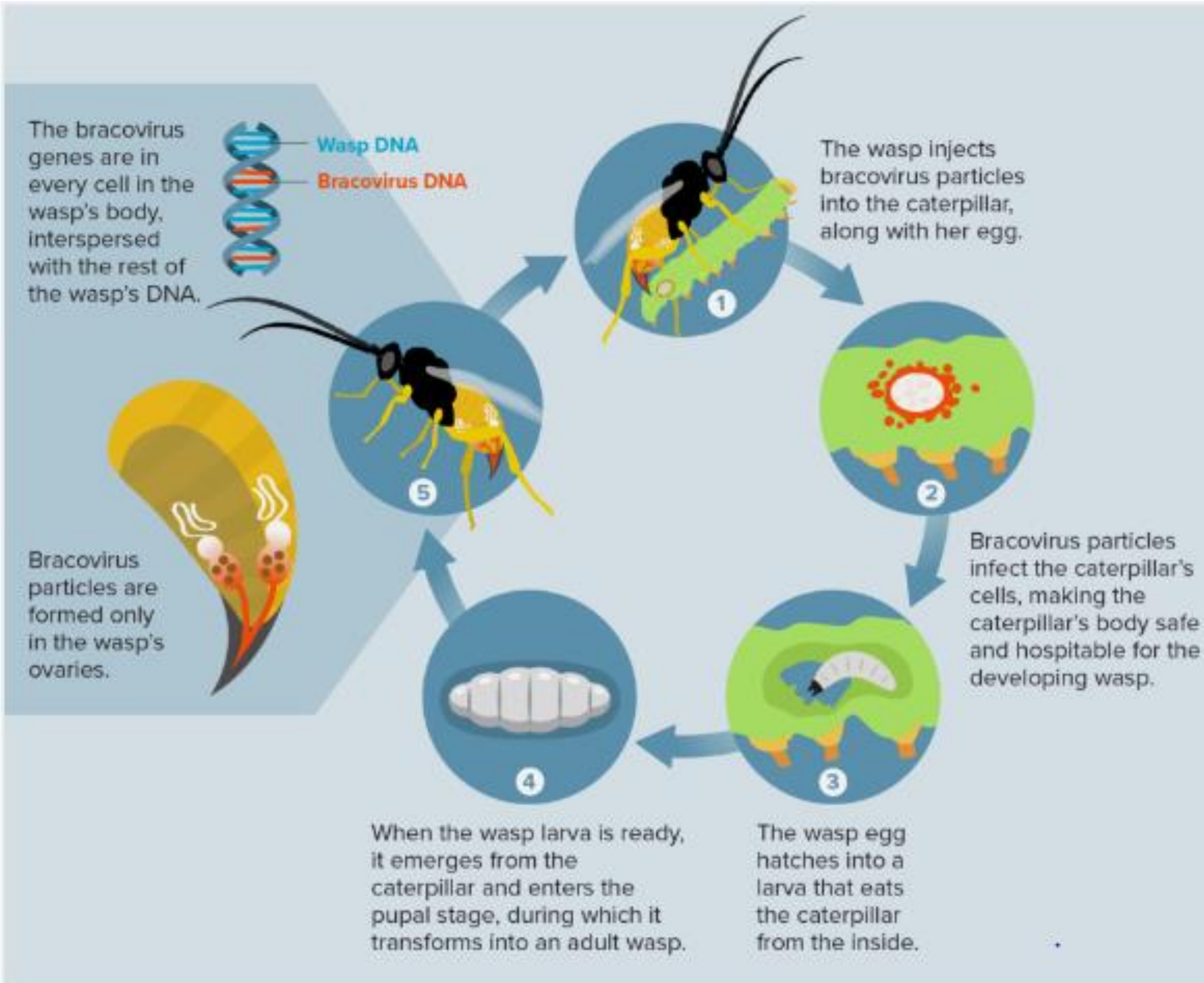
Partners in diversification

The quintessential example of a wasp-domesticated virus involves a group called the bracoviruses, which are thought to be descended from a virus that infected a wasp, or its caterpillar host, about 100 million years ago. That ancient virus spliced its DNA into the genome of the wasp. From then on, it was part of the wasp, passed on to each new generation.

Over time, the wasps diversified into new species, and their viruses diversified with them. Bracoviruses are now found in some 50,000 wasp species, including *M. demolitor*. Other domesticated viruses are descended from different wild viruses that entered wasp genomes at various times.

Researchers debate whether domesticated viruses should be called viruses at all. “Some people say that it’s definitely still a virus; others say it’s integrated, and so it’s a part of the wasp,” says Marcel Dicke, an ecologist at Wageningen University in the Netherlands who described how domesticated viruses indirectly affect plants and other organisms in a 2020 paper in the Annual Review of Entomology.

As the wasp-virus composite evolves, the virus genome becomes scattered through the wasp’s DNA. Some genes decay, but a core set is preserved—those essential for making the original virus’s infectious particles. “The parts are all in these different locations in the wasp genome. But they still can talk to each other. And they still make products that cooperate with each other to make virus particles,” says Michael Strand, an entomologist at the University of Georgia. But instead of containing a complete viral genome, as a wild virus would, domesticated virus particles serve as delivery vehicles for the wasp’s weapons.



Here are the steps in the life of a parasitic wasp that harbors a bracovirus.

Sources: Adapted from G. R. Burke & M. R. Strand/ Insects 2012 , Reporting by N. Rogers (Knowable Magazine (CC BY-ND))

Those weapons vary widely. Some are proteins, while others are genes on short segments of DNA. Most bear little resemblance to anything found in wasps or viruses, so it's unclear where they originated. And they are constantly changing, locked in evolutionary arms races with the defenses of the caterpillars or other hosts.

In many cases, researchers have yet to discover even what the genes and proteins do inside the wasps' hosts or prove that they function as weapons. But they have untangled some details.

For example, *M. demolitor* wasps use bracoviruses to deliver a gene called *glc1.8* into the immune cells of moth caterpillars. The *glc1.8* gene causes the infected immune cells to produce mucus that prevents them from sticking to the wasp's eggs. Other genes in *M. demolitor*'s bracoviruses force immune cells to kill themselves, while still others prevent caterpillars from smothering parasites in sheaths of melanin.

The wasps keep control

Virus-taming is likely a dangerous endeavor. After all, the wild relatives of domesticated viruses can be deadly, commandeering cells to produce viral particles and then to burst, releasing their contents. Some of them make the innards of insects dissolve into goop. In fact, even in the domesticated situation, sometimes specialized cells in wasp ovaries must burst in order to release viral particles.

"The wasp has to find a way to control that virus so that it's not infecting and killing the wasp itself," says Kelsey Coffman, an entomologist at the University of Tennessee.

How have wasps evolved to control their pet viruses? Most important, they've neutered them. The virus particles can't reproduce because they don't contain the genes that are crucial to building new virus particles. Those remain in the wasp genome.

Wasps also control where and when the domesticated virus particles are produced, presumably to reduce the risk of the virus going rogue. Bracovirus particles are made only in one pocket of the female's reproductive tract, and only for a limited time.

And key virus genes have been lost altogether such that the domesticated viruses cannot replicate their own DNA. This loss is seen even in recently domesticated viruses, suggesting that it's an important first step.

In fact, any viral genes that don't help the wasp will gradually accumulate mutations. In bracoviruses, so much time has passed that the unused genes are unrecognizable. In viruses domesticated more recently, the remnants can still be identified.

A "missing link" revealed

There's nothing special about having a genome full of dead viruses. Viruses jump into animal genomes all the time; even our own DNA is littered with their remains. But only parasitic wasps are known to maintain whole sets of genes that still work together to build viral particles.

Researchers are eager to understand how these relationships start. For clues, some are turning to a little orange wasp called *Diachasmimorpha longicaudata*, which may be in the early stages of domesticating a poxvirus. The poxvirus is not a true domesticated virus because its DNA hasn't entered the wasp's genome. Instead, it replicates on its own in the wasp's venom glands.

Like other virus-taming wasps, *D. longicaudata* injects viral particles into its host, which in this case is a fruit fly maggot. And Coffman and Burke, with researcher Taylor Harrell, have shown that without the poxvirus, most of the wasp larvae die. But unlike fully domesticated viruses, the poxvirus also replicates outside the wasp, producing new virus particles in the maggot's cells. The wasp benefits from the poxvirus, but she doesn't fully control it.

This weak control could reflect the type of virus the wasps started with, says Coffman. Most domesticated viruses are descended from types of viruses called nudiviruses, which can integrate into wasp genomes more easily than poxviruses.

But it's also possible the wasps just haven't had enough time yet. Indeed, the wasp-poxvirus partnership is so new it appears to be present in only one species of wasp. It's even missing from another species that is so similar that Coffman didn't at first realize she had both wasps in her lab.

Still, the virus is isolated to certain tissues and only replicates when eggs are developing, which could mean that *D. longicaudata* has already established some defenses. The viruses also seem to be losing their ability to be transmitted without the wasp's help. "I've tried feeding the flies with a lot of virus and they don't seem to get infected that way," Coffman says.

The poxvirus system is exciting, adds Coffman, because so little is known about how virus domestication begins. "We can't go back in time and know how it started. But with this system—it's new. We've got this snapshot of, you could say, the missing link."

Though no one knows for sure why virus domestication keeps happening in parasitic wasps, researchers suspect it's related to their lifestyle. Internal parasites live in their hosts' innards, hazardous environments that are actively trying to kill them. From a wasp's perspective, viruses are like packages loaded with tools for solving this most dire problem.

Support for this idea comes from 2023 research looking at the genomes of more than 120 species of wasps, ants, and bees. The researchers scoured these genomes for signs of the types of viruses that tend to become domesticated. They inferred the presence of domesticated viruses by detecting virus genes that have been kept in a functional state over evolutionary time. Such preservation would not be expected unless the genes were helping the wasps to survive or reproduce.

As expected, non-parasitic insects showed little evidence of having these domesticated viruses. The same was true of parasites that develop on the outsides of their hosts' bodies, where the host immune system can't get at them. But in the parasites that develop inside other insects—called endoparasitoids—domesticated viruses appeared to be far more common.

"There is a special connection between viruses and these endoparasitoids," says Julien Varaldi, an evolutionary biologist at Claude Bernard University Lyon 1 in France and one of the study's authors. "It's suggesting that those viruses do play an important role in the evolution of this way of life."

And with hundreds of thousands of wasp species and uncountable strains of viruses, there are ample chances for the two entities to team up. It is, Strand says, "an evolutionary sandbox of opportunity."

Nala Rogers is a science journalist and a champion of underappreciated organisms. Her work has appeared in outlets such as Science, Nature, Popular Mechanics, Discover, and Scientific American. You can read more of it at https://authory.com/nalarogers.

This story originally appeared in Knowable Magazine. 2024. DOI:10.1146/knowable-050724-2

Honey bee colonies maintain CO_2 and temperature regimes in spite of change in hive ventilation characteristics

Apidologie. Volume 53, article number 51, (2022) [Open Access Article]

Abstract

CO_2, a byproduct of respiration, is toxic at high concentrations so regulation of CO_2 within the honey bee hive is an important colony function. In this study, we measured hive CO_2 concentrations at 1-s intervals while ventilation characteristics of the hive were changed every few days, and we analyzed the data for effects of increased ventilation on colony behavior and thermoregulation. Average CO_2 concentrations were significantly higher, by > 200 ppm, when hives had screened bottom boards (higher ventilation) compared to hives with solid bottom boards (lower ventilation) at the same time. Daily CO_2 concentration amplitudes, hourly temperature, daily temperature amplitudes, nor hourly hive weight changes were not significantly affected by the changes in hive ventilation. In a second experiment, we found average CO_2 concentrations at the top center of the upper hive box, on top of the frames, were significantly lower than concentrations at the center of a solid bottom board underneath frames, which was expected due to the higher density of CO_2 relative to air. Bee colonies have been reported to cycle air, with shorter periods of 20 to 150 s and longer periods of 42–80 min, but a periodogram analysis of the CO_2 concentration data found no evidence of important CO_2 cycle periods other than a strong 24-h period. Bee colonies maintained strong daily cycles of CO_2 concentration, with average maximum concentrations > 11,000 ppm, even in conditions of increased ventilation, indicating that managing CO2 concentration is a complex colony behavior.

For the full article, see: https://link.springer.com/article/10.1007/s13592-022-00954-1

****

How to Contact Us:

Visit our website at: https://www.ccbaor.org/
Address: POB 1916 Newport, OR 97365
Email: centralcoastbeekeepers@gmail.com
facebook: CCBA meta