



Keeping Bees Healthy

Bee SYMPOSIUM

8:00 a.m. - 6:30 p.m.

SATURDAY, MAY 9, 2015

UC DAVIS CONFERENCE CENTER

Presented by the Honey and Pollination Center
at the Robert Mondavi Institute

and the Department of Entomology
and Nematology

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Agenda

Bee Symposium: Keeping Bees Healthy

Saturday
May 9, 2015

Hosted by
The Honey and Pollination Center at the Robert Mondavi Institute
and the Department of Entomology and Nematology, UC Davis

8:00 – 9:00 a.m. **Registration, Continental Breakfast**

9:00 a.m. **Welcome and Introductions**

Amina Harris, Director, Honey and Pollination Center, Robert Mondavi Institute, UC Davis

Michael Parrella, Professor and Chair, Department of Entomology and Nematology, UC Davis

9:15 a.m. **Helping Bees Stand on Their Own Six Feet**

Marla Spivak, Distinguished McKnight University Professor, Apiculture and Social Insects, Department of Entomology, University of Minnesota

10:00 a.m. **Sociality as Key to Understanding Responses to Pesticides in Honey Bees**

Brian Johnson, Assistant Professor, Department of Entomology and Nematology, UC Davis

10:45 a.m. **Break**

11:00 a.m. **Combined Effects of Viruses and Nutritional Stress on Honey Bee Health**

Amy Toth, Assistant Professor, Department of Ecology, Evolution, and Organismal Biology, Department of Entomology, Iowa State University

11:45 a.m. **Lunch**

Graduate Student Poster Presentations

Educational Exhibits

1:30 p.m. **Best Management Practices to Support Honey Bee Health**

Elina L. Niño, Extension Apiculturist, Department of Entomology and Nematology, UC Davis

2:15 p.m. **Lightning Round Talks**

Sarah Red-Laird: The Bee Girl

Jake Reisdorf: Getting into Beekeeping, Thoughts from a 12-year-old Beekeeper

Katharina Ullmann: Project Integrated Crop Pollination

John Miller: PAm! Keeping Bees Healthy with Forage

Benjamin Sallmann: The Bee Informed Partnership

Gretchen LeBuhn: Professor, San Francisco State University

3:00 p.m. **Break**

3:15 p.m. **Pesticides, Parasites and Pollinators: The Impacts of Environmental Stressors on Bees**

Nigel Raine, Professor and Rebanks Family Chair in Pollinator Conservation, School of Environmental Sciences, University of Guelph; Ontario, Canada

4:00 p.m. **Enhancing Forage for Bees**

Neal Williams, Associate Professor, Department of Entomology and Nematology, UC Davis

4:30 p.m. **Winners of the Graduate Student Poster Competition Announced; Introduction to the Häagen-Dazs Honey Bee Haven**

Christine Casey, Director, Honey Bee Haven, Department of Entomology and Nematology, UC Davis

4:45 p.m. **Board Buses to Honey Bee Haven for Tours and Closing Reception**

Christine Casey and Robbin Thorp, Professor Emeritus, Department of Entomology and Nematology, will lead garden tours

6:30 p.m. **Close**

Door Prize List

(One prize awarded prior to each presentation)

Dadant
- Smoker
- Box of AP23 Pollen Patties

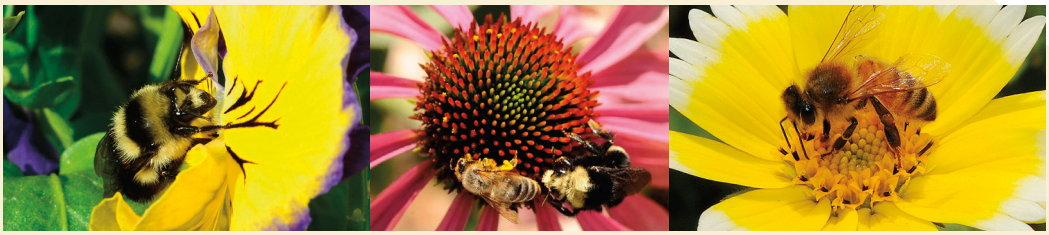
Mann Lake
- 5-gallon pail of Pro-Sweet
- Assembled Hive Kit: Hive Body, Frames, Bottom Board, Inner Cover and Telescoping Cover

Nod Global
- "Healthy Bees. Healthy Planet" Canvas Bag with Two T-shirts

Z Specialty Food
- 3-Jar Sampler

Special thanks to Sudwerk Brewery, Davis, for its generous donation of beer for the reception in the Häagen-Dazs Honey Bee Haven.

The Honey and Pollination Center



Our mission is to help make UC Davis the world's leading authority on honey bee health, pollination, and honey quality.

Our Story

2011

The Robert Mondavi Institute held its first honey conference, and the idea of an independent center was formed.

2012

The university accepted the proposal to establish the Honey and Pollination Center at the Robert Mondavi Institute for Wine and Food Science.

2013

Foundation is set for developing a set of short courses for mead-makers at all levels of experience.

2014

Creation of the UC Davis Honey Flavor Wheel and the first-ever UC Davis Wildflower Honey.

2015

The inaugural Bee Symposium is hosted at UC Davis.

Established in October 2012, the Honey and Pollination Center has continually grown its programmatic initiatives to help establish UC Davis as the world's leading authority on bee health, pollination and honey quality.

This Bee Symposium is the culmination of a year-long collaboration with the Department of Entomology and Nematology. The center plans to make the Bee Symposium an annual event, bringing top researchers to UC Davis.

The California Master Beekeeping Program was funded by the College of Agricultural and Environmental Sciences. Course development is underway, guided by UC Davis Cooperative Extension apiculturist Elina Niño. This series of courses will help educate and strengthen the state's beekeeping population through mentoring and hands-on experience.

Working with the Department of Viticulture and Enology, the center is developing a set of courses to meet the needs of mead makers at all levels, from beginners to commercial mead makers.

The Department of Food Science and Technology is collaborating with the center on honey authenticity research. This interest was enhanced by the publication of the Honey Flavor Wheel in summer 2014. The wheel has been featured at national honey tastings, in magazines and books, and online. The Honey and Pollination Center's impact will increase as we forge stronger relationships with our university collaborators.

Friends of the Honey and Pollination Center

Queen Bee Level
$2,500
Michael Cicchella
Natural American Foods

Native Pollinator Level
$1,000
American Beekeeping Federation
Les Dames d'Escoffier, San Francisco

Honey Bee Level $500
First Northern Bank
Moonlight Meadery
Z Specialty Food
O Olive Oil

honey.ucdavis.edu/support

Speaker Biographies

Amina Harris

Director, Honey and Pollination Center at the Robert Mondavi Institute for Wine and Food Science, UC Davis

As founding director of the Honey and Pollination Center, Harris has overseen the development of coursework for mead enthusiasts and commercial mead makers, the Bee Symposium and the creation of the acclaimed UC Davis Honey Flavor Wheel. She is presently working with the Department of Entomology and Nematology to create a curriculum for California Master Beekeeping. In addition, Harris owns Z Specialty Food, LLC with her husband and son, which has been offering unique American varietal honeys for over 30 years.

Michael Parrella

Professor and Chair, Department of Entomology and Nematology, UC Davis

As chair of the Department of Entomology and Nematology, Parella runs a research program to develop integrated pest management/biological control strategies for the environmental horticulture industry. This includes floriculture, nursery and bedding plant operations and landscape plants in the urban environment. His true love, however, is fly-fishing, as evidenced by Entomology 198 – a course specifically designed for fly-fishers. Parella holds a Ph.D. in entomology from Virginia Polytechnic Institute and State University.

Marla Spivak

Distinguished McKnight University Professor, Apiculture and Social Insects, Department of Entomology, University of Minnesota

Spivak's research focuses on protecting the health of all bees, breeding bees for their natural defenses against diseases and parasites, and propagating floral-rich and pesticide-free landscapes to support the nutrition, health and diversity of bee pollinators. She has bred the Minnesota Hygienic honey bee line. These bees are able to defend themselves against diseases and parasitic mites. Current studies include the benefits of propolis to honey bees, and the effects of agricultural landscapes and pesticides on honey bee and native bee health.

Brian Johnson

Assistant Professor, Department of Entomology and Nematology, UC Davis

Johnson completed his Ph.D. at Cornell University and conducted postdoctoral research at UC Berkeley and UC San Diego. He is an expert on animal social behavior and behavioral genetics. He has conducted research on the honey bee's communication strategies and evolution, as well as on honey bee division of labor. He has recently begun to research colony collapse disorder. Currently, he is researching the ways bees communicate with one another to make the honey needed to get the hive through winter.

Amy Toth

Department of Ecology, Evolution, and Organismal Biology
Department of Entomology
Iowa State University

Toth is an assistant professor in the Departments of Ecology, Evolution, and Organismal Biology and Entomology at Iowa State University. She is interested in the mechanisms and evolution of insect social behavior and uses honey bees and paper wasps as model systems. Her research projects involve individual behavioral differences and foraging behavior, comparative evolutionary genomics of social insects, and the influences of nutrition and viruses on honey bee behavior and health. She received her Ph.D. from the University of Illinois.

Elina L. Niño

Elina L. Niño, Cooperative Extension Apiculturist, Department of Entomology and Nematology, UC Davis

Niño conducts research on the reproductive processes involved in queen bee mating. Niño will be developing the recently funded Master Beekeeping Program at UC Davis. She was a USDA-NIFA-AFRI postdoctoral fellow at the Pennsylvania State University and expanded her program to study the socioeconomic factors affecting the success of local queen breeding programs. A member of the Entomological Society of America, she received numerous honors as a graduate student. Niño received her Ph.D. from the Pennsylvania State University.

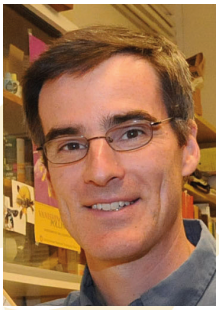
Nigel Raine

Professor and Rebanks Family Chair in Pollinator Conservation, School of Environmental Sciences, University of Guelph; Ontario, Canada

Raine has conducted extensive research on the impact of pesticides on bees. Pesticides applied at levels that are not fatal to bees are still likely to affect their behavior. Raine's lab has shown that chronic exposure of bumble bees to pesticides impairs natural foraging behavior and increases worker mortality, leading to significant reductions in brood development and colony success. Raine has tracked the behavior of over 1,000 individual bees and found that foraging performance of bees exposed to pesticide was significantly reduced.

Neal Williams

Associate Professor, Department of Entomology and Nematology, UC Davis



Williams conducts research on how pollination spans evolution, including sustainable pollination. One of his primary areas of research is sustainable pollination strategies for agriculture. This work is critical given ongoing pressures facing managed honey bees and reported declines in important native pollinators such as bumble bees. Williams and his colleagues explore the role of wild native bees, honey bees and other managed species as crop pollinators and the effects of landscape composition and local habitat quality on their persistence.

Christine Casey

Director, Häagen-Dazs Honey Bee Haven, UC Davis

Casey has served as director of the Häagen-Dazs Honey Bee Haven for the past three years. While conducting research on use of landscape plants by arthropod natural enemies, she developed an appreciation for the many bees that forage in urban landscapes. Her research and extension background is in ornamental plant integrated pest management. She has conducted research on the use of landscape plants by arthropod natural enemies. She has a Ph.D. in entomology from the University of California, Davis.

Lightning Round

Sarah Red-Laird

Executive Director, Bee Girl; American Beekeeping Federation, Kids and Bees Program Director

Bee Girl, a nonprofit organization founded by Sarah Red-Laird, aims to conserve bees by educating the public on their importance through programs focused on community classes and events, public lectures, and our "Kids and Bees" and university programs. The organization also facilitates a "Farming for Bees" initiative, which empowers land managers who provide habitat for bees. Bee Girl engages with communities across the nation and the globe, spreading knowledge and bringing a sense of wonder from the hive to the people.

Jake Reisdorf

Sixth-grader at Carmel Middle School
Owner and Operator, The Carmel Honey Company

Jake Reisdorf became fascinated with honey bees at the age of 10 and attended multiple seminars on beekeeping long before owning his first hive. The Carmel Honey Company began as a student "real world" homework assignment. Reisdorf is happiest when he is learning about bees or sharing his knowledge of bees and regularly gives presentations educating classrooms on the importance of honey bees. Reisdorf hopes to inspire future generations, and make a positive impact on the fate of the honey bee and the ecosystems we all inhabit.

Katharina Ullmann

Crop Pollination Specialist, Xerces Society for Invertebrate Conservation; Manager, Outreach Component "Project Integrated Crop Pollination"

Katharina Ullmann develops materials and tools that growers can use to inform sustainable pollination management strategies on their farms. In addition, she is working with project partners and farmers to show integrated crop pollination in action. Ullmann's doctoral research at UC Davis explored how crop rotation and tillage practices impact the squash bee. She has also participated in developing pollinator-friendly wildflower mixes, and testing the impact of urban development and farm hedgerows on pollinators.

John Miller

Owner and Operator, Miller Honey Farms, Inc., Blackfoot, Ida., Newcastle, Calif., and Gackle, N.D.

John Miller's company operates on average about 15,000 hives and provides pollination services to almond and pit fruit growers in Calif. and Wash. Miller serves in various industry roles, including past chair of the National Honey Board, and past-president of the California State Beekeepers Association. He currently serves on the local economic development corporation in Gackle, North Dakota and is current president of the Mountain Mandarin Growers Association. He is president of En-R-G Foods, LLC, Steamboat Springs, Colo.

Ben Sallmann

Bee Informed Partnership, NorCal Tech Transfer Team; University of California Cooperative Extension, Butte County, Calif.

As a member of the Bee Informed Partnership, Ben Sallmann works closely with queen breeders and commercial beekeepers in the Northern California region. His responsibilities include hive assessments, sampling for varroa, nosema, and viruses, and testing for hygienic behavior. He grew up working for his family's apiary in Wisconsin. Ben is currently based out of the University of California Cooperative Extension office in Butte County, Calif. He graduated from Ripon College in Ripon, Wisc. in 2004 with a B.A. in anthropology and global studies.

Gretchen LeBuhn

Director, Great Sunflower Project; Professor, Department of Biology, San Francisco State University

Gretchen LeBuhn is professor of biology at San Francisco State University and the director of the Great Sunflower Project. Her research spans the fields of ecology, biodiversity and conservation biology. She has worked on understanding and conserving pollinator systems in the mountains of Ecuador and the Sierra Nevada, Calif. She focuses on developing standardized, cost-effective methods for assessing biodiversity. Most recently, she and her collaborators evaluated and developed a monitoring plan for surveying pollinators on a global scale.

Graduate Student

Poster Abstracts

Jennifer VanWyk

Graduate Group in Ecology,
Ph.D. Candidate
UC Davis
Professor: Neal Williams

Wet Meadow Restoration Buffers the Impact of Climate Change: Pollinator Resilience During the California Drought

In light of recent global declines in pollinating species, understanding how degraded habitat and intensive restoration practices affect pollinator persistence in the face of climate change is essential. Can pond-and-plug restoration buffer the effects of drought on bee and forb populations in wet meadows? In these restoration projects, the primary goal is to increase both floodplain connectivity with the water table and seasonal water retention. This study analyzes community structure and population dynamics of pollinators across the last four years of California's extreme precipitation. Study meadows were classified as restored, degraded, or remnant based on the status of floodplain connection. Twenty-two subalpine meadows in the Sierra Nevada were surveyed annually from 2011 to 2014. The data spans years of both extreme wet and historic drought. Flowering plant and pollinator communities were surveyed during peak bloom. Insect visitation was directly associated with floral density and diversity. Successful restoration projects can buffer the detrimental impacts of drought on bee and plant populations. We found that restored meadows support larger populations and higher species diversity than degraded counterparts. Restored meadows also supported more similar pollinator communities regardless of precipitation: both annual species turnover and dissimilarity of the pollinator communities between years was smaller in restored compared to degraded meadows. A bipartite network of interacting plant and pollinator species was constructed for each meadow, and network architecture was described by nestedness, connectivity and evenness. Similarity among pollinator communities is visualized using nonmetric multidimensional scaling (NMDS), and a multi-response permutation procedure (MRPP) tests for dissimilarity of meadows between years. Understanding the factors that affect non-target species community composition can guide the restoration process and help predict long-term outcomes.

John M. Mola

Graduate Group in Ecology,
Ph.D. Candidate
UC Davis
Professor: Neal Williams

Spatially Explicit Sampling of Bumble Bee Workers to Construct a Dynamic Map of Colony Density and Foraging Movements

The foraging range of individual bumblebees is critical in that it defines the resource domain for their colony, and is an underlying process limiting how many colonies can exploit a resource area. Understanding how foraging range changes in response to landscape configuration and throughout the flight season is central to explaining colony success and therefore local population dynamics. While some estimates of foraging range exist for a handful of bumblebee species, these estimates often lack a spatially explicit sampling design, sample for only a single

point in the season, and are almost exclusively in anthropogenic environments. Herein, I present proposed and ongoing research aimed at determining the foraging range and colony density of *Bombus vosnesenskii* at the McLaughlin Reserve in central California. Within my study I employ a spatially explicit capture-recapture design utilizing microsatellite techniques for parentage analysis to construct a full-season dynamic map of colony foraging movements, floral associations, and colony density. Furthermore, this preliminary data will be used in subsequent years to estimate between-year dispersal distances, colony density across seasons, and as part of further studies into *B. vosnesenskii* population genetics. *Bombus vosnesenskii* is an extremely important California native bee species in both agricultural and natural environments, and understanding its foraging range, floral associations, and natural colony densities could provide critical insight for population management and monitoring.

Brittney Shaull

Department of Agricultural and Resource Economics, Ph.D. Candidate
UC Davis
Professor: Rachael Goodhue

Pesticide Risk to Hives During Almond Pollination: The Impact on Fees and Beekeeper Turnover

Each year, around 60-75 percent of the United States' managed honey bee colonies are transported to California for almond pollination. Consequently, almond growers are dependent on a strong U.S. honey bee population for their almond harvest. While in almond pollination, a honey bee hive can be exposed to various chemicals, through pesticides applied to the almond orchard in which it is located or to adjacent almond orchards or crop acreage. The colony is not always destroyed by pesticide exposure, but it can be harmed sublethally, for example by inhibiting brood development. These sublethal impacts are potentially costly to the beekeeper in terms of additional health treatments and weakened hive strength. This analysis develops a theoretical model regarding the incentives created by these risks when setting pollination fees and selecting contract locations. These risks could be factored into almond pollination fees each year, or alternatively beekeepers may "vote with their feet" and decline contracts in areas with high pesticide risk. The theoretical model is paired with an assessment of potential exposure to pesticides during almond pollination using the California Pesticide Use Reporting Database to develop a pesticide risk index for areas within bee forage range of almond orchards. The outcome is compared to currently available data regarding pollination fees. In future work, we plan to compare changes in the risk index with changes in almond pollination fees, controlling for the expansion in almond acreage. We hope to explore beekeeper turnover at each location, as we posit that beekeeper turnover will be higher in areas with larger pesticide risk. We are working on accessing the data necessary to perform this analysis. Discovering the relationship between pesticide risk and almond pollination fees is crucial in making the almond pollination market more transparent, while reducing health risks to honey bees during almond pollination.

Danny Klittich

Department of Entomology and Nematology, Ph.D. Candidate
UC Davis
Professor Michael Parella

Neonicotinoid Pesticides and Declines in Honey Bee Health; Will a Ban Solve the Issue?

(This poster is based on the 2014 UC Davis Debate Team topic for the Endangered Species Act 2014 meeting.) Over the past decade, there have been public concerns over large losses in domesticated honey bee populations. These losses could threaten honey production and, more importantly, pollination services for crops such as almonds, stone fruits, and berries.

Researchers have worked feverishly to identify the most salient factors contributing to these declines. The introductions of *Varroa destructor*, *Nosema ceranae*, and Israeli Acute Paralysis Virus have coincided with the onset of colony collapse disorder (CCD) and are suspected to play a role in these losses. Calls to ban neonicotinoids, a relatively new class of insecticides, overlook the fact that the magnitude of the relationship between pesticides and CCD remains disputed. Numerous studies that implicate neonicotinoids as a cause of CCD are insufficient in rigor and depth. Other classes of pesticides, including those used to control hive pests and fungal diseases, have been found to impact honey bee health and performance. Part of the perceived pollinator crisis stems from the monetization of ecosystem services, as our reliance on the honey bee shifts from demand for honey production to agricultural pollination. However, the reliance on pollinator services does not come from its necessity for overall food stability, but rather for the production of certain specialty crops. In instances where crops require pollination, stable populations of alternative pollinators can compensate for possible honey bee losses. Given the current state of knowledge, we argue that banning neonicotinoids is a premature and disproportionate response to a complex issue.

Margaret Rei Scampavia

Department of Entomology and Nematology, Ph.D. Candidate
UC Davis
Professors: Ed Lewis, Neal Williams

Native Bee Nest Site Selection in Agroecosystems

The availability of both foraging and reproductive habitat potentially limit native bee population distributions, which in turn limits native bee pollinator services. Prior studies focus on how foraging habitat influences bee distribution, but few consider nesting limitations. To determine how farming practices that influence soil properties affect nest site selection of ground-nesting bees, I studied nest site selection of ground-nesting bees in an open grid of varying soil treatments. In each of four blocks located east of the Häagen-Dazs Honey Bee Haven, I created soil plots separated by impermeable underground barriers. These plots contained combinations of soil treatments intended to mimic soil conditions found in an agricultural landscape. The soil factors included compaction/tillage, irrigation/no irrigation, and the presence/absence of a commonly used pesticide (esfenvalerate, a synthetic pyrethroid). Nest initiation by a bee within a soil type indicated a choice for that set of factors, and was measured by sampling with soil emergence traps. This experiment was conducted in the spring and summer of 2013, and was repeated again in 2014. The majority of bee nests sampled belonged to the family Halictidae, or the sweat bees. In 2013, nest initiation was positively influenced by irrigation. Pesticide use and tillage, however, did not significantly affect nesting. However, in 2014 both tillage and irrigation positively influenced bee nest site initiation, and the two in combination had a non-additive effect on nesting. The results of these findings implicate that we would expect to find native bees nesting in, rather than around, agricultural fields where potentially damaging practices such as tillage and pesticide application could harm nesting bees. To promote healthy native bee populations, it would be beneficial to create nest site shelters for native bees by tilling and keeping damp bare patches of untreated soil around the edges of agricultural fields.

Leslie Saul-Gershenz

Department of Entomology and Nematology, Ph.D. Candidate
UC Davis
Professor: Neal Williams

Native Bee Parasite Shows Multitrait, Host-Specific Variation and Local Adaptation

Pheromones are pre-mating isolating mechanisms and species-specific communication systems for mate location (Hansson et al. 1990). The nest parasite *Meloe franciscanus* appropriates this system by mimicking the female bee sex pheromone of its host bees.

1. We report that allopatric populations vary the chemical blend used to attract male bees of different host species of *Habropoda* bees, *H. pallida* and *H. miserabilis* (Apidae).
2. We also report that the nest parasite larvae show behavioral adaptations to local environmental conditions and host behavior in their perching height. *Meloe franciscanus* larvae perch at significantly different heights in different populations to attract different host species and in response to local environmental conditions.

Emily Kearney

Environmental Science, Policy and Management, Ph.D. Candidate
UC Berkeley
Professor: Claire Kremen

Hedgerows Increase Native Crop Pollinator Occurrence but Do Not Increase Functional Redundancy or Response Diversity in These Communities

Currently, pollinators are integral to the production of 75 percent of leading global food crops but managed pollinators, such as the European honey bee, are experiencing drastic declines. This makes native, crop-pollinating bee species even more important as they provide direct pollination services and can increase the effectiveness of pollination by managed honey bees even at low abundances. However, in intensively managed agricultural landscapes where demand is highest for pollination services, abundance of native pollinators is lowest. Restoration techniques, like hedgerows, can enhance native pollinator communities but it is unclear if they adequately support resilient communities that can survive disturbance or adapt to climate change. Functional redundancy or the number of species that have similar roles in ecosystem processes has been used as a predicative measure of community resilience. Along the same lines, response diversity or the diversity of phenotypic traits within a group of functionally redundant species can be used to assess how environmental changes might impact a community. Using a comprehensive dataset of native pollinators collected on hedgerows and unrestored weedy strips in California's Central Valley, we found that hedgerows increased the occurrence of crop-pollinating native bee species. However, hedgerows did not increase functional redundancy or response diversity of crop-pollinating native bee communities. These results suggest that hedgerows can be an important part of pollination management in highly modified agricultural areas but more action may be necessary to increase community resilience.

W. Cameron Jasper

Department of Entomology and Nematology, Ph.D. Candidate, UC Davis
Professor: Elina L. Niño

Breeding Honey Bees: From Evolutionary and Functional Genomics to Sociology

Honey bee colony health is affected by many different pests and pathogens. While chemical treatments can be successful in treating these afflictions, they can also themselves have negative health consequences for honey bees. The over-use of chemical treatments can also lead to resistance in the pests or pathogens. As such, selective breeding for pest or pathogen resistant

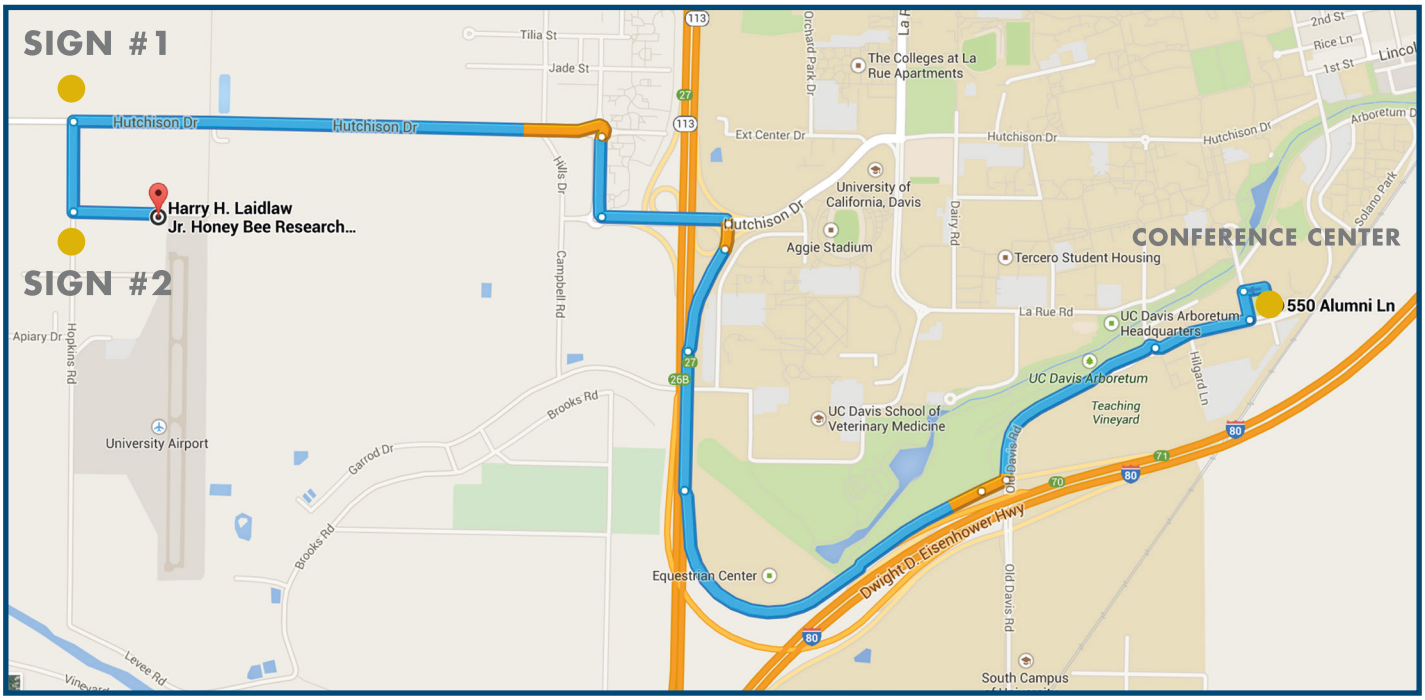
traits can mitigate the use of chemical treatments. To create successful breeding programs, it is critical to understand what regulates behavioral, physiological, and transcriptional post-mating changes in queens. Previous research shows that seminal fluid components (SFC) and insemination volume trigger and maintain particular aspects of queen post-mating changes. Here we expand on that work and report on the effects of seminal fluid versus sperm components, including how transcription in both the brain and fat body is affected (in progress). Our data will be used to inform ongoing efforts of creating local/regional breeding programs and also may provide insights into how SFCs regulate gene expression in specific tissues.

K. Ash Zemenick

Graduate Group in Ecology,
Ph.D. Candidate
UC Davis
Professor: Jay Rosenheim

The Effects of Opportunistic Visitors on Flower Visitor Network Structure: Implications for Floral Microbes

Plants and their primary pollinators exist in integrated communities where flowering plants are connected through shared pollinators. The structure of plant-pollinator interactions is highly organized (non-random). First, plant species predictably vary in promiscuity (number of visitor species). Most plant species have a few pollinator species, and some plant species have many pollinator species. Second, there is high potential for indirect effects between plant species through shared visitors as even specialist plants share flower visitors with other plants in the community. Flower visitor networks typically focus on pollen movement, so they tend to be bee-centric. While opportunistic visitors (non-bees) may not be important in pollen movement, they could be important vectors of floral microbes, which can have direct and indirect effects on bee health, plant health, and pollination success. We used a historical flower visitor dataset to evaluate how opportunistic visitors affect plant promiscuity and the potential for indirect effects between plant species, which can have important implications for floral microbe spread and dispersal within a plant community. The dataset (Robertson 1929) documented over 15,000 visits to 452 plant species from 1887 to 1916 in Carlinville, Ill. We assessed how opportunistic visitors influence overall plant promiscuity compared to bees. We found that more promiscuous plants have a low proportion of bee visitors compared to less-promiscuous plants. So, opportunistic visitors may define the most promiscuous plants (hubs) in the network. The potential for indirect effects between plants due to shared non-bee flower visitors is significantly higher than the potential for indirect effects between plants due to shared bee flower visitors (measured by Muller's Index). Since opportunistic visitors may be effective dispersal agents of floral microbes, they could be determining which plants act as super-spreaders of floral microbes, which can directly and indirectly affect bee health.



UC Davis Conference Center

550 ALUMNI LANE DAVIS, CALIF.

Get on CA-113 N. from Old Davis Rd

From 113 N., take the first exit: Hutchison Drive

Stay on Hutchison; Hopkins Rd., is a left turn after approx. 2 miles

Turn onto Hopkins Rd., drive to Bee Biology Rd. and turn left

Arrive at the Harry H. Laidlaw Jr. Honey Bee Research Facility

Harry H. Laidlaw Jr. Honey Bee Research Facility

1 BEE BIOLOGY ROAD DAVIS, CALIF.

Things to Know:

- Shuttle service from the Conference Center to the bee garden starts at 4:45 p.m. and runs continuously until 6:30 p.m.
- Remember to bring your personal items to the garden. The Conference Center will not be open upon your return and the Honey and Pollination Center is not responsible for lost or stolen items.
- Parking at the garden is limited; if the lot is full park between the olive trees along Bee Biology Road.
- Two signs will direct you to the garden: one on Hutchison Road at the left turn for Hopkins Road, and the second at the end of Hopkins Road, at the left turn for Bee Biology Road.
- There will be light refreshments in the garden.
- Last shuttle will leave the garden at 6:30 p.m.

With Generous Support From

Vendors and Exhibitors

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www.beegirl.org

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Z Specialty Food
zspecialtyfood.com

Sacramento Area Beekeepers Association
www.sacbeekeepers.org

Food For Bees
foodforbees.com (coming soon)

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