

Wolfpack's Waggle

January 2018 Newsletter

NC State Apiculture Program

Dedicated to the dissemination of information and understanding of honey bee biology and management

Issue 1, January 2018

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What have we been up to?

The beginning of a new year always brings reflection about the previous. We've had another successful year, with 11 peer-reviewed publications (a record high for our program, second year in a row) and 8 presentations at scientific meetings. We had 14 active grants totaling \$3.2M, and we have 20 people in the program. We have been joined by our new project manager, Sharon Munger, who has really helped to facilitate all of the logistics within the program and has been a fantastic addition to our team. On the extension side, collectively we delivered ~15 presentations and workshops to various beekeeper groups for ~2,800 individual contacts, and we were covered by four media stories on our work. Our Queen & Disease Clinic is growing ever-more popular among beekeepers and queen producers, and it is really starting to gain traction in becoming a self-sustaining resource for beekeepers to ascertain the reproductive quality of queens (and drones) and the disease levels in their colonies. Overall, 2017 was a great year, and we hope the same for 2018!

New grant to explore effects of pesticides

Joe Milone successfully secured our latest research grant to follow up on his work investigating the overall 'exposome' of queens and their colonies.

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NC State Queen & Disease Clinic

APICULTURE PROGRAM



Quality Assurance

Morphometric Analysis: multiple measures of queen or drone, body and reproductive tract (rearing quality)

Semen Quality: total sperm count, and sperm viability in queens (mating success), or drones (mating potential)

Genotyping Analyses: full assessment of paternity for up to 48 workers and an estimate of queen mating frequency

Quality Report: a "grade" report of a queen or drone's reproductive quality for your quick interpretation

Pathogen Screening: identification of presence and relative levels of ABPV, BQCV, DWV(A&B), IAPV, LSV, Trypanosomes, and both Nosema species

Mitotyping for Africanization: genetic analyses of maternal ancestry as African or European using population genetic techniques and markers

Your Bees. Your Data: any results or interpretations from our work is held in the strictest confidentiality and anonymity

Customized Experimentation

This highly-tailored collaboration involves custom experimental design, analyses, and interpretation. This unique partnership between science and industry has been utilized to:

- Test the impact of various agrochemicals
- Assess the effects of banking on queen quality measures
- Evaluate novel management practices' improvements in queen mating quality
- Observe the effects of shipping on queen health and sperm quality

Contact us for more information & pricing

Queen & Disease Clinic Pricing (five sample minimum, bulk pricing available)

Analysis	Pricing (per sample)	Samples Tested		
		Queens	Drones	Colonies
Reproductive Quality	\$24.00	✓	✓	
Standard Pathogen Screen	\$55.00	✓	✓	✓
Apiary Pathogen Screen	\$220.00*	Up to 10 samples tested		
Mitotyping (Africanization)	\$35.00	✓	✓	
Genotyping (Mating Number)	\$320.00	✓	✓	

Custom Disease Screening

Additional and custom pathogen targets available upon request

Lab spotlight: Lauren Rusert

Lauren Rusert is a new MS student in the lab starting this past fall, but she is no stranger to honey bees, beekeeping, and apiculture science. She has spent the last several years working in the Hawaii Department of Agriculture and their apiary inspection service, so she comes to NC State with a wealth of knowledge and

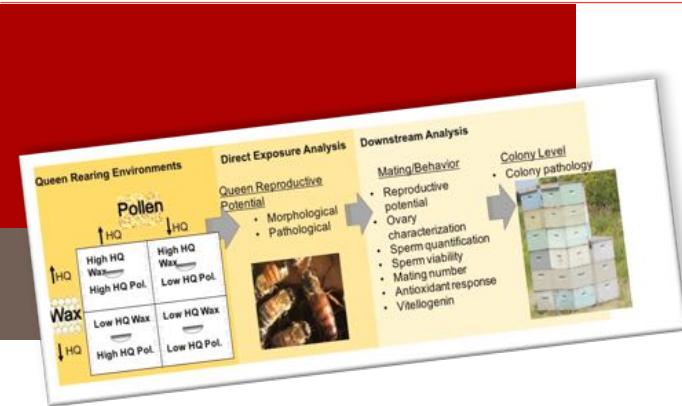
experience which she will apply to her research on the mating biology of queens and the population dynamics of honey bees in the Hawaiian archipelago on islands with and without the parasitic varroa mite.

In her spare time (what little of it that she has), Lauren enjoys giving talks to beekeepers,



gardening and other outdoor activities, and perhaps most notably trains for and participates in triathalons (in Hawaii, she finished several Ironman competitions)! Welcome aboard, Lauren, we anticipate that you'll do a lot of great work here.

New funding from FFAR explores queen and colony exposome



Logic map for our research testing the down-stream effects of multiple pesticides through multiple routes of exposure

Pollinators are threatened by multiple stressors including pesticide and disease exposures. A toxicological legacy of single pesticide response studies fail to accurately assess the implications of exposure from multiple chemicals in conjunction with disease. The exposome concept, encompassing the totality of exposures over a lifetime, can be used to provide new insight into pollinator stressor dynamics.

In our new grant from the Foundation for Food and Agriculture Research (FFAR), we propose a new approach to honey bee toxicology which examines the direct and downstream pathological consequences of realistic multiple pesticide exposure. Queens are central to colony survival and can serve as a

The grant will support Joe Milone, a second-year doctoral student in our program, on his research investigating how multiple pesticides simultaneously affect queen- and colony health at multiple levels (individual and colony) and at different timescales.

new tool for studying the aftereffects of exposure. Using previous pesticide residue data from commercial colonies, we will rear queens in contaminated wax and pollen exposure environments. Each chemical combinations is based on field relevant hazard quotients, summing total toxicity for each mixture. Queen breeder colonies will either be fed pollen with or without the pesticide mixture and queens will be reared on treated or untreated wax inside each colony. Exposed queens will be sampled upon emergence to understand the direct effects of exposure while other queens will continue on to mating. Following mating, a portion of queens will be sampled to detect changes in reproductive fitness. Lastly, remaining queens will continue on to

colony establishment, upon which colony-level disease response will be quantified. This 1st objective queen exposome study will explore on complete queen life history and will elucidate the impact exposure may have on later established colonies. During queen assessments, we will sample pesticide residues in order to detect pesticide movement through a hive



Joe in his research apiary on the Lake Wheeler farm complex, testing the effects of pesticides on entire colonies.

New FFAR grant (Continued)

matrix and quantify the role of different pathways. Exposures from pollen and wax will be tracked and pesticides movement from bee bread to royal jelly will be quantified. Objective 2 will use residue data from Objective 1 in combination with viral profiles from highly varroa infested colonies in order to test multi-stressor exposure tolerance across Conventional Commercial (CC) and Regionally Adapted (RA) within a high throughput *in vitro* study system. This will inform how intensive management has indirectly impacted selection for exposure tolerance. Viral sampling during this process will also elucidate how specific pathogens may exploit diminished



Joe Milone, PhD student

immunocompetence from pesticide exposure.

Ultimately the proposed project lays the groundwork for a short term queen assessment system which links downstream colony fitness and population exposure tolerance to multi-stressor interactions. This will provide a novel insight into better understanding multiple stressor interactions in honey bees.

NC State Apiculture Program

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Joe Milone, PhD Student (Entomology)
Hannan Levenson, MS Student (Entomology and Evolution & Ecology)
Lauren Rusert, MS Student (Entomology)

Undergraduate Researchers

Claire Collins (media intern), Alexandria Fava, Elizabeth de Jongh, Carson Noel, Kimberly Rogers, Olivia Loyack, Nissa Coit (UNC), Jerry Oxendine

Support the NC State Apiculture Program!

The Apiculture Science fund-raising efforts operate under the auspices of the North Carolina Agricultural Foundation, Inc. a 501(c)3 organization. You will receive an official receipt for your donation.

Make a gift toward emerging needs – Consider supporting the program with a gift that would go toward the current area of greatest importance. Flexible funding enables the Apiculture Program to address critical needs as they emerge, often enhancing the program beyond what would be possible through restricted grant funding. Funding of any amount, from \$10 to \$10,000, will be extremely helpful.

Make a gift-in-kind – The Apiculture program is always seeking creative solutions to its material needs. If you have surplus equipment or other non-monetary assets to give (e.g., gently used honey extractors, microscopes, even vehicles), please consider donating them to the program. You will receive credit for the monetary value of the gift and the gratitude of our faculty and students.

MAKE A DONATION

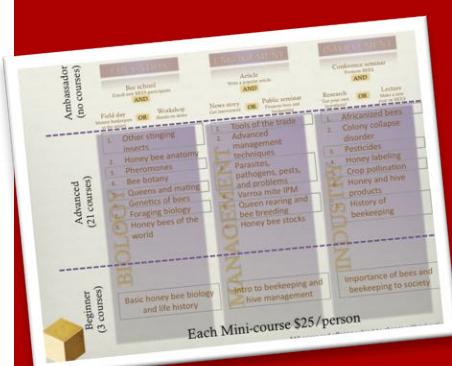
Make an estate gift – If you are interested in planning an estate gift to benefit Apiculture, please let us know! We can provide you with the tools you and your attorney will need to ensure that your wishes are fulfilled. Please click the link above for more information.



Check out our new website!

In conjunction with our department merger, we decided to update and move our program's website, which is now located at <http://ncsuapiculture.net>.

With a cleaner look and streamlined content, we hope this new look will be easier to navigate and enable us to include regular blog posts. Be sure to update your bookmarks!



BEES network

Our online courses in the Beekeeper Education & Engagement System (BEES) are still up and running, although we have been continually delayed in creating new content. Enroll today at:

go.ncsu.edu/BEES

Random notes

New publications

de Mattos, I. M., A. E. E. Soares, and D. R. Tarpy. (2018).

Mitigating effects of pollen during Paraquat exposure on oxidative stress and pathogen prevalence in *Apis mellifera* L. *Ecotoxicology*, **27**: 32–44.

Presentations

The following presentations were given by various lab members at the recent ABRC symposium in Reno, NV.

Amiri, E., C. V. Melandez, K. Le, M. K. Strand, D. R. Tarpy, and O. Rueppell. (2018). The egg as an indicator of the quality and stress of honey bee queens.

Metz, B. and D. R. Tarpy. (2018). Variation in the ontogeny of drone morphological and reproductive quality

Li-Byarlay, H., H. F. Boncristiani, G. Howell, M. Strand, D. R. Tarpy, and O. Rueppell. (2018). Insights from methylomic and transcriptomic analyses of lethal IAPV infection in honey bee pupae

Rusert, L. M., D. R. Tarpy, and J. S. Pettis. (2018). Impacts of the varroa mite on queen bee quality in the Hawaiian islands. [POSTER]

Milone, J. P. and D. R. Tarpy. (2018). The impacts of developmental multi-pesticide pollen and wax exposure on queen honey bee (*Apis mellifera*) health, mating, and colony development

Welcome aboard!

We're lucky to have recruited two new undergrads to the lab. **Nissa Coit** is a Biology major at UNC Chapel Hill but has joined the lab to get involved in honey bee research and beekeeping. As the President of the UNC Beekeeping Club, she has been involved in many different

aspects of pollinator conservation and outreach events. Her goal is to pursue a graduate degree in honey bee biology.

Jerry Oxendine is our newest addition, having taken ENT 203 last fall and became interested in bees and research. He's a psychology major and an IT expert, and he will be mainly helping Brad conduct several research projects this spring as well as help out with the clinic in sample process and data analysis.

...and sadly missed.

Sarah Hassan was an undergrad who worked with Joe Milone last spring semester, then did an extensive internship with Bee Downtown last summer to fulfill an internship requirement for her Horticulture major. While we had hoped that she stay on board through this summer to conduct her own research on the effects of urbanization on pollen- and nectar-bearing trees in the Raleigh area, she found it too much to juggle at the same time and thus decided to focus on other things. Thanks for all your help, Sarah, and best of luck!

Congratulations!

Kudos to **Joe Milone** for winning the student paper competition for the American Bee Research Conference (ABRC) at the recent symposium in Reno, NV during the American Beekeeping Federation annual conference. The ABRC is a yearly scientific conference conducted by the American Association of Professional Apiculturists (AAPA), and this year Joe presented his results from his first field season on the effects of multiple pesticides on queens and their colonies. Congratulations Joe, and keep up the good work!

Teacher's corner: Courses at NC State

We will not be teaching any courses this Spring 2018 semester at NC State. This past fall semester, our ENT 203 course, "An introduction to the honey bee and beekeeping", regained traction and was once again at maximum enrollment of 191 students. It was a terrific set of students, some of my favorite in the last 10 years. We will take this spring and summer to gear up for yet another successful semester this fall!

<http://go.ncsu.edu/honeybees>

Tarpy's back page

"Honey bees may be necessary for crop pollination, but beekeeping is an agrarian activity that should not be confused with wildlife conservation."

There has long been an ongoing effort among conservation biologists to distinguish honey bees from all other pollinators. The above quote derives from an opinion piece in a recent issue of the top research journal *Science*, and I (along with most honey bee researchers that I know) agree with the sentiment that honey bees should not be a primary focus or recipient of conservation efforts. This is in large part because honey bees, as a semi-domesticated species (and indeed not native to North America), are not in any danger of going extinct and therefore are not in need of protection. Instead, the 4,000 other native bee species in North America (and ~20,000 worldwide), the vast majority of which are solitary and not managed by humans, can only persist through habitat conservation and other proactive protective measures, and these efforts need to be prioritized.

The frustration and concern of those who study native bees (i.e., non-honey bees) are in fact shared by most who study honey bees, including myself. To me, the primary frustration stems from the general public not realizing or recognizing the diversity of bees, and that honey bees are not wholly representative of all pollinators (in fact, they are the oddity by being colonial, perennial, semi-domesticated, and industrialized). Unfortunately, in an effort to reach a broader audience, the media often simplifies the narrative and glosses over this nuance, resulting in the prevailing conventional wisdom that bees and pollinators are worthy of protection (a fully positive message) and that protecting honey bees are the best means to that end (an erroneous message). This should not be synonymized with the message that honey bee researchers communicate themselves.

I find it further frustrating, however, that in an effort to counteract this misconception, honey bees are often demonized, discounted, or both. The above quote, and the opinion piece from which it derives, is an example of this. Although honey bees are a critical component to pollination in commercial production agriculture, dismissing them as being merely "agrarian" and therefore not important to conservation is counterproductive in two ways. First, it pits one approach to addressing the problems that face pollinators (conservation of native bees) against other approaches to addressing similar problems (managed apiculture). Both have value, and both approaches share more problems in common than they differ, and thus they should be working in parallel rather than in opposition. Second, by arguing that agrarian activity is not worthy of conservation efforts actually stymies the justification for pollinator protection. Pollination is important because it is an ecosystem service—a direct or indirect benefit of our biosphere to human well-being. A stable and plentiful food supply is arguably one of the most tangible means of promoting human well-being, and thus all pollination in agriculture (not just by managed bees) is what gives pollinator conservation its main justification and strength of argument. Separating wildlife conservation from agriculture therefore negates the very reason it is should be a societal priority, and it makes it all the more difficult to convince the general public and (more importantly) policy makers that pollinator conservation should remain prominent.

The plight of honey bees is what brought worldwide attention to the common problems that confront all pollinators, and they have been likened to the canary in the coal mine for the larger issues of agricultural intensification, pesticide misapplication, and habitat loss. The solution should not be to shoot the canary; instead, we should take a more balanced approach that incorporates both the practical realities of agricultural systems as well as the idealized goals of bolstering overall wildlife conservation rather than taking an either-or approach.

Sincerely, David