

Wolfpack's Waggle

October 2013 Newsletter

NC State Apiculture Program

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

Issue 4, October 2013



More inside

- Page 2 BEES network update
Lab spotlight: Megan Walz
- Page 3 The new Queen Clinic for high-throughput measurements of queens
- Page 4 Donate to the NC State Apiculture Program
- Page 5 Random notes
- Page 6 Teacher's Corner
Tarpy's back page

What have we been up to?

It was a long and productive research season, with many projects and experiments. We tested (1) when honey bee queens become infected by viruses (from the grafting source or the cell builder), (2) the immunocapacity of workers sampled from across an urban gradient, (3) when queens are colonized by beneficial microbes in their guts, (4) how worker larvae respond to microbial challenge depending on their genetic diversity, (5) the genetic architecture of oxidative stress-induced drones and their worker offspring, (6) the dynamics of queen mating flights, and (7) the interplay between colony genetic diversity and propolis foraging (mechanisms of social immunity) and individual expression of anti-microbial peptides (mechanisms of physiological immunity). And of course, we've been busy processing samples for the Bee Informed Partnership (BIP), delivering talks and webinars to beekeeping groups, and writing up our findings!

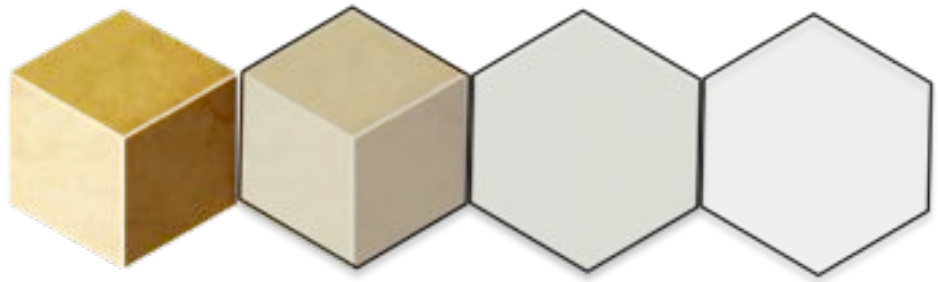
New Queen Clinic now available!

We are now offering a high-throughput service for empirically testing the reproductive quality of queens. This is particularly valuable to determine the sperm viability of queens to detect potential problems.

More on Page 3



Beekeeper Education & Engagement System



New developments in the BEES network

The exciting online platform for mini-courses on honey bee biology, management, and industry continues to grow and prosper

The **BEES** network is a new online resource for beekeepers at all levels. The system is entirely internet based and aims to foster an online learning community among beekeepers. The structure of the **BEES** network is broken into three ascending levels of difficulty (Beginner, Advanced, and Ambassador) and three general areas of content (honey bee biology, honey bee management, and the honey bee industry).

Beginner level

BEES 1.01: Basic honey bee biology and life history (1.66 hours)

BEES 1.02: Introduction to beekeeping and hive management (1.95 hours)

BEES 1.03: Importance of bees and beekeeping to society (1.71 hours)

Each course only \$25 per person, online enrollment

<http://entomology.ncsu.edu/apiculture/BEES.html>

Advanced level

BEES 2.01.02: Honey bee anatomy

BEES 2.01.05: Queens and mating

BEES 2.01.07: Foraging biology

BEES 2.02.03: Pathogens, parasites, pests, and problems

BEES 2.02.04: Varroa mite IPM

BEES 2.02.05: Queen rearing and bee breeding

BEES 2.03.01: Africanized bees

BEES 2.03.07: History of beekeeping

Lab spotlight: Megan Walz

Megan Walz is an undergraduate research who has been working in the lab for over 2 years. Currently a senior in Biology, she transferred from VA Tech as an engineering major and soon thereafter joined the lab helping with DNA and RNA

extractions. As she continued to grow her skill sets, she wrote and successfully obtained an undergraduate research grant for \$1,000 to study the **effects of genetic diversity on the physiological resistance to American foulbrood (AFB)**, the most



noxious brood disease in honey bees. Her research project rivals most MS theses! We've been very lucky to have Megan in the lab these last few years.



Photo by Alex Wild

The new NC State Queen Clinic

For only ~\$15 per queen, we are able to quickly quantify the physical and insemination success of honey bee queens. With beekeepers increasingly concerned about queen longevity and productivity, this exciting new resource will be invaluable for queen producers and their customers alike. Please contact us if you're interested!

The past few years has witnessed a dramatic rise in awareness and documentation of the alarming declines in pollinator communities worldwide. Recent survey results from beekeeping operations in the U.S. have shown that one of the *primary perceived problem for beekeepers is 'poor queens'*. While this factor encompasses many different symptoms, most of these reports document premature supersedure (queen replacement), inconsistent brood patterns, early drone laying (indicative of sperm depletion), and failed requeening as indicative of low queen quality. Determining the factors that result in low-quality queens is therefore of fundamental importance for improving colony productivity and survival.

In our previous studies, we measured the physical quality, insemination quality (i.e., stored sperm counts), and mating quality (i.e., number of mates) of honey bee queens from different commercial sources. We measured the various morphometric characters of each queen using standard procedures. We also dissected each queen's spermatheca and quantified the number of stored sperm on a fluorescent microscope. We found

very strong correlations among most of the measures of queen reproductive quality. Overall, we found that newly purchased commercial queens were of sufficiently high reproductive potential at the time of purchase, and that their sperm viability was adequate (~90%). **The question is: what happens to sperm viability of queens after they are purchased and introduced into new colonies?**

But counting sperm takes a lot of time: while the dissection (~2 min) and staining (~30 min) are relatively straight forward, quantifying sperm number and viability by our standard protocol requires taking 50 separate pictures of live and dead sperm, which then need to be manually counted (>2 hours per queen). Increased time and labor costs also introduce variation in sperm counts, as different observers can introduce different bias. **What we need is a faster way to count sperm.**

This plea was recently answered by [Project Apis m](#). They have generously funded a \$29,480 grant to purchase a Vision CBA Analysis System® (Nexcelom Bioscience, Lawrence MA) for high-throughput

processing of sperm samples. This technology enables high sensitivity fluorescence and brightfield cell counting, which will enable us to count dead and living sperm. As such, this equipment will increase our potential sample size by a factor of 100, resulting in greater resolution of our findings and a much higher-throughput and repeatable analysis of the queens, resulting in higher quality and reporting of the data to the cooperating beekeeper.



Our new Nexcelom machine automatically measures sperm viability and counts stored sperm in queens.

New Queen Clinic (Continued)

Since purchasing the new device, we have been busily processing samples on live queens with resounding success—after dissection and staining, the **total sperm number and percent sperm viability is automatically quantified in less than one minute!** The total processing time for morphological measurements, dissection, sperm staining, and sperm quantification takes approximately 3-4 hours for a set of 20 queens.

We have further developed a means by which to place any queen samples into context. Because we have so much data on other queens, we can quantify the relative quality of any queen compared to the global population. Thus we have developed a system of grading queens based

on their relative quality compared to all others.

We are now offering this service, which costs only \$15 per queen (10 queen minimum), to some selected large-scale commercial queen producers who have been eager to assess the quality of their queens before they are sold. We also hope that other beekeepers who suspect that their queens are failing to utilize the clinic to verify their actions. Thus our new Queen Clinic will be a valuable resource for beekeepers to make better informed decisions about their queens.

Project Apis m.



Funding for the Nexcelom Vision System to quantify sperm viability and number was generously supported by a \$29,480 grant from Project Apis m., without which the NC State Queen Clinic would not be possible.

NC State Apiculture Program

David Tarpy, Associate Professor
and Extension Apiculturist
919-515-1660
david_tarpy@ncsu.edu

Jennifer Keller, Apiculture
Technician
919-513-7703
jjkeller@ncsu.edu

Margie Gurganus, Genetics
Technician
919-513-6732
mcgurgan@ncsu.edu

[Michael Simone-Finstrom](#), USDA
Postdoctoral Fellow
[Ming Hua Huang](#), Postdoctoral
researcher

Carl Giuffre, PhD Student
(Biomathematics)

Holden Appler, MS Student (co-advisor,
[Steve Frank](#))

Undergraduate Researchers
Megan Walz, Sam Freeze, Rahma
Elkamhawy, Jennifer Fulp, Amanda
Smith

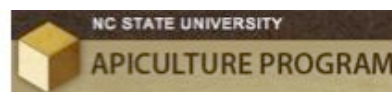
[http://entomology.ncsu.edu/
apiculture](http://entomology.ncsu.edu/apiculture)

Support the NC State Apiculture Program!

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 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 contact the lab for more information.





Online webinars on bees and beekeeping

For the last several years, we have been holding periodic live webinars in lieu of in-state visits to beekeeper groups due to budget cuts. Recordings are available on our website. Let us know if you or your club would like to participate live during our next offering!



BugFest 2013

As we do every year in September, Jennifer helped to organize a booth at the entomological extravaganza at the NC Museum of Natural Sciences to teach thousands of attendees about honey bees. ENT 203 students also volunteered their time for extra credit in the course.

http://www.technicianonline.com/features/article_a9f47cc8-24d1-11e3-9d91-001a4bcf6878.html

Random notes

New publications

Boncristiani et al. (2013). In-vitro infection of pupae with Israeli Acute Paralysis Virus suggests variation for susceptibility and disturbance of transcriptional homeostasis in honey bees (*Apis mellifera*). *PLoS ONE*, **8**(9): e73429

Tarpy et al. (2013). Genetic diversity affects colony survivorship in commercial honey bee colonies. *Naturwissenschaften*, **100**: 723-728.

Niño et al. (2013). Differential effects of insemination volume and substance on post-mating changes in honey bee queens (*Apis mellifera* L.). *Insect Molecular Biology*, **22**: 233–244.

Rangel et al. (2013). The effects of honey bee (*Apis mellifera* L.) queen reproductive potential on colony growth. *Insectes Sociaux*, **60**: 65-73.

We also published two chapters in the second volume of the BEEBOOK, a new comprehensive resource for standardizing apicultural research techniques, including one chapter on Instrumental Insemination and another on Miscellaneous methods. For more information, see the

open access 2013 issues of the [*Journal of Apicultural Research*](#).

BIP update

For the past two years, we have been working with several tech-transfer teams (in CA, MN, and now FL) who have been busy working with beekeepers on various aspects of bee health. In doing so, they have sent us over **1,200 colony samples for which we analyzed the workers for seven important honey bee viruses** using quantitative PCR (qPCR). We are now in the process of relating how those virus levels are associated with other aspects of colony health, such as varroa counts, nosema prevalence, colony population, and other important factors.





Teacher's corner: ENT 203

An Introduction to the Honey Bee and Beekeeping

Another fall semester, another offering of one of the most popular courses in the Entomology Department. We have a really great set of 180 students who are very inquisitive and interactive. Many have already volunteered at BugFest and soon at the State Fair for extra credit, which reinforced what they have learned by interfacing with the general public.

Next semester: no scheduled courses

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

Tarpy's back page

"I think it was Sigmund Freud who once said that there are two important things in life: love, and work. Some of us are blessed with having them be one in the same..."

I wrote these words a short 10 years ago when I first arrived at NC State University in 2003. Seems like yesterday and forever ago at the same time! It was the opening to the first column that I ever wrote in the NC Bee Buzz, the newsletter of the NCSBA. Such columns have always served as an excellent conduit to connect to the state's beekeepers.

In that same spirit, we have now launched our very own newsletter specifically about the NC State Apiculture Program. The title, the *Wolfpack's Waggle*, is borrowed directly from yet another newsletter, that of the Eastern Apicultural Society during their annual summer conferences. So just as the waggle dance of a returning honey bee forager is famous for communicating distance and directional information to food resources, we hope our new in-house publication will help communicate the many directions of our research, outreach, and teaching programs.

Part of the reasoning behind this new newsletter is that while our program is doing many things, many people aren't aware of them. I believe this is because if one doesn't hear that anything is going on, then it is often assumed that *nothing* is going on. There is also a tendency on our part to focus on what we are doing rather than communicate it to others, particularly during this time of budget cuts and de-emphasis on travel. So we hope that the *Wolfpack's Waggle* will help provide a new balance between doing and disseminating—to highlight the projects in the lab.

We are indeed lucky to love our work, and we hope this new venue serves as a means to express it. Sincerely, David