

# Wolfpack's Waggle

April 2015 Newsletter

NC State Apiculture Program

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

Issue 2, April 2015



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## What have we been up to?

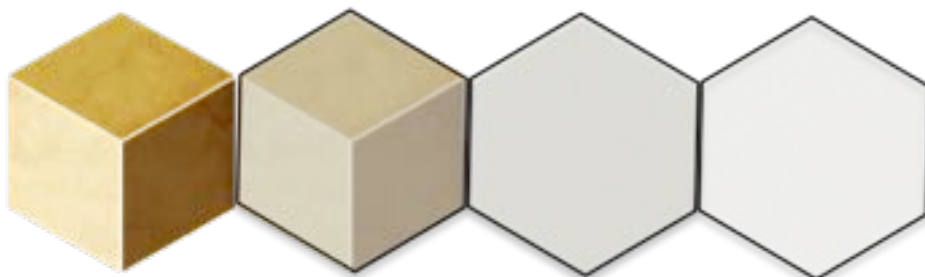
April is always the busiest month of the year for us. The semester is wrapping up, grant writing is at its height, the BEES network and Queen & Disease Clinic have their highest traffic, and the summer research season is already in full swing. At last count, we have no fewer than 33 different experiments that we're actively working on. Some of the larger projects are using *in vitro* rearing to quantify the genomics of "queenliness" (spearheaded by Mike Simone-Finstrom), studying the disease ecology and immunology of social and native bees (spearheaded by Margarita Lopez-Urbe), measuring the oxidative stress of migratory bees and developing RNAi methods in bees (spearheaded by Hongmei Li-Byarlay), and elucidating the collective decision-making process of queen rearing (spearheaded by James Withrow). Margie and Deniz have been making huge strides in the lab on updating our viral screenings, as well as several other techniques (e.g., new DNA/RNA extraction protocols, estimating queen mating number by directly genotyping sperm, etc...). Looks like it'll be another productive summer!

## The genetics of remote, feral honey bees

A set of new papers investigate the population- and mating genetics of the bees living in the Arnot forest. What we have learned may be able to unravel the secrets to their ability to persist while our managed bees are dying in droves.

More on Page 3

## Beekeeper Education & Engagement System



# New developments in the BEES network

The migration of course content to the new DELTA server is now complete, and our new eStore front is up and running!

The **BEES** network has moved! What was once hosted on the Extension server of the College of Agriculture and Life Sciences (CALS) has now migrated to the Distance Education server. While it is a pity that budget cutbacks continue to impact extension delivery, it is comforting that we will be able to continue these courses for the time being. It's initial roll-out has been a bit rocky but we think most of the kinks have been worked out.

### 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)

### 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

**Sign up today @:**

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

## Lab spotlight: Igor Medici de Mattos

This year we welcome Igor Medici, a biology student from Ribeirão Preto, Brazil working on his PhD thesis. Igor's research is centered on the assessment and analysis of viruses in honey bee populations and how pesticides affect a colony's pollination.

European honey bees are the majority of the honey bee population in the United States. Medici, however, is more accustomed to Africanized honey bees, which populate his country. He says, "Brazil has less of a pesticide issue than the U.S., they are also more resistant to Colony Collapse

Disorder, unlike European honey bees, which leaves more room for productivity research". He is interested in comparing the different sub-species through research.

Welcome to NC State, Igor!





## Non-managed honey bee colonies: survivors, or simply escaped swarms?

Many beekeepers and clubs have been actively engaged in breeding “local survivor stock” for their bees. At issue is the fact that the US managed honey bee population, genetically, is pretty much wide open; most beekeepers buy their bees and queens from southern states because of their favorable winters. The consequence of this is that bee populations very rarely get a chance to undergo selection for a given locality, and thus they do not have a chance to become optimized for their local climate.

One approach that many have taken is to breed from nearby non-managed honey bee populations. The idea is that, since they’ve been living outside of beehives (presumably for several generations), they have likely been subjected to natural selection and are therefore putatively resistant to the many problems that face beekeepers. While logically very sound, there are a couple of important hurdles that need to be cleared to make sure that the feral bees can offer benefits to beekeepers everywhere.

First, we need to determine that the non-managed bees (that is, those not living in human-made dwellings

such as beehives) are indeed feral bees. The distinction is critically important, because if the bees living in trees are merely “escaped swarms” from nearby managed bees, then genetically they are not distinct from the bees that we already have, and thus they would offer nothing new since they have not undergone any selective pressure to resist anything. Only by providing evidence that they are genetically distinct would we be able to entertain that they are indeed “survivor stock” that may help beekeepers keep their colonies healthy and alive.

Second, we need to ensure that living in the wild doesn’t somehow disrupt the normal life history of bees from one generation to the next. Importantly, multiple mating by queens and the subsequent increased genetic diversity within hives is critical for colony health and longevity, so we need to see if feral bees are any different when it comes to their levels of genetic diversity.

Third, we need to distinguish if the survival of feral bees is a function of the bees adapting to their problems (most notably varroa mites) or

# What can the feral honey bee population tell us about our managed bees?

Quite a lot! Some bees, living in the wild, seem to be able to co-exist with all of the same problems that face the managed honey bee population. If we can figure out their secrets, we might be able to co-opt them. But we have a couple of important first steps.

whether those other problems have adapted to bees living in the wild. Some studies have shown that bees have in fact been select to be more tolerant of varroa mites, whereas other studies have shown the mites to be less virulent in the bees.

We have just wrapped up a pair of experiments that help answer some of these important questions. We



The Arnot Forest in upstate NY has one of the best-studied feral honey bee populations anywhere, investigated by Dr. Tom Seeley since the 1970s.



## New research on feral bees (Continued)

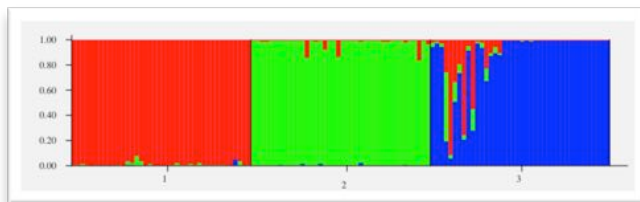
teamed up with Dr. Tom Seeley, a preeminent honey bee biologist at Cornell University, and Dr. Debbie Delaney, a former member of our program and terrific population geneticist now at the University of Delaware. Several years ago, we secured a grant from the North American Pollinator Protection Campaign (NAPPC) to test the population genetics and diversity of bees living in the Arnot forest, an isolated nature reserve in upstate NY that Tom has famously been studying for 40 years.

Published online in the journal *Apidologie*, our first paper demonstrates that the bees in the Arnot forest are wholly genetically distinct from their counterparts in nearby managed apiaries. In other words, it is quite clear that these are indeed feral bees and not escaped swarms!

In a second paper,

published in *PLoS ONE*, we estimate the mating frequency of the Arnot queens. Perhaps surprisingly, we found that these rural, isolated queens mated at the same numbers as our managed counterparts. Thus feral bees seem to have comparable levels of genetic diversity as managed bees.

Together, these exciting findings buoy the hopes that the feral honey bee population may offer some insights into how they have been able to survive in light of the many problems we all face. This may therefore lead to breeding strategies to glean such benefits into our managed stock.



Population genetic structuring of the bees in and around the Arnot forest. Different colors represent distinct genetic signatures. Clearly, managed Apiary 1 (red) and Apiary 2 (green) bear little to no resemblance to the Arnot population (blue). This demonstrates that the feral bees have something to offer genetically.

## NC State Apiculture Program

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## 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.



## Tarpy lab in the news

We and our collaborators just published the first thorough census of the gut microbiome (think probiotics) in queen bees. We found that the microbiome changes as the queen matures, but the microbiomes of different queens are very similar – regardless of the environment each queen is in. This is actually very good news knowing that if you transfer a queen between hives, you're not affecting her gut microbes.

[LINK](#)



## SAHRC 2015

A few weeks ago, 15 of us traveled up to Virginia Tech to attend the 11<sup>th</sup> annual student symposium of the Southern Appalachian Honeybee Research Consortium. Carl, Igor, James, Ravi, Brinkley, Jennifer (Fulp), and Gabriela all presented their work and did a fantastic job. Every year, this grass-roots gathering of NC State, UNCG, UNCC, Wake Forest, VT, East TN State, and Clemson honey bee programs just gets better and better!

## Random notes

### New publications

Tarpy, D. R., D. A. Delaney, and T. D. Seeley. (2015). Mating frequencies of honey bee queens (*Apis mellifera* L.) in a population of feral colonies in the United States. *PLoS ONE*, **10(3)**: e0118734.

Milbrath, M. O., T. van Tran, T., W-F. Huang, L. F. Solter, D. R. Tarpy, F. Lawrence, and Z. Huang. (2015). Comparative virulence and competition between *Nosema apis* and *Nosema ceranae* in honey bees (*Apis mellifera*). *Journal of Invertebrate Pathology*, **125**: 9–15.

Rogers, S., D. R. Tarpy, and H. J. Burrack. (2014). Flower morphology influences pollinator community with implications for cross-pollination: observations in rabbiteye blueberry (*Vaccinium ashei* Reade). *International Journal of Fruit Science*. <http://dx.doi.org/doi:10.7282/T361120H>

### Welcome aboard!

We have several new people in the lab. First, we've been joined by a visiting PhD student from the University of Sao Paulo, **Igor Medici de Mattos** (see page 2), who will be doing some work on viruses and sublethal effects of pesticides. Second, **Jacob Gantt** is a new undergraduate researcher who is helping Mike on the queen genomics project. Finally, **Deniz Chen** joined us in January as a new technician

who will be working on clinic samples and many other projects, and he has already made significant contributions to our program. Glad to have you all part of the team!

### Renewal grant for oxidative stress

We have been very fortunate to be able to continue our productive collaboration with **Olav Rueppell's** group at UNC Greensboro and **Mimi Strand** at the Army Research Office on the genetic architecture of oxidative stress and aging.

Our 4-year renewal, while not directly funding our program, will enable us to continue research within this paradigm. We are making great progress in elucidating the factors that result in stress and oxidative damage in bees, which will help improve their longevity.

### Congratulations Margarita!

**Margarita Lopez-Uribe**, a postdoc in our lab since this past July, was just awarded a highly prestigious NSF Minority Postdoctoral Fellowship. These 2-year awards are highly competitive, with only 15 being awarded nationwide each year.

Margarita's research will center around the disease ecology of social and solitary bees. At issue are important concerns such as pathogen spillover, trade-offs between individual (physiological) and social (behavioral) immunity, and population-wide genetic diversity.

## Teacher's corner: Courses at NC State

We're teaching two courses this Spring 2015 semester at NC State. ENT 401, "Honey bee biology and management", which is a distance education (DE) course despite it having three weekend field days for hands-on beekeeping activities, is at an all-time high enrollment. ENT 601/801, "Social behavior of insects," is a graduate-level course being co-instructed with Hongmei Li-Byarlay and John Meyer, and it is also at an all-time high enrollment of 15 MS and PhD students.

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



## Tarpy's back page

We are just now wrapping up the fourth year of the Bee Informed Partnership ([beeinformed.org](http://beeinformed.org)) and entering the last fiscal year of the USDA-CAP grant that has funded this nationwide initiative. Our program has been a participating member ever since its original conception, mostly by working with the multiple tech-transfer teams all across the nation by processing samples they collect for virus levels.

Another aspect, and perhaps the main effort of the BIP, has been to survey beekeepers every year in order to understand the extent and pattern of colony losses all across the country. You've seen the [press releases](#) every year, where the media highlights new statistics about how our honey bee population is doing. This isn't done by some systemic institutionalized governmental effort, it's all done through the Bee Informed Partnership! We hope to continue these efforts beyond the life of the grant, so stay tuned.

The Colony Loss Survey has evolved from our winter loss survey because last year we found that commercial beekeepers lost 25% of their colonies over the summer, and so we are now starting to survey for the entire year. The National Management Survey is conducted annually in conjunction with the Colony Loss Survey. Designed to take about 30 minutes, the two surveys are aimed at looking for relationships between colony losses and colony management (including disease treatment strategies, supplemental feeding) and other factors that may influence colony health (such as colony location, honey production, and forage type). Your participation in this survey is voluntary, and your responses will be kept completely confidential. In any publication or presentation resulting from this research, no personally identifiable information will be disclosed.

Just like in a honey bee colony, there is strength in numbers. Please take part in the collective and submit your survey today! <http://10.selectsurvey.net/beeinformed/TakeSurvey.aspx?SurveyID=BIP2015>

Sincerely, David