

**PROGRESS SUMMARY**  
**PAM – NHB PROJECTS 2017**  
MARCH 9, 2018

Last year (2017) commenced the National Honey Board (NHB) collaboration with Project Apis m. (PAm) to administer and manage the NHB Production Research Funds. This will allow management of the projects to better support the beekeeping industry by harmonizing the NHB research funding with several other stakeholder efforts and funding resources PAm coordinates, in addition to additional flexibility possible through PAm. With NHB as the funding sponsor, PAm is the administrator of the proposal, accountability and funding process. Scientific Advisors and Pam Board of Directors (including two NHB representatives) concluded the selection process by naming the following projects for funding:

**FUNDED PROPOSALS**

**Jeffery S. Pettis**, Principal Investigator, Pettis and Associates, LLC, Salisbury, Maryland

Title: *Protecting Queens for Improved Colony Productivity.*

With the objective to assess the feasibility of modification to the standard 100 queen shipping battery box, the components (heating and cooling devices) were sourced and some engineering of the device accomplished. In summer, three regiments were tested to evaluate whether bulk bee stocking rate and water availability within the standard 100 queen shipping boxes influenced sperm viability when queens were exposed to extreme heat (40C for two hours). The USPS employee education process was investigated in preliminary contacts, and a rough fact sheet for UPS was developed and is under review currently, anticipating meetings with leadership in late Spring. With some extreme heat events within colonies documented, the effect to drone sperm viability during mating and in the queen banks needs further investigation.

**Dennis vanEngelsdorp**, Principal Investigator, University of Maryland, and Humberto Boncristiani, Primary Researcher

Title: *Investigation of possible new threats to honey bee health.*

This project uses the extensive sample set and database of the Bee Informed Project survey work to identify some specific phenomena which may be relevant early warning signs of bee health threats, some of which are confidential pending more data analysis. Investigators requested a 3-month no-cost extension for the project due to complicated immigration issues related to the current climate. The PhD student identified to work on this project will now be on payroll in mid-December and will resume the important research investigations. Investigators will be able to complete the experimental work, and then an extra three months are required to do a complete analysis of the results and complete the final report. This extension request has been granted, moving the end date to May 2018.

**Matthew Smart**, Principal Investigator, US Geological Survey, and Jonathon Lundgren, Cooperator

Title: *Developing a rapid assessment technique to understand the effect of forage quality on nutritional status and honey bee health.*

Objectives of this project are to: 1) Determine the 'complete' (lipids, proteins, glycogen = stored carbohydrates) nutritional profiles of adult honey bees from a large sample set of apiaries (6 colonies from each of 36 apiaries across 3 states), 2) Analyze the data in the context of land use surrounding the sampled bees to determine the differential impact of land use quality on honey bee nutrition, and 3) Determine final outcomes of sampled colonies in relation to fall nutritional state (honey production, survival, population size for almond pollination).

The lab is currently processing and analyzing samples to standardize and streamline the protocol, and will be processing study samples over the coming months.

**Julie Shapiro**, Principal Investigator, Honey Bee Health Coalition, and Mike Smith, Cooperating Investigator  
Title: *Bee integrated demonstration project*.

The overarching goal of the Bee Integrated Demonstration Project is to demonstrate how honey bee health can be improved by using a portfolio of tools together in the same agricultural landscape to address the primary risk factors affecting bee health. Bee Integrated launched in April 2017, with three farmer/beekeeper pairs that will participate for 3 years. In its first year, the project's system of best management practices was implemented as planned on all three pilot sites. Data collection and site observations were conducted successfully with exception of some hives still being located in California. The resulting samples and records, especially those pertaining to the forage component, are still undergoing analysis. Preliminary results are expected to be available for review in April.

**Olav Rueppell**, Principal Investigator, University of North Carolina, Kaira Wagoner and Taylor Reams, Investigators  
Title: *Understanding semiochemical tools for natural Varroa control principle*.

The long-term objective of this research is to develop novel approaches for sustainable *Varroa* control and beekeeping. The two aims for this proposal were to 1) understand the factors that determine *Varroa* parasitism of honey bee brood, and to 2) study the stimuli that elicit hygienic behavior of nurse bees towards *Varroa*-infected brood. Progress towards these objectives include two experiments, one based on the fact that no effective *Varroa* trap has been developed despite discovering chemical mite attractants over 20 years ago. Results showed that nurse bee visitation rate was significantly correlated with mite infestation risk, rather than chemical signals. The second was to test a compound discovered on brood (P32), with preliminary evidence showing it to be higher with mite infestation, and inducing increased hygienic response. Results confirm that P32 induces higher hygienic response, without significant differences among various selected strains. It was also discovered that the solvent (hexane) induces some hygienic response; as this was an intended control treatment, materials and methods will be adjusted going forward.

**Jonathan Snow**, Principal Investigator, Barnard College, New York

Title: *Defining sensitivity and cellular impacts of pharmacologic and genetic inhibition of aminoacyl-tRNA synthetases on N. Ceranae and its honey bee host*

Honey bee infection by the microsporidian, *Nosema*, has long been a known stressor of bees, and as *N. ceranae* has been displacing *N. apis* throughout the USA, treatment recommendations and thresholds are currently unknown, with only one treatment is available (Fumagillin). As microsporidia, including *N. ceranae*, do not possess the biosynthetic pathways for most amino acids and must import amino acids from the host cell, this project explores molecular pathways of the parasite to exploit weaknesses, test a new *Nosema* treatment (Halufunginone), while verifying safety for bees and exploring other treatments based on the molecular pathway details. Halufunginone, a well-characterized inhibitor of prolyl-tRNA synthetase activity, has been a successful treatment against malaria-causing *Plasmodium* species and preliminary results show it more effective than fumigillin at reducing *Nosema* infection, with no additional bee mortality in cage trials. Progress includes generating relevant template molecules (dsRNA molecules) for use in the RNAi experiments to explore exploiting the molecular pathways. Survival and knock-down studies will begin during the upcoming field season. Transcriptome analysis revealed that AAR induction increased the expression of 248 genes as compared to control bees and decreased the expression of 137 genes compared to control bees, many of which are not well characterized but this may indicate an additional pathway- ribosome biogenesis- has potential for *Nosema* control.

**Bee Understanding**, Richard Crespin, Principal Investigator, Collaborate Up.

Title: *The Bee Understanding Project: Sponsorship Agreement*.

The Bee Understanding Project job swap and documentary film program brings together growers, beekeepers, crop advisors, and entomologists to test ways of improving cooperation and accelerating the adoption of technical solutions that drive real improvements in honey bee health. The first phase of the Project focused on stakeholders in and around corn production in North Dakota. The second phase will focus on almond production

and beekeeping communities to create solutions in pollinator health. Project Apis m. worked with industry representatives to recommend beekeepers and growers for this effort, filming began in Feb. and we have had positive feedback about the process.