



# ***The Signal***

Monthly newsletter of the W. M. Keck Center for Behavioral Biology  
at North Carolina State University  
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***The Signal Wishes All Its Readers a Happy Holiday Season and  
a Prosperous, Productive and Healthy New Year!***



## **Keck Center's Trudy Mackay Receives Honorary Doctorate**



William Neal Reynolds Distinguished University Professor Trudy Mackay received an honorary doctorate from the University of Buenos Aires in Argentina. The award ceremony was followed by a lecture on "The Genetic Architecture of Complex Traits: Past, Present, and Future." The degree was bestowed by the Chancellor of the University of Buenos Aires, Dr. Ruben Hallu, and the Dean of the Faculty of Natural Sciences, Dr. Jorge Aliaga. Mackay's significant contributions to the field of quantitative genetics were cited, especially the recent

generation of the *Drosophila melanogaster* Genetic Reference Panel, a collection of inbred wild-derived fly lines with fully sequenced genomes that are available worldwide as a community resource. Mackay has had a long-standing relationship with the population and quantitative genetics group at the University of Buenos Aires. While in Argentina, she participated together with Dr. Robert Anholt as faculty of the Latin American School for Evolution, which was attended by students from Argentina, Chile, Uruguay, Colombia, Peru and Brazil.

**This issue of The Signal contains the Announcement and Call for Abstracts of the Fifteenth Annual Student/Postdoc Symposium of the W. M. Keck Center for Behavioral Biology on February 21, 2014.**

# Guppies, Humans, and Moose, Oh My!

by Andrea Vogel

On November 7, the Keck Center hosted Dr. Lee Dugatkin. Dugatkin is well known for his work on evolution of social behavior. He is a Distinguished University Professor at the University of Louisville in the Department of Biology. He is also the author of *The Principles of Animal Behavior*, a widely used textbook of animal behavior, and several books ranging from cooperation to evolution. Dugatkin's latest book, which he talked about at the Museum of Natural Sciences later in the evening, deals with natural history in the early United States.

Dugatkin's seminar, "The interaction of genetic and cultural transmission in shaping mate choice in animals and humans" discussed how cultural transmission - which he defined as "the transmission of behavior via social learning (imitation or teaching) - could shape mate choice in both guppies and humans, both before and after courtship. In other words, he asked whether females would find a potential mate more attractive if they knew by observation that he was preferred by another female. The decision to use guppies was based on the social structure and the clear honest signaling of guppies. In guppies, males who have more orange on their fins and bodies are more desirable mates. Dugatkin manipulated this honest signal by making it seem as though a female was more interested in a male with less orange, and watching if a focal female was more interested in the male with more or less orange.

The human study was done through surveys of men and women, where the survey-taker was given a short description about how other people ranked a potential date, based on looks, sense of humor and wealth. The survey-taker then decided if he or she would like to date the potential person. Surprisingly, Dugatkin found quite a bit of overlap between the results from the human and guppy experiments. Women were more inclined to be attracted to men if they were deemed attractive by others, and sense of humor or wealth appeared to be associative features of such attraction.

Dr. Dugatkin's results showed that what others think of potential mates can sway their decision-making processes. It was a reminder of how cultural transmission can impact thinking, and could be applied



*Dr. Lee Dugatkin*

to choices other than mates and courtship. The talk which he gave at the North Carolina Museum of Natural History later that night was titled, "Mr. Jefferson and the Giant Moose: When Natural History and History Collide" and was connected to his new book *Mr. Jefferson and the Giant Moose: Natural History in Early America*. It was geared towards the public, and was about the events occurring soon after the American Revolution. Thomas Jefferson sent a large moose over to Europe to demonstrate the awe-inspiring nature present in North America, as a way to rebuff the European notion proposed by the influential French naturalist Buffon, that North American nature was inferior to European. Dugatkin's talk was captivating and intriguing. It showed what the prejudice of the time was towards North America, and highlighted the absurdity of the time, captured through the final act of sending moose remains over to make the point that the new world is in fact not inferior to the old one.

Dugatkin's talks both showed how culture can impact thinking; in the first talk by exemplifying how cultural transmission can impact your behavioral decision making, and in the second by exemplifying how European writers could impact how people viewed a continent, even though the writers had never been to North America.



# Two Tales of Lepidoptera

by Megan Fritz

On November 20th and 21st, the W. M. Keck Center for Behavioral Biology co-hosted Dr. David Heckel, Entomology Department Head from the Max Planck Institute for Chemical Ecology in Jena, Germany. Heckel's interests focus on the evolution of complex adaptation in insects. His seminar was entitled "QTL mapping in Lepidoptera: The search for genes for resistance to Bt toxin and for male response to sex pheromones".

In the first half of the seminar, Heckel focused on the genetics of pheromone response in *Ostrinia nubilalis*. *O. nubilalis*, the European corn borer is a Lepidopteran agricultural pest found throughout Europe and North America. To attract mates, female *O. nubilalis* release a species-specific pheromone "bouquet". These bouquets are made up of multiple molecular components. It is the blend of components that signals female interest in mating, and elicits upwind flight and courtship responses from conspecific males. Polymorphism in a gene affecting the ratio of pheromone components in the bouquet alters male response. This is because male *O. nubilalis* have odorant receptors (ORs) that are finely tuned to each component of the female pheromone.

The finding that genes for pheromone component ratios and genes for male response are unlinked in *O. nubilalis* suggests that these signal-response traits should be under strong stabilizing selection. Heckel is interested in determining how novel signal-response systems can evolve in the face of such strong stabilizing selection. The *O. nubilalis* system is a useful one for investigating signal-response system diversification. Among *O. nubilalis* populations, females of different pheromone "races" produce unique pheromone blends, and males respond strongly to females of their own race. Yet, these divergent races are interfertile, and can be hybridized for QTL studies. Heckel and colleagues examined responses of hybrid males to the pheromone blends of both races with the ultimate goal of locating QTL involved in differential male responses. To accomplish this, his group developed a novel bioassay that was the first to score male response as a quantitative trait. To their surprise, the assay revealed a QTL that was responsible for neuronal development, rather than the OR candidates they were expecting. They found that race-specific differences in OR neuron connectivity to glomerular targets are responsible for male behavioral differences. In another study, Heckel and colleagues identified QTL responsible for race-specific female pheromone blends. Allelic variation at a fatty-acyl reductase (FAR) gene expressed in the female pheromone gland

underlies race-specific differences in pheromone composition. FARs are important for a reduction step in the pheromone biosynthetic pathway that determines the final pheromone blend produced by females. Pheromone gland FAR genes are Lepidoptera-specific. Heckel postulates that mutations in these genes, whose expression alters the products of the pheromone biosynthetic pathway, can help to explain pheromone divergence and ultimately speciation in the Lepidoptera.

In the second half of his seminar, Heckel described his research on the genetics of Bt resistance in laboratory-reared *Heliothis virescens*, the tobacco budworm. The soil bacterium *Bacillus thuringiensis* (Bt) produces crystal (cry) toxins that are lethal to some insect species. The genes responsible for cry toxin expression have been engineered into corn and cotton crops, which are grown throughout the US and Australia. Dr. Heckel is interested in determining the genetic basis for Bt resistance in order to manage resistance and preserve Bt crop technology.

Cry toxins are ingested when insect pests feed on transgenic corn or cotton plant tissues. Toxicity is the result of pore formation in cells of the gut wall. Multiple protein processing steps are required between ingestion and lesion formation. Each one of these processing steps represents a potential target for natural selection, opening up the possibility that there are multiple ways to evolve Bt resistance. This presents a significant challenge for researchers trying to understand and manage Bt resistance.

In two separate studies, Heckel and colleagues crossed two *H. virescens* colonies that differed in their tolerance to Bt, in order to locate QTL that were responsible for Bt resistance. The first candidate gene they discovered was a member of the cadherin gene superfamily. Cadherin receptors in the insect midgut are important for cry toxin binding, cleavage and activation. However, Bt resistant *H. virescens* carry an ancient retrotransposon insertion in the gene coding region, which results in a truncated, non-functional cadherin protein, and ultimately poor cry toxin binding. The second candidate gene encoding an ABC transporter was discovered several years later. A 22 bp deletion in the ABC transporter gene is found in highly resistant *H. virescens*. ABC transporters are involved in the removal of toxic chemicals from cells, although their role in Bt toxicity remains unclear.

Heckel concluded by remarking that the evolution of Bt resistance is ongoing and dynamic. He proposed that molecular and quantitative genetics can be useful tools to study Bt resistance.

# Symposium 2014

## Announcement and Call for Abstracts

The Fifteenth Annual Student/Postdoc Symposium of the W. M. Keck Center for Behavioral Biology will be held on Friday, February 21, 2014, in the Stanley G. Stephens room, 3503 Thomas Hall, at North Carolina State University. Participation is open to all students, postdoctoral fellows and faculty, and is mandatory for students enrolled in the Concentration for Behavioral Biology.

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### Preliminary Program

8:30	Breakfast
9:15	Welcome by Dr. Robert Anholt, Center Director
9:30	Symposium
10:45	Coffee break
11:15	Symposium
12:30	Lunch
2:00	Symposium
3:15	Break
3:45	Symposium
5:00	Reception and dinner

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Presentations will be 12 minutes with 3 minutes for discussion. Participants should submit an abstract by e-mail to Allison Nolker ([ajnolker@ncsu.edu](mailto:ajnolker@ncsu.edu)) or Gabriel Zilnik ([glzilnik@ncsu.edu](mailto:glzilnik@ncsu.edu)) no later than **February 7**. The abstract should contain no more than 300 words without figures or tables. It must provide a title and the name of the presenting author (without co-authors or affiliation).

Trainees within their first year may present their future research objectives. Advanced trainees will present progress of their research. Computer-assisted projection and a PC-type laptop will be available for PowerPoint presentations. All presentations must be rehearsed with the mentor.

**Faculty, students and postdocs who plan to attend the reception and dinner MUST RSVP to Suzanne Quick ([ssquick@ncsu.edu](mailto:ssquick@ncsu.edu)) no later than February 7.**

# Sex, Drugs and the Brain

by Sheryl Arambula

On Monday, November 25<sup>th</sup>, 2013, Dr. John Meitzen led a riveting discussion on the scarcity of data comparing sex differences between males and females. The study of sex differences is an important but controversial topic. Do these differences even matter? How large are the differences between males and females? To what degree are these differences hardwired? Erroneously, people may believe that sex differences are simply a result of society and assume that what is valid in a male is valid in a female. But it is now known that there are intrinsic differences in the gene expression, physiology, anatomy, behavior and brain of males and females.

Therefore, it was surprising to find out that these sex differences are still being ignored in the scientific community and this problem is pervasive in all disciplines of science. Frequently in research, the sex of the subjects is rarely compared when analyzing results and even more alarmingly, it is often times unreported. Animal studies overwhelmingly focus on male subjects. Perhaps lack of money or time, concern that female hormonal cycles may lead to discrepancy in data, or ignorance of the widespread variation between the sexes may contribute to these data being unreported.

Meitzen exemplified his point by presenting data from multiple studies on sex differences in drug taking behaviors which are, at least in part, due to underlying hormonal differences between the two sexes. For example, estradiol is thought to heighten the reinforcing effects of cocaine in female rats and Meitzen is studying the electrophysiological basis for these estrogen dependent effects on cocaine addiction in spiny neurons of the striatum. These experiments underscore the importance of studying sex differences.

The current problem of disregarding sex differences in research needs to be addressed. We do not yet know the extent to which basic behavioral responses and neural mechanisms differ by sex. Though, elucidating these differences could lead to enhanced, personalized treatments for sex-biased diseases. Thank you John for an insightful and enjoyable discussion!

## Grants

**David Tarpy** received a two-year \$20,000 grant under the FAPESP--North Carolina State University program to study "Queen quality - an important trait for the bee colony and the bee keeper" with Dr. Klaus Hartfelder at the University of São Paulo (Brazil).

## Seminars

On **December 5**, 3:30 pm, Dr. Martin L. Chalfie from the Department of Biological Sciences at Columbia University will present a seminar titled "Transduction and modulation of touch sensitivity in *C. elegans*." The seminar will be in 101 David Clark Laboratories.

On **January 13**, 1:30 pm, Dr. John R. Carlson from the Department of Molecular, Cellular and Developmental Biology at Yale University will present a seminar titled "Chemosensory perception in the fly." The seminar will be in 3503 Thomas Hall.

On **January 30**, 3:30 pm, Dr. Russell S. Lande from the Division of Biology at Imperial College London will present a seminar titled "Phenotypic plasticity, adaptation, and extinction in a changing environment." The seminar will be in 101 David Clark Laboratories.

## Publications

The following publications from the W. M. Keck Center for Behavioral Biology have appeared in print:

Niño, E. L., Malka, O., Hefetz, A., Tarpy, D. R. and Grozinger, C. M. (2013). Pheromone production in two glands is differentially regulated by distinct mating factors in honey bee queens (*Apis mellifera L.*). *PLoS One* **8**: e78637.

Rogers, S., Cajamarca, P., Tarpy, D. R. and Burrack, H. J. (2013). Honey bees and bumble bees respond differently to inter- and intra-specific encounters. *Apidologie* **44**: 621-629.

## Of note...

**Robert Anholt** and **Trudy Mackay** presented lectures at the Latin-American School for Evolution at the University of Buenos Aires (Buenos Aires, Argentina).

**Lauren Dembeck** was appointed as a trainee representative to the Genetics Society of America Women in Genetics Committee for 2014–2015, which provides guidance on issues related to enhancing gender equity within the Society and the scientific community.

**Jim Hunt** presented a paper on "How social wasps evolved" at the annual meeting of the Entomological Society of America in Austin, Texas.

**Trudy Mackay** received a Philosophiae Doctor honoris causa degree from the University of Buenos Aires in Argentina.

**Lisa McGraw** gave a seminar in the Department of Biology at Miami University of Ohio. She also gave a lecture on the science of sexuality at the University of North Carolina in a freshman seminar course entitled “Sex, Sexuality, and the Body in Early Modern European Literature” as part of the “Distinguished Lecture Series.”

**John Meitzen** presented a poster at the annual Society for Neuroscience Meeting in San Diego (CA).

**Nadia Singh** presented seminars on genetic and environmental determinants of meiotic recombination rate variation in *Drosophila* at Brown University, the University of North Carolina at Greensboro and the École Polytechnique Fédérale de Lausanne in Lausanne, Switzerland.

**Leslie Sombers** gave presentations at the Southeast Regional Meeting of the American Chemical Society in Atlanta (GA) with A. C. Schmidt, X. Wang, Y. Zhu, E. Mitchell and G. S. McCarty on carbon nanotube yarn microelectrodes for enhanced detection of neurotransmitter dynamics in live brain tissue; with J. G. Roberts, J. V. Toups, E. Eyualet and G. S. McCarty on an *in situ* electrode calibration strategy for voltammetric measurements *in vivo*; with L. E. Dunaway, A. C. Schmidt and G. S. McCarty on real-time voltammetric detection of met-enkephalin in rat adrenal tissue, and; with A. C. Schmidt, L. E. Dunaway, J. G. Roberts, T. J. Shogren and M. P. Zach on recessed carbon-fiber microelectrodes for use with FSCV in living tissue.

**David Tarpy** gave seminars in the Thomas Jefferson Scholars lecture series at North Carolina State University, the North Carolina Society of Toxicology, the North Carolina Entomological Society and the North Carolina State Agricultural Foundation. He also gave an invited symposium presentation on connecting genetics of the colony with research and extension at the Entomological Society of America meeting in Austin (TX). He also gave presentations at the same meeting with **Ming Hua Huang**, **Michael Simone-Finstrom**, Michael Strand and Olav Rueppell on management practices and honey bee stress: effects of migratory beekeeping on longevity and oxidative stress, and with **Michael Simone-Finstrom** on mechanisms of parasite resistance in honey bees: interactions among individual and social immune defenses.

To contribute to The Signal, to be placed on our mailing list or for information about the W. M. Keck Center for Behavioral Biology, contact Dr. Robert Anholt, Department of Biological Sciences, Box 7617, North Carolina State University, Raleigh, NC 27695-7617, tel. (919) 515-1173, anholt@ncsu.edu.

**The W. M. Keck Center for Behavioral Biology gratefully acknowledges support from its corporate sponsors.**



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