

The Signal

Monthly newsletter of the W. M. Keck Center for Behavioral Biology
at North Carolina State University
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Keck Center Scientist to Be Featured in Hollywood Movie

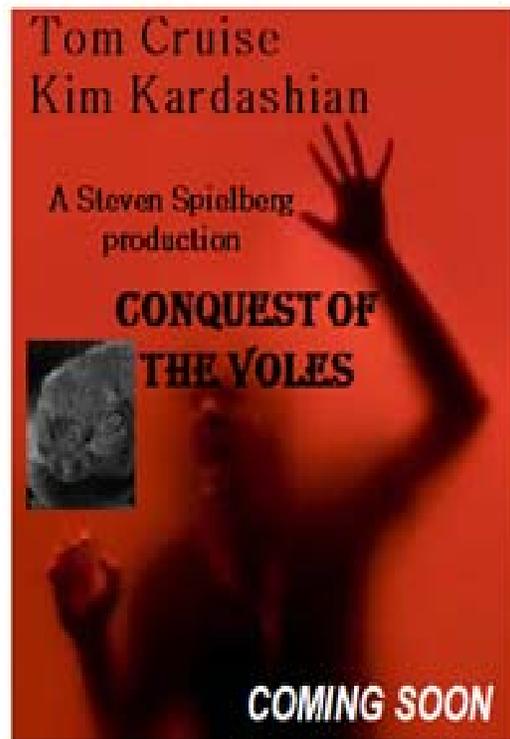


Lisa McGraw (left) and director Steven Spielberg (right)

It would be an understatement to say that Keck Center scientist Lisa McGraw was surprised, when she received a late evening phone call from no other than Hollywood director Steven Spielberg with a request to serve as advisor for a future feature film due to be released in the spring of 2014. The movie “Conquest of the Voles” is based on a story in which a scientist, who suspects his wife from having an affair, becomes fascinated with the biological underpinnings of marital fidelity. He decides to swap genes between two species of voles, one known to be monogamous and the other polygamous. The experiment works, but a lab worker gets infected through a needle prick and the polygamous genes spread through the local population, where they create havoc.

While working on the movie’s script, Spielberg researched some of the scientific literature and this alerted him to Lisa. During the telephone conversation he offered her a consultancy as well as a small appearance in the movie.

“It was so exciting to talk with Steven,” says Lisa, “He was terribly nice and approachable.



Poster for marketing Conquest of the Voles

It’s exciting to be in the movie! It is only a small part. I have to wear a white lab coat and when Tom Cruise runs in and shouts “Where are the voles?” I have to look straight into the camera with a terrified expression, point to the left, and say “Over there!”

The small appearance is not without monetary benefits. McGraw will receive \$285,000 for her involvement with the project. She will donate 10% to the Keck Center and use the rest to fund her research program.

Let’s congratulate Lisa on this remarkable experience.

Beetle Love

by Katherine Knudsen

On Monday, March 18th, 2013, Dr. Allen J. Moore gave the W. M. Keck Center distinguished seminar on “Quantitative to Molecular Genetics of Parenting.” Currently the head of the Department of Genetics at the University of Georgia, Moore has served as a faculty member at several universities across the United States and across the pond to universities in England. Moore’s impressive career has led him to work with an amazing array of model systems including the cockroach (*Nauphoeta cinerea*), the honey bee (*Apis mellifera*), the giant tropical ant (*Paraponera clavata*), the Asian lady beetle (*Harmonia axyridis*), and the pond dragonfly (*Libellula luctuosa*), to name a few. Some of Moore’s work has been on sexual selection, mate choice, sexual conflict, pheromonal signaling, and parental care. Moore has a strong interest in complex traits, especially in how behavior and environment influence evolution. One of his favorite hobbies is taking pictures of parents and their offspring.

For his Keck Center distinguished seminar, Moore discussed his work on parental care in the burying beetle (*Nicrophorus vespilloides*). In *N. vespilloides*, uniparental female care, uniparental male care, and biparental care can be seen. Moore began his talk by giving the broad definition of parental care as “Any parental trait that enhances the fitness of the parent’s offspring.” However, as he pointed out, parental care is not a simple phenotype and is often multivariate, including multiple components. Moore uses quantitative and molecular genetic approaches to study the genetic basis behind variation in parental care. His talk focused on sex differences in parental care in *N. vespilloides*. Parental care can be examined in three categories, the first of which is direct care. Direct care is measured as the amount of time the parent spends directly provisioning for the offspring, such as the parent beetle regurgitating food to the larvae. The second category, indirect care, is measured as the amount of time the parent spends in care activities that are not a direct interaction with the offspring, such as the parent beetle maintaining and defending the carcass in which the larvae live. The third category is family size, which is the number of offspring the parent will care for. In *N. vespilloides*, increasing family



Dr. Allen Moore

size leads to a decrease in female indirect care and increased female direct care.

In *N. vespilloides*, female uniparental care is most commonly seen (51%), followed by biparental care (44%), with male uniparental care only seen 5% of the time. Moore explained that in the biparental care situation, the female is most involved in direct care, while the male is more involved in indirect care. Males abandon the larvae earlier than females, and it has been shown that the form of care received by the offspring does not affect their fitness. Moore showed several humorous videos in which females were seen feeding the larvae and males were seen grooming themselves. Since parental care by males does not seem to affect the fitness of the offspring, it raises the question of why males care for the offspring. One theory is that male care is a backup plan in case something happens to the female.

To understand the genetic basis behind the sex differences in parental care, Moore used RNA-seq to examine changes in gene expression in caring versus non-caring parents. The data showed 628 significant changes in transcript levels in females, but only 32 significant changes in males, providing more evidence that parental care in *N. vespilloides* is primarily a female role. Moore discussed predicting genetic pathways that influence parenting, focusing on the *forager* gene and the insect version of vasopressin. Both genes are shown to affect behavior in other insects. Moore explained how the *forager* gene could be manipulated to influence social interaction in *N. vespilloides*, extending the duration of direct care from both male and female parents.

Moore’s work has shown that there is a genetic basis to variation in parental care, and that this variation can be quantified. These genetic studies both help to understand how parental care evolves and aid in the understanding of behavioral diversity and complexity.

Cyborg Insects

by Megan Garlapow and Jessica Nye

Imagine you are trapped under a pile of rubble after an earthquake, and a group of screeching cockroaches scampers past you in a coordinated manner. The scuttling cockroaches are part of a search and rescue team looking for survivors. This could be the future if Dr. Alper Bozkurt's research continues on its path. Bozkurt, an Assistant Professor in the Department of Electrical and Computer Engineering at North Carolina State University, led an exciting social evening discussion on March 13, 2013, on his research in biomimetics. Bozkurt discussed his research trajectory, which began with a master's degree in biomedical engineering from Drexel University. He then shifted his research interest to biomimetics as he pursued a Ph. D. at Cornell University. He has always wanted to conduct research to save people, and he originally would look at nature to inspire engineering. After working on developing microneedles based on a mosquito proboscis, Bozkurt and his colleagues began using electrodes to control insects.

At Cornell he had access to moths, so he implanted the electrodes into pupae where the soft tissue allowed for better biomechanical coupling between the electrode and the moth, the soft-targeted electrode implantation allowed for indirect flagging of muscle tissue. When an adult moth emerged with the electrode properly implanted, Bozkurt could guide it through flight tests. The implanted electrode allowed him to heat the moth from the inside, which improved flying. He targeted the dorsolateral and dorsoventral muscles and with a controller told the moth in which direction to fly and even to flap each wing independently. However, due to the size of the



electrodes, the moths were unable to fly for long durations. To improve this Bozkurt tethered an implanted moth to a helium balloon which allowed the moth to fly with this heavy load for longer flight times.

With all of his work on bionics, Bozkurt was called in to consult on the Disney movie *G-Force*. Ultimately, Disney did not develop a moth character but rather a fly, but while consulting, Bozkurt remembered a brief appearance of a cockroach character. This cockroach inspired his current research at North Carolina State University. Since Bozkurt joined the faculty at NCSU in 2010, he has worked with cockroaches, implanting micro-electrodes in the antennal node of the cockroach. This experimental design allows for a large computer chip to be secured on the back of the cockroach. The electrodes implanted in the antennae directly control the central nervous system. Without training the cockroaches, Bozkurt can get them to follow user-guided commands from a controller.

Ultimately, Bozkurt's goal of helping people could be realized if he can develop teams of cockroaches that can stay close to each other in a "cyborg storm" as they roam piles of rubble, looking for survivors. Radio frequency signals can be used to keep cockroaches congregated, as well as attached video cameras to survey the area. In theory, the nimbleness and size of cockroaches could really make them the perfect search and rescue tool. With enough cyborgs, a rubble pile could be searched quickly and with no cost of additional human lives. Bozkurt's work has been featured on television multiple times, including The Discovery Channel, CNN, National Geographic, and Reuters.



Call for Abstracts

Genes and Behavior Conference

May 29 and May 30, 2013

The Stanley Stephens Room

3503 Thomas Hall, 9:15 am

As part of the University Global Partnership Network ((UGPN), the Keck Center organizes a conference on "Genes and Behavior" on May 29 and May 30, 2013. The UGPN includes the University of Surrey, UK; North Carolina State University, USA; and the University of São Paulo, Brazil. While these institutions have established bilateral relations for some years, the UGPN is designed to leverage mutual strengths in research and education to broaden collaborative endeavors. This conference will be attended by representatives from the University of Sussex and the University of São Paulo and is designed to showcase potential research areas at NCSU that could result in international collaborations, including international student exchange.

Undergraduate students, graduate students and postdocs are invited to present posters.

Titles and an abstract of 250 words or less must be submitted *no later than April 29* by e-mail to

anholt@ncsu.edu

A limited number of submissions will be selected for an oral presentation.

Participation is not restricted to Keck Center affiliates, but is open to all members of the NCSU community.

Outreach

Carlos Botero Reaches Out at the Life Discovery - Doing Science Conference

Carlos Botero was a keynote speaker at the inaugural meeting of the Life Discovery - Doing Science conference at the University of Minnesota, St. Paul (<http://www.esa.org/ldc/>). The event was co-hosted by the Ecological Society of America, the Society for the Study of Evolution, the Botanical Society of America, and the Society for Economic Botany. Through a series of workshops, discussion panels and targeted presentations, researchers from universities and liberal arts colleges came together with middle and high school teachers with the goal of sharing ideas, resources, and perspectives, while building partnerships and discussing ways to improve science education.

Reaching Out: Urban Ecology in NYC

by Lea Shell and the Your Wild Life team

During March, Your Wild Life researchers headed up to New York City for two weeks to do some urban ecology in the Big Apple. Our purpose: To assess damage from Superstorm Sandy and install equipment and sensors that will allow us to measure the consequences of the storm on urban arthropod communities and ecosystem processes over time. We explored parks and natural spaces across four boroughs, including the street medians.



Some of the most rewarding experiences for me happened when we had conversations with park visitors and those involved with the local park conservancies. We were able to share our excitement about doing urban ecology in a much beloved city. We made some observations about how New Yorkers interact with their environment. Our biggest surprise was that most fell into one of two camps: Camp A - those so used to seeing people do weird things in the medians of their cities that they do not bother to notice; or Camp B - those so in tune with their environment that they notice and ask with burning curiosity about every permit, permission, funding source and ecological impact of our study. No matter the camp, we enjoyed engaging them ALL! We shared our experiences with others through our blog and Twitter - we even scheduled meetings with other interested scientists and bloggers through social networking. We carried and handed out “trading cards” about our projects to interested folks, sparking discussions about our research and citizen science opportunities.



Top: Elsa Youngsteadt on the Long Island Rail Road with the tools of our urban ecology trade: stepladder and litterbags; left: Elsa Youngsteadt on the Long Island Rail Road with the tools of our urban ecology trade: stepladder and litterbags.

Our March trip marked the first of several research trips planned to NYC. On this trip, we were laying the groundwork for future efforts. We installed climate data-loggers to monitor small-scale weather patterns throughout Queens and Manhattan. We also set out litterbags (paper and leaves in a mesh onion

bag, pinned to the soil) in order to see how effective soil arthropods are at breaking down leaf (and regular) litter in the medians and parks. I am excited by all of the interest in our projects in NYC and the connections we made on this trip with other researchers – we cannot wait to learn more about the “other” urban islands, like green roofs and bioswales, to compare insect and microbe success in such unlikely places.



Clint Penick, Mary Jane Epps, Elsa Youngsteadt and Lea Shell grabbing breakfast before a long day in the field.

For more information about our projects: check out our blog at YourWildLife.org and follow us on Twitter @YourWild_Life

Seminars

On Monday, **April 22**, at 1:30 pm, Dr. Michael W. Young from the Laboratory of Genetics at The Rockefeller University will present a seminar titled “Genes Controlling Sleep and Circadian Rhythms in *Drosophila*.”

The seminar will be in 3503 Thomas Hall.

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 Biology, Box 7617, North Carolina State University, Raleigh, NC 27695-7617, tel. (919) 515-1173, anholt@ncsu.edu.

Publications

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

Rangel, J., Keller, J. J. and Tarpy, D. R. (2013) The effects of honey bee (*Apis mellifera* L.) queen reproductive potential on colony growth. *Insectes Sociaux* **60**: 65-73.

Van Engelsdorp, D., Tarpy, D. R., Lengerich, E. J. and Pettis, J. S. (2013). Idiopathic Brood Disease Syndrome and queen events as precursors of colony mortality in migratory beekeeping operations in the Eastern United States. *Prevent. Vet. Med.* **108**: 225-233.

Jacobson, A. L., Booth, W., Vargo, E. L. and Kennedy, G. G. (2013) *Thrips tabaci* population genetic structure and polyploidy in relation to competency as a vector of Tomato spotted wilt virus. *PLoS One* **8**: e54484.

Vargo, E. L., Leniaud, L., Swoboda, L. E., Diamond, S. E., Weiser, M. D., Miller, D. M., and Bagnères, A. -G. (2013) Clinal variation in colony breeding structure and level of inbreeding in the subterranean termites *Reticulitermes flavipes* and *R. grassei*. *Mol. Ecol.* **22**: 1447-1462.

Perdereau, E., Bagnères, A. -G., Bankhead-Dronnet, S., Dupont, S., Zimmermann, M., Vargo, E. L. and Dedeine, F. (2013) Global genetic analysis reveals the putative native source of the invasive termite, *Reticulitermes flavipes*, in France. *Mol. Ecol.* **22**: 1105-1119.

Jacobson, A. L., Johnston, J. S., Rotenberg, D., Whitfield, A. E., Booth, W., Vargo, E. L. and Kennedy, G. G. (2013) Genome size and ploidy of Thysanoptera. *Insect Mol. Biol.* **22**: 12-17.

Uzsák, A. and Schal, C. (2013) Sensory cues involved in social facilitation of reproduction in *Blattella germanica* females. *PLoS One* **8**: e55678.

Böröczky, K., Wada-Katsumata, A., Batchelor, D., Zhukovskaya, M. and Schal, C. (2013) Insects groom their antennae to enhance olfactory acuity. *Proc. Natl. Acad. Sci. USA* **110**: 3615-3620.

Groot, A. T., Staudacher, H., Barthel, A., Inglis, O., Schöfl, G., Santangelo, R. G., Gebauer-Jung, S., Vogel, H., Emerson, J., Schal, C., Heckel, D. G. and Gould, F. (2013) One quantitative trait locus for intra- and interspecific variation in a sex pheromone. *Mol. Ecol.* **22**: 1065-1080.

Wilson, R. H., Lai, C. Q., Lyman, R. F. and Mackay, T. F. C. (2013) Genomic response to selection for postponed senescence in *Drosophila*. *Mech. Ageing Devel.* **134**: 79-88

Of note...

Leyda Lugo-Morales won first place in the 8th Annual Graduate Student Research Symposium of the Pittsburgh Conference on Analytical Chemistry and Spectroscopy in Philadelphia, PA. with her poster presentation entitled "Enzyme-modified carbon fiber microelectrode based on the voltammetric detection of H₂O₂."

Trudy Mackay gave a seminar at the Department of Genetics, University of Georgia, Athens (GA) and was a keynote speaker at a symposium at the Center for Integrated Genomics, University of Iowa, Ames (IA).

Lisa McGraw gave a graduate student invited seminar in the Department of Population Biology, Ecology and Evolution at Emory University, entitled "Uncovering the neurogenomic architecture of social and reproductive behaviors".

Heather Patisaul gave a seminar on neuroendocrine and behavioral consequences of early life exposure to endocrine disruptors at the Department of Biology at the University of Missouri, Columbia (MO).

She also presented a poster at the Joint US EPA and NCSU Interactive Collaboration Forum, titled "Assessing neuroendocrine and behavioral impacts of endocrine disruptors"

Leslie Sombers and her students presented their work at the Pittsburgh Conference on Analytical Chemistry and Spectroscopy in Philadelphia, PA. The group presented posters by **Sombers L. A., Schmidt A. C., Roberts J. G. and McCarty G. S.** on the voltammetric detection and characterization of met-enkephalin in brain tissue in the SEAC Session highlighting Young Investigators and **Schmidt A. C., Roberts J. G., McCarty G. S. and Sombers L. A.** on advancing fast-scan cyclic voltammetry to the detection of neuropeptides and their direct effects on the dopaminergic system. **Qi L., Spanos M. and Sombers L.A.** gave an oral presentation on monitoring the effects of levodopa treatment on dopamine dynamics using fast-scan cyclic voltammetry at carbon-fiber microelectrodes.

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<https://harvest.cals.ncsu.edu/giving/index.cfm?AllocationCodeList=011355>