



# *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 Spooky Halloween!!!!*



## *From the Director*



I am pleased to report that Chancellor Woodson has requested the Board of Trustees of the University of North Carolina on the recommendation of the review team of our September 2014 external review to continue the W. M. Keck Center for Behavioral Biology. The review team provided a number of recommendations, including the need for increased visibility of the Center across the University, the need for succession planning, and the stabilization of the Center's budget. The College of Sciences concluded that the activities of the Center can not be provided by any other unit within the College or the UNC system and recommended continuance of the Center. I am also pleased to report that the College of sciences has pledged stable budgetary support for the Center until July, 2020.

1

*This issue of The Signal contains the Program for the Keck Center's Faculty Research Symposium on December 2.*

*This issue of The Signal contains the traditional Halloween Story.*

# Love and Learn: How Fish Do It.

*by Kaj Hulthén*

On October 13, 2016, the W.M. Keck Center for Behavioral Biology had the pleasure to host Dr. Molly E. Cummings from the Department of integrative Biology at the University of Texas at Austin. Cummings gave a very interesting talk entitled “Are cognition and mating system linked? A comparative behavioral genomics approach with poeciliid fishes”.

In order to shed new light on “the mate choice mind” Cummings presented multiple studies from two fascinating model systems that differ in the mating landscape a female must learn, which she referred to as either ‘complex’ or ‘simple’, respectively. In Northern swordtails (the complex system) males come in multiple and discrete reproductive phenotypes (courtiers, coercers or mixed strategy males) that differ in their attractiveness to females whereas in the Western mosquitofish (the simple system) males rely solely on coercive tactics for mating success.

To investigate neural and molecular processes associated with female choice on alternate phenotypes in the complex Northern swordtail system, Cummings and colleagues combined dichotomous choice trials in a controlled laboratory environment with whole brain gene expression profiling and quantitative PCR to link gene expression to variation in behavior. The study identified differential gene expression patterns while females interacted with males with elaborate courtship behaviors, unattractive males and other females. In addition, the group demonstrated a correlative pattern between some of these genes and individual variation in female preference responses towards males.

Further, and in order to shed light on the localization of the specific brain regions associated with mate preference in this species, Cummings and colleagues also mapped gene expression in 10 different brain regions within the social behavior network (SBN). The study revealed correlations between female preference behavior and gene expression in the medial and lateral zones of the dorsal telencephalon, as well as the medial preoptic area of the brain, key regions considered to control sexual behaviors, reward, learning and multi-sensory processing.



*Dr. Molly Cummings*

Next, Cummings presented the results of a powerful comparative study where she took advantage of the previously mentioned contrasting mating systems of Northern swordtails (courtship) and the Western mosquitofish (coercive). The aim was to explore if three functionally related preference candidate genes exhibit differential expression profiles between these close relatives with contrasting mating systems. Whole brain gene expression patterns revealed that two genes were positively associated with female mate choice in swordtails, but interestingly, this relationship was reversed in the mosquitofish such that these genes were down-regulated in females expressing male biases (nevertheless elevated in association with total activity patterns under asocial conditions). Given the opposing patterns of gene expression and female behavioral responses between two closely related species uncovered in this study, these genes may be key modulators of mate preference behavior and hence act as a substrate for the evolution of mate preference behavior.

Cummings used a wide variety of approaches to uncover the mechanism of mate choice, hence this was just a sample of all the studies she shared with us during this fascinating seminar.

# This is Your Brain on Hormones

by Erin Peterson

On October 13<sup>th</sup>, the Keck Center social evening discussion was led by NCSU's own Dr. John Godwin. His research focuses on animal behavior and sex determination with the ultimate goal of finding genetic factors associated with adaptive behavioral and sexual phenotypes. His talk, "Hormones and the social brain - A 'grand unified theory' of male behavior," was attended by professors and students alike and focused not only on how hormones affect behavior, but also on how they affect brain structure and sexual development.

Beginning with a history lesson on how the study of hormones and sexual differentiation has evolved, Godwin talked about classical experiments that led researchers to look not only for behavioral differences associated with hormones, but also physical differences in both the body and the central nervous system. A pioneering study using guinea pigs showed that treating a pregnant mother with androgens produced hermaphroditic pups. This brought together the idea that hormones were responsible not only for reproduction but also development. This aided in explaining the sterility of freemartin heifers, which occurs when a female calf is born with a male twin. The male will develop normally, but the female is masculinized due to exposure to male hormones *in utero*. Another major experiment linked hormones and sex-specific mating behavior, mounting in males or the lordosis response in females. This experiment showed that male pups, castrated and treated with estrogen, exhibited lordosis, while female pups treated with testosterone would engage in mounting behaviors. These observations led researchers to consider how hormones may induce structural differences in the brain in early development.

With this idea in mind, it was possible to consider the multiple divisions of sex determination and how we bring together distinct aspects to fit what is normally considered to be a binary system. Sexual differentiation is not a single factor trait, but includes genetic sex, gonadal sex, external genitalia, and the brain. With the current political issue of HB2 in North Carolina, this is relevant when we consider how science determines what an individual's "true sex" is and how as scientists, we need to carefully choose the way we relay findings related to sex determination and sex hormone research to the media.

Godwin also spoke of his own research in the blue-head wrasse, a fish species that can undergo sex change as a mature adult. This species, among other fishes, have a more socially controlled mode of sex determination that can lead to unidirectional sex change as mature adults, or even systems that allow for switching back and forth. This flexibility is thought to be due to different developmental trajectories in fish and mammals. While mammals have an "organization" period as embryos, where they are determined to be male or female and then undergo "activation" to sexual maturity as adults, fish appear to skip this organization and then activate fully as adults. This may be in part due to simplified reproductive tissue structures and a less divergent male and female brain structure and expression patterns seen in fish.

While it may seem as though these differences may divide fish and other species, Godwin discussed how levels of hormones and sex responses can be related across organisms, particularly when considering behavioral responses to hormones. For example, the amount of estradiol in the brain has been linked to socio-sexual behaviors in multiple species, including quails, mice, cichlid fishes, and goby fishes. But, this association does not always appear in the same manner or direction. For example, amount of male behavior in quails, which includes pecking aggression, follows an upside down "U" curve in response to the amount of estradiol levels. Both very high and very low amounts of the hormone will lead to less "male-like" behavior. Within fishes, amount of estradiol and male-typical behaviors follows a more linear pattern, but in different species can have opposite effects. For example, in cichlids high amounts of estradiol are associated with dominant male behavior but in goby, low amounts are associated with male dominance.

Thus, there are still questions to be answered in regards of how hormones affect not only behavior but also morphology of the brain. After a night of interesting findings and great discussion, the discussion finished with noting the frequent adjustments of scientific theory. In particular, many of the foundation experiments explaining the relationship of hormones with sex and behavior remain valid, while many pioneering studies have been overturned or shown to be at least partially incorrect.

# Saving and Protecting Wild Cats

by Desiree Unselt



*Left to Right: Colleen Balik-Meisner, Sean Dallachie, Michele Balik-Meisner, Maria Adonay, Yichen Si, Andrea Vogel, Allison Schloop, Khushi Goda, Anna Rogers, JD Pittman, Kim To, Alease Daniel, Kelly Roche, Andrew Goncharov, Ryan Weston, Sneha Mokashi, Toby Quadri, Brent Chen. [Photo by Desiree Unselt]*

On Sunday, October 16, 2016, undergraduate and graduate students from the Genetics Program, the Genomic Sciences Program and the W. M. Keck Center for Behavioral Biology traveled to Pittsboro, North Carolina as a work group to help at the Carolina Tiger Rescue, formerly known as the Carnivore Preservation Trust. Its mission is saving and protecting wild cats in captivity and in the wild. The vision of the Carolina Tiger Rescue is working toward the day when wild cats are not owned by individuals as pets, are not used for entertainment purposes, are not subject of trade, and can prosper in sustainable, native habitats. The organization rescues tigers, lions, cougars, caracals, servals, ocelots and kinkajous. It provides a lifelong sanctuary for the animals, educates the public about the plight of wild cats in captivity and in the wild, conducts non-invasive research to further understand and aid wild cats, and advocates for action to maintain wild cats in sustainable native habitats, or when that is not a viable option, for the respectful, humane treatment of them in captivity. The objective of our visit was to help this non-profit organization maintain part of their

55 acres of land. We were tasked with clearing a road along the parameter, which would allow large vehicles easy access throughout the sanctuary. During our four hours, we were able to clear approximately a quarter of a mile. Then, after donating our time, we were given a tour, which allowed us to see and hear the stories of the wild animals.



## Mechanisms of Aging

by Desiree Unsel



*Cold Spring Harbor Laboratory*

On September 26-30, 2016, I attended the Mechanisms of Aging Meeting at Cold Spring Harbor Laboratory.

A particular talk of interest was by Dr. Linda Partridge from University College London. She discussed the advancements being made from understanding the effects of dietary restriction. Moderate dietary restriction can improve overall health during aging and extend lifespan. Moreover, recent studies have demonstrated that specific nutrients rather than calorie count determine the effects of dietary restriction. These specific nutrients include types of protein and amino acids being consumed. Changes in specific amino acids in the diet can have an effect on growth, reproduction, physiology, health, and longevity.

In *Drosophila*, this was shown by restricting the amount of yeast consumed, their protein source, which led to extended lifespan compared to reducing carbohydrate or total calories, which had a lesser effect. The same effects were seen when reducing rodent dietary protein consumption.

These results led to the conclusion that protein restriction has a greater effect than carbohydrate or fat restriction. Additionally, specific amino acids or their ratio can determine health and aging. Reduction of methionine in *Drosophila* and reduction of methionine or tryptophan in rodents can improve health during aging and increase lifespan.

These findings are elucidating potential targets for improvement in organismal health during aging.

## Graduate Student Professional Development Workshop

by Desiree Unsel



*Aqueduct Conference Center, Chapel Hill*

On October 5-7, 2016, I attended the Thirtieth Annual Graduate Student Professional Development Workshop (GSPDW), where I had the opportunity to meet graduate students from many disciplines at North Carolina State University who are interested in professional development. The goal of this workshop is to provide advanced graduate students with professional skills and experiences beyond those normally obtained during their formal academic training. The workshop is designed to expose graduate student participants to many professional development issues including personnel management, leadership skills, role of personality types, interviewing skills, stress management, ethics, oral scientific communication and interactions with the media. The workshop was held at the rustic Aqueduct Conference Center in Chapel Hill. There were many networking opportunities among graduate students as well as with guest-invited speakers. The main focus of this workshop was to aid in growth and understanding of becoming a successful leader. We discussed personal and professional life integration, understanding and recognizing diversity, and self-discovery. This workshop was invaluable. It helped me build connections with graduate students and well-established individuals in various fields. It also exemplified the resources and support available to me as a graduate student at NCSU.

# Nessie

by Robert Anholt

The rain was coming down hard as McDuff steered his old Audi into the cobble-stoned courtyard of the inn. By the time he jogged across the courtyard and entered the inn he was soaked to the bone. Inside he was greeted with the warm smell of pipe and cigar tobacco and a welcome whiff of whisky. A half dozen men and women sat in maroon leather-padded chairs eating lamb stew or sipping beer and smoking. The dimly lit room had low cross beams and a dark wood-paneled interior. McDuff walked to the fireplace in which sizzling wooden logs were sending thin lines of smoke and occasional sparks into the chimney. Two men were sitting in comfortable chairs. One was overweight with a wiry mustache and rosy cheeks that suggested high blood pressure. He was wearing a Barbour coat and a grey and green-checked flat hat. The other man was thin with deep sunken eyes and a wrinkled forehead. He wore a woolen hat with earflaps and a smudged sweater that had seen better days. Both men were smoking identical pipes and were nursing a glass of Glendronach.

“Mind if I join you?” asked McDuff.

“Suit yerself, laddie,” said the fat man, “Name is Donovan Scully and this here is Walt McGregor.” “James McDuff.”

“You a city boy, aren’t ye, from Glasgow, I presume?” said Walt.

“Yes, I am a student at the University of Glasgow. Quite a drive down here, especially in this weather, bumpy roads and all. Here to work on my doctoral thesis.”

McDuff expected the men would be impressed and ask him what his thesis was about, but they stayed silent and just looked at him intently. A glass of whisky had materialized in front of McDuff and the warmth of the fire had already dried his cloths. He took a sip and waited for one of the men to continue the conversation.

Finally, Donovan asked him “What then brings ye to the shores of Loch Ness?”

McDuff took another sip of the Glendronach and explained “I am here to document the creature of the Loch.”

“You’re daft, laddie,” said Donovan, “There is no creature. It’s a myth. Good for tourism though.” “Incorrect” said McDuff, adopting a professorial tone of voice, “First, every myth has a kernel of historical reality. Second, if the creature had been

sighted only once, long ago, yes, then it would a myth. But there have been many sightings off and on, and although none are individually reliable, their cumulative occurrences suggest the creature exists. Ergo”, he carried on using a term he believed to be intellectual, “one can assume that the creature is very reclusive, probably residing near the north shore of the loch, and seldom appearing above the water surface. Furthermore, since sightings go a long way back, it must reproduce. Thus, there must at all times at least be one male and one female to produce a limited number of offspring. And - here he raised a finger and spoke emphatically to impress upon Donovan and Walt his superior scholarly intellect – that means that the gene pool is small; ergo, a lot of inbreeding.”

“Aye, laddie, that’s us,” said Walt unfazed by McDuff’s lecture.

“How will ye find the creature then?” asked Donovan.

“I brought an underwater acoustic stimulator,” explained McDuff, “Once I am out on the loch I will lower it into the water and crank the frequency up into the supersonic range. That should mobilize the creature and drive it to the surface, where I will video record his appearance with my iPhone. Once I demonstrate the creature’s existence beyond doubt I can study his life cycle, food preferences and the effect of climate change on his habitat.”

“Any climate change will be welcome”, said Walt, listening to the rain pelting against the windows.

“I need a boat,” said McDuff, “I saw a boathouse as I drove along the shore. Is there anyone here who can take me on the loch?”

“Wobble,” said Donovan.

“Wobble?”

“Over there,” he pointed at a man who slouched into a chair in the far corner of the room. He was dressed in an oilskin coat and captain’s hat. He appeared to be asleep.

“Wobble isn’t his real name”, said Walt, “We call him that because that’s what he does when he has a wee bit much to drink.”

McDuff finished his whisky and walked over to Wobble.

“Wobble,” he said. No response.

He shook his shoulder. The man stayed sound asleep.

“Try this,” said Walt who had wandered up behind McDuff. He held his whisky glass under Wobble’s nose. Immediately the man said up, looking around bewildered.

“James McDuff. I need to get on the loch tomorrow for a scientific expedition. I hear you have a boat. Can you take me on the loch?”

As Wobble spoke, a pungent smell of whisky emerged from his mouth.

“Tomorrow is stormy weather. The loch can be deadly.”

With that he closed his eyes and sank back in his chair.

“I will pay you well.”

No response.

“Fifty pounds for the day.”

No response.

“One hundred then.”

Wobble opened one eye, then the other, and glared at McDuff. McDuff smiled. “See you in the morning at 6:00 am at the boathouse.”

“I will be there at 7:00,” said Wobble, “I need me beauty sleep.”

The next morning the rain had intensified and the wind had picked up. After a heavy breakfast with sausages, eggs and haddock, McDuff waited at the boathouse sheltering under its leaking roof. He had all but given up hope that Wobble would remember the previous evening’s conversation or that he would show up, but at 8:00 o’clock Wobble came swaggering down the muddy lane, a pipe in his mouth, oblivious of the water streaming from his hat and coat. The boat was a small rickety wooden vessel, appropriately named “*Sea Snake*”, which was written with faded letters on the bow, and it had a small captain’s cabin, where they could stay out of the rain. Wobble yanked the chain of the outboard motor and after a couple of tries it sputtered to life. He slipped the rope from the mooring and the boat drifted slowly onto the loch, heading north.

As they sailed down the loch, the rain became heavier and the wind stronger. Howling gusts of wind made it impossible for them to communicate, except yelling at the top of their voices close to each other. The surface of the loch became intertwined with the curtain of rain and the boat swirled wildly. Wobble struggled to keep the rudder on a straight course.

“There’s the north shore, laddie,” he yelled, “Now we must go back or the loch will take us down!”

“Five minutes,” yelled McDuff “Help me with the stimulator.”

He held onto the railing, while retrieving the acoustic stimulator from his backpack. He slipped, hit his head against the boards and could barely clamber up as the boat was tossed by the turbulent

waves. Wobble was remarkably steady and managed to pull him up by the elbows. McDuff lowered the instrument in the water, 10 meters, 20 meters, then 50 meters deep. That was as far as it could go. He flipped a switch and watched the digital display as he moved the dial – 100 Herz, 500 Herz, 1000 Herz, 20,000 Herz and from there into the supersonic range. He held onto the rail of the swaying boat and looked intently at the loch. Nothing happened.

“I cannot control the boat!” yelled Wobble with dread in his voice “The motor has died.”

Then it happened.

Suddenly, amidst the heavy downpour, from the surface of the water a large brontosaurus-like creature appeared. It had a long neck and its color was green, but looked nearly black against the dark sky. Scales covered its skin and it had a pointed head with small narrow expressionless eyes. A second later, a similar creature appeared a few feet away.

Wobble stared at the creatures in horror. McDuff was ecstatic. “I knew it!” he yelled. “It’s Nessie and its mate!”

He fumbled in his pocket for his iPhone, but before he could retrieve it, the first creature dove its head with lightning speed into the boat and grabbed Wobble by the scruff of his oilskin coat. Wobble’s scream was muffled by the thundering rain and wind as the creature lifted him off the boat and pulled him under water to the bottom of the loch.

“Wobble!” McDuff shouted.

In the whirling water he saw an object swirling around. It was the captain’s hat.

McDuff panicked. It suddenly dawned on him that he was now alone in a deadly storm on the loch in a small dysfunctional boat at the mercy of two gigantic monsters.

One of the creatures resurfaced, glared at McDuff and dove under again. A second later McDuff saw a smooth muscular tail curl over the stern of the boat. The boat was flung into the air and landed heavily on the roaring water. McDuff was tossed like a ragdoll and hit the deck hard. He landed on his iPhone, which cracked into pieces.

“It’s under the boat,” murmured McDuff. He tried to compose himself and held on to the wet slippery rail.

Again the creature lifted the boat, this time higher. The boat was flung thirty meters in the air and as it crashed into the loch it broke in half and came apart.

That evening Donovan Scully and Walt McGregor were drinking their usual whisky near the fireplace



in the inn. They were worried and waited silently. Wobble and McDuff had not returned. The storm was passing and the rain had fizzled to a drizzle. The wind had calmed.

The next morning a search party was organized. A coast guard chopper flew over the loch. They found him washed up on the north shore, clinging to a wooden plank with the faded letters “*Sea Snake*”. Miraculously, he was alive but in critical condition due to exhaustion and hypothermia. They took him to the inn. A doctor was brought in from a nearby town.

Walt held a glass of Glendronach under McDuff’s nose. He opened his eyes and looked unfocused at the ceiling.

“Do you know where you are?” asked the doctor. No response.

“What month is it?” No response.

“What’s yer name, laddie?”

At this McDuff seemed to focus. He slowly turned his head to the doctor, Walt and Donovan and with a croaking voice muttered “Nessie.”

## Seminars

On **November 10**, 3:30 pm, Dr. Jane Hurst from the Institute of Integrative Biology at the University of Liverpool, UK, will present a seminar, titled “Minding your pees and cues -- Communication through scent.”

The seminar will be in 3503 Thomas Hall.

On **December 2**, 9:00 am - 5:00 pm, the W. M. Keck Center for Behavioral Biology presents a Faculty Research Symposium. Breakfast (8:30 am) and lunch are provided.

The symposium will be in 3503 Thomas Hall.

On **December 8**, 3:30 pm, Dr. Steven Phelps from the University of Texas at Austin will present a seminar, titled “Caught in peculiar positions: Variation in the mechanisms of monogamy.”

The seminar will be in 101 David Clark Laboratories.

## Grants

**David Tarpy** received a three-year \$437,559 grant together with R. McLaughlin and D. Seth Carley from the North Carolina Department of Transportation to study storm water infiltration and pollinator habitat zones along highways.

**Hongmey Li-Byarlay** received a one-year \$10,000 grant from the North American Pollinator Protection Campaign to investigate a new way to combat viruses with RNA-targeting biotechnology in *Apis mellifera*.

**David Tarpy** together with M. Spivak received a one-year \$6,500 grant from the United States Department of Agriculture, North Central Region Sustainable Agriculture Research and Extension (NC-SARE) Partnership Program to study causes of honeybee queen failure in beekeeping operations.

**David Tarpy** received a two-year \$20,000 grant from the Triangle Center for Evolutionary Medicine (TriCEM) to study immunologically structured societies.

**Coby Schal, Ayako Wada-Katsumata** and Jules Silverman received a three-year \$650,000 grant from the National Science Foundation to investigate the neuronal basis of sugar aversions in cockroaches.

## Publications

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## Of note...

**Robert Anholt** served on an NIH study section to review predoctoral and postdoctoral fellowship applications.

At the International Congress of Entomology in Orlando, Florida: **Alexis Barbarin**, **Zach DeVries**, **Michael Fisher**, **Colin Funaro**, **Jeremy Heath**, **Angela Sierras**, **Ayako Wada-Katsumata** and **Coby Schal** presented talks. **Zach DeVries** won first place, and **Colin Funaro** and **Michael Fisher** won second place in their respective sections in the Student Oral Presentation. **Johannah Elsensohn**, **Jennifer Baltzegar**, **Sophia Webster** and **Nicole Gutzman** won the overall best Student Debate. **Zach DeVries** also was awarded the 2016 Lillian and Alex Feir Graduate Student Travel Award in Insect Physiology, Biochemistry, or Molecular Biology, and **Coby Schal** was awarded the Nan-Yao Su Award for Innovation and Creativity in Entomology, both from the Entomological Society of America.

**Jennifer Baltzegar** together with J. Cavin Barnes, **Johanna Elsensohn**, **Nicole Gutzmann**, M. S. Jones, S. King and J. Sudweeks presented a poster on gene drive insects in agriculture at the International Congress of Entomology, Orlando, FL.

**Hongmei Li Byarlay** presented a poster at the IUSSI Breakout Meeting, Orlando, FL: Li-Byarlay, H., M. Simone-Finstrom, M., M. Huang, M. Strand, O. Rueppell, and D. R. Tarpy. (2016). "Oxidative stress in honeybee drones: Increased tolerance instead of repair damage."

**Yang Liu** is a 12 month Visiting Associate Professor in the Schal lab, investigating heliothine moth sex pheromones. Yang is with the Chinese Academy of Agricultural Sciences in Beijing, China.

**Trudy Mackay** was an invited speaker at the Max Planck Symposium of Complex Trait Genetics in Berlin, Germany. She also presented a seminar at Texas A&M University, College Station, TX.

**Yvonne Matos** successfully defended her PhD dissertation on the biology and control of bed bugs and Asian cockroaches.

**Coby Schal** presented a plenary address on "Olfactory and gustatory adaptations in anthropophilic insects" at the International Society of Chemical Ecology meeting in Iguassu Falls, Brazil. Coby also presented a 60 min webinar in Washington D.C. (~600 attendees) for the Healthy Homes program at HUD on cockroach allergens and roach control, and a similar talk at the National Environmental Health Association meeting in San Antonio, Texas. He also presented two symposium talks at the National Conference on Urban Entomology on "Gut bacteria mediate aggregation in the German cockroach" and "The State, Challenges and Opportunities of Funding in Urban Entomology." Coby presented a Science Café at the NC Museum of Natural Sciences – "Got Roaches?" and a short talk at the CALS Stewards of the Future Microbiome symposium.

**David Tarpy** gave invited seminars in the Department of Entomology at the University of California, Davis, and in the EPA-RTP council, Cutting Edge Speaker seminar series. He also presented a symposium talk on sustainability of honeybees through increased genetic diversity at the colony and population levels at the ICE Conference, Orlando FL. His group presented three posters: Strange, J. P., **D. A. Delaney**, **D. R. Tarpy**, and R. R. James, Sixteen novel microsatellite loci for *Megachile rotundata* (Hymenoptera: Megachilidae) and related taxa; **Kietzman, P. M.** and **D. R. Tarpy**. Identification of stop signaling in foraging honeybee (*Apis mellifera* L.) colonies; and, Withrow, J. and **D. R. Tarpy**. Emergency queen selection in honeybees (*Apis mellifera*).

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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 7614, North Carolina State University, Raleigh, NC 27695-7614, tel. (919) 515-1173, [anholt@ncsu.edu](mailto:anholt@ncsu.edu).



December 2, 2016

The Stanley Stephens Room

**8:30 bagels and coffee**

9:00 Welcome – Robert Anholt

**Session I: Moderator Coby Schal**

9:15 Will Kimler

*What would Darwin do? An historical view of evolution & behavior*

9:30 Trudy Mackay

*Quantitative trait genetics*

9:45 Marcé Lorenzen

*Hidden-in-plain-sight: Uncovering Medea*

10:00 John Godwin

*Where the boys are - Biasing sex ratios of invasive mice to save species on islands*

10:15 Lisa McGraw

*Investigating the neurogenetic architecture of individual variation in monogamy*

**10:30 coffee break – group photograph**

**Session II: Moderator Trudy Mackay**

11:00 Brian Langerhans

*Phenotypic determinants of mating success without mate choice*

11:15 Reade Roberts

*A gene, a SNP, two undergraduate classes, several dozen ears and armpits, three hundred and fifty five swabs, six hundred bacterial species, a colony of mosquitoes, and human evolution*

11:30 Russell Borski

*Novel aspects of leptin and glucocorticoid biology in the adaptive stress response of vertebrates*

11:45 Coby Schal

*Translational research on insect semiochemicals*

12:00 David Tarpay

*Caste determination and plasticity of reproductive potential in honey bees*

**12:15 pizza lunch**

**Speakers are invited to a working lunch in 3508 Thomas Hall**

**Session III: Moderator Fred Gould**

1:15 John Meitzen

*Estradiol, biological sex and striatal neurons*

1:30 Helen Huang

*Neural control of artificial limbs*

1:45 Leslie Sombers

*Electroanalytical approaches to monitoring real time chemical signaling in live brain tissue*

2:00 Santosh Mishra

*Role of novel ligands in itch sensation*

2:15 Troy Ghashghaei

*Hedonic olfactory learning is regulated by developmentally defined circuits in the mouse forebrain*

**2:30 tea break**

**Session IV: Moderator John Godwin**

3:00 Heather Patisaul

*The placenta: the new frontier of neuroendocrine disruption?*

3:15 Fred Gould

*Can genes drive safely?*

3:30 David Aylor

*Genetic susceptibilities in diverse mouse populations*

3:45 Michael Cowley

*Maternal/offspring interactions in high fat-exposed mice*

4:00 Robert Anholt

*Functional reconstruction of the evolution of chemoreceptor gene clusters in Drosophila*

4:15 General discussion: *How do we envision the future of the Keck Center?*

5:00 Adjourn

**7:00 speakers are invited for dinner at Château MacAnholt**

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