

# THE OPEN READING FRAME

News and Recent Events from  
the Biology Graduate Program at the University of Kentucky

## Thoughts from the DGS



This 4<sup>th</sup> issue of the *Open Reading Frame* comes at an auspicious time for the Biology Graduate Program. First, the newsletter appears just as a new cohort of students arrives and each begins settling into their graduate careers. I hope everyone will welcome Jeffrey, Sepideh, James, Kinga, Jacob, Kristen, Sandeep, Kayla, and Courtney to our Ph.D. program, Bookie to our thesis Master’s program, and also Tyler, Grant, Steven, Elizibethe, and Charlie, our new non-thesis Master’s students. I’m sure they will all appreciate kind words of advice and help in answering questions about how things are done. I hope they also will look through these pages and aspire to join their peers in contributing to them soon.

The newsletter also is coming out as we begin to discuss in earnest the state of the Biology Graduate Program, leading up to our faculty retreat on the BGP in September. Discussions such as these often tend to focus on negative things. If our goal is to make improvements in the program, then we need to identify what isn’t working so well and seek fixes. We will need to honestly evaluate how things are going and what might need some attention. But, I also urge everyone to have a copy of this newsletter readily available. It is the perfect antidote to negativity as the entries document the many successes of our program. The past 6 months have seen two nationally competitive fellowships, obtained, six grants received, 14 papers published in a diversity of journals, and 26 presentations given at meetings all over the world. These give ample evidence that our students, and by extension the program, are doing much that is great. Moreover, I firmly believe that we will exit the review process with a wiser plan if we maintain a strong focus on how to enhance the things that are going well in addition to fixing things that need it. So, how can we facilitate more of our students gracing these pages in future newsletters? And, are we properly emphasizing accomplishments that are the stepping stones to success after finishing in our program? This newsletter affirms that we are creating many opportunities and our students are capitalizing on them. Let’s figure out how to do more of it.

Dave Westneat,  
Director of Graduate Studies  
Department of Biology

## Getting it done!

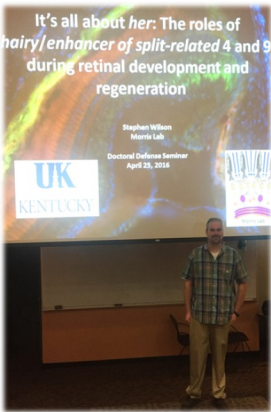
### PhD Defenses

**Zana Rafiq Majeed** (Cooper Lab) defended his thesis on April 8. He is currently an Assistant Professor in the Department of Biology, College of Science, University of Salahaddin, Erbil, Iraq.

**Wen Wen** (Morris Lab) defended her thesis on April 15. She has accepted a postdoc position with Dr. Jia Luo, Department of Pharmacology and Nutritional Sciences, here at UK. Dr. Luo's lab studies the effects of alcohol exposure during embryonic development. She starts in September.



**Stephen Wilson** (Morris Lab) defended April 25. He has accepted a postdoc position with Dr. Dawn Cornelison, Department of Biological Sciences, University of Missouri. Dr. Cornelison's lab studies muscle satellite cell differentiation.



**Masters Degrees**

**Stephanie Bryant** (Smith Lab) Stephanie successfully defended her M.S. She is currently at the University of Louisville.

**Mason Murphy** (Weisrock Lab) Mason defended his thesis and will be starting work on his PhD this fall at Miami University of Ohio.

**Nick Roller** (Rucker Lab) completed his Masters degree and plans to attend Law School.

**Kalen Wright** became our very first graduate of the Biology Plan B Program. She begins medical school at the University of Louisville in August.

**Qualifying Exams**

**Todd Rounsaville** (Arthur Lab) April 1

**Rose Marks** (McLetchie Lab) May 3

**Yuechen Zhu** (Cooper Lab) July 13



**Fellowships**



**Paul Hime** (Weisrock Lab) was awarded the prestigious **Blue Waters Graduate Research Fellowship** from the NSF-funded **National Center for Supercomputing Applications** (NCSA). This award will fund his last year of doctoral work and will provide access to the ridiculously powerful *Blue Waters Petascale Supercomputing Cluster*. Paul says he will use this opportunity to develop new computational approaches to Bayesian phylogenetic inference. Only ten of these fellowships are awarded each year nationwide.



**Megan Rhoads** (Osborn Lab) was awarded an **American Heart Association Pre-doctoral Fellowship**. This two-year award will fund her proposal titled “*Sympathetic Nerve Activity and T-Lymphocytes in Spontaneously Hypertensive Caribbean Vervets.*” This project focuses on how sympathetic activation alters the adaptive immune system in a non-human primate model of spontaneous hypertension. Megan will focus on how T-lymphocyte cytokine secretion and inflammatory cascades are affected by sympathetic nerve activity and how the two systems together may contribute to the development and maintenance of spontaneous hypertension.





Departmental and University Fellowship recipients:

Spring 2016

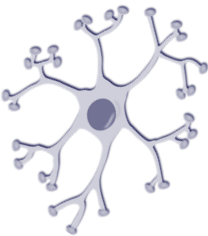
KOF Kara Jones  
LTJ Kim Vertacnik  
LTJ Kat Sasser  
Ribble Scott Hotaling

Fall 2016

GSAY Jacqueline Dillard  
KOF Shishir Biswas  
LTJ Mansi Sethi  
LTJ Kristen LaRue  
LTJ Cagney Coomer

Spring 2017

GSAY Jacqueline Dillard  
GSAY Allison McLaughlin  
KOF Emily Bendall  
LTJ Kat Sasser  
LTJ Megan Weaver

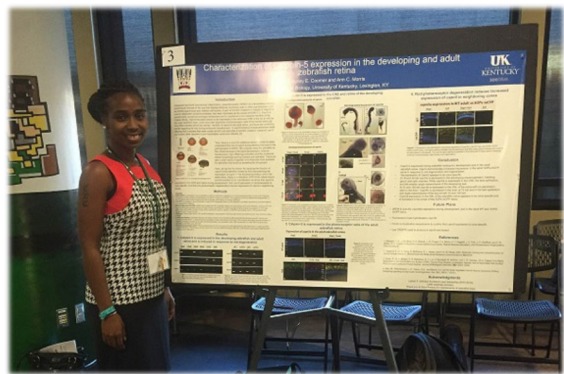


Awards, Grants and Honors

Awards

Shishir Biswas (Seifert Lab) and Brittany Slabach (Crowley Lab) were awarded the College of Arts and Sciences Certificate for Outstanding Teaching. The award recognizes excellence in undergraduate instruction by Teaching Assistants. In addition to this recognition they each received \$500.

Shishir Biswas and Sruthi Purushothaman (Seifert Lab) both received travel awards from the Society for Developmental Biology to attend the 75<sup>th</sup> Annual Society for Developmental Biology Meeting this coming August in Boston and a satellite symposium on the Evolution of Regenerative Abilities. Shishir will present a poster about his transcriptomics work with spiny mice and Sruthi will present results from her work looking at the genetic basis for patterning during salamander limb regeneration.



Cagney Coomer (Morris Lab) recently received a travel award to attend the 2016 NEURAL (National Enhancement of Underrepresented Academic Leaders) Conference at the University of Alabama Birmingham June 22-24. At the conference, she won both an Outstanding Poster Award AND a \$1000 travel award for her "science shark tank" presentation. She is using the new travel award to attend the Gordon Research Conference on Visual System Development in Vermont this coming August.

Megan Rhoads (Osborn Lab) was awarded the American Physiological Society Caroline tum Suden Award for her abstract titled “Alpha and Beta Adrenergic Receptor Expression is Increased in the Renal Medulla of Spontaneously Hypertensive African Green Monkeys.” Megan also received an American Physiological Society Minority Travel Fellowship to attend Experimental Biology 2016 in San Diego, CA.

Jim Shaffer (Gleeson Lab) was awarded first place and a \$250 check for his poster "Prescribed fire impacts on tree seedling growth in a Kentucky Bluegrass Savanna-Woodland remnant® at the KY/TN Joint Prescribed Fire Council Meeting in Ft. Campbell, KY.

Brittany Slabach (Crowley Lab) received a scholarship to attend the 2016 Summer Institute in Statistics and Modeling Infectious Diseases at the University of Washington. The summer institute is an annual event and one of three summer institutes presented by the Department of Biostatistics at the University of Washington. The \$1,800 scholarship provides attendance to three modules, and includes travel cost. Brittany’s goal is to gain a strong foundation in epidemiological models, and to use data parameters from her field data to develop two disease transmission models that will better help manage disease outbreak in wild populations.



## Grants

**Jacqueline Dillard** (Westneat Lab) was awarded an \$18,980 **Doctoral Dissertation Improvement Grant** from the **NSF** to investigate dispersal and paternity patterns in the horned passalus, *Odontotaenius disjunctus*. These funds will go towards investigating whether the general correlation between genetic monogamy and cooperative family formation in animal societies is a consequence of environmental selective pressures that simultaneously favor reduced dispersal and extra-pair mating. Specifically, Jacqueline will assess how resource density, decaying logs in this case, influences mating and dispersal behavior in the horned passalus to determine if increased distance between breeding resources reduces movement of both young adults and potential extra-pair mates.



**Paul Hime** (Weisrock Lab) was awarded \$18,967 for an **NSF Doctoral Dissertation Improvement Grant** (DDIG), entitled "*DISSERTATION RESEARCH: Assessing gene- and site-specific support for deep amphibian relationships across nuclear loci that interact with mitochondria and ribosomes*". This research explores why different regions of the genome may strongly support different evolutionary hypotheses for relationships among the three amphibian orders.

**Scott Hotaling** (Weisrock Lab) was awarded a UW-NPS Research Grant (\$5000) with co-PIs L Tronstad, JJ Giersch, L Zeglin, and D Finn. "A unique 'icy seep' habitat in the high Teton Range: potential refuge for biological assemblages imperiled by climate change".

**Kara Jones** (Weisrock Lab) received the Society of Systematic Biologists Graduate Student Research Award from the Society of Systematic Biologists. This \$1500 grant is to help support further research to unravel the evolutionary history of a diverse salamander clade.

**Rose Marks** (McLetchie Lab) received the **Anderson-Crum Field Research in Bryology Award**, a \$500 grant to support field work in bryology from the **American Bryological and Lichenological Society**.

**Schyler Nunziata** (Weisrock lab) was awarded an \$18,946 **Doctoral Dissertation Improvement Grant** from the National Science Foundation entitled, "*Estimating the genetic and demographic response of an amphibian meta-population to global climate change.*" This research uses genomic approaches to study the conservation, evolution, and ecology of wetland populations. Using salamanders as a study system, the goals are to understand how genetic diversity changes across sub-populations as a result in changes in gene flow, and how these are mediated overall by changes in climate. To achieve these goals, Schyler will generate and analyze genome-wide patterns of genetic variation and develop new models that will be used to project how populations respond to environmental change.

## Honors

Megan Rhoads (Osborn Lab) has been appointed to serve on the **American Physiology Society's Communications Committee** for a 3-year term.

## Presentations and Publications

### Presentations

**Bagley, R.K.** and C.R. Linnen. Evolution 2016. Austin, TX. June 17-21, 2016. Host-associated divergence in a sympatric population of the red-headed pine sawfly (*Neodiprion lecontei*). Her talk focused on the red-headed pine sawfly, *Neodiprion lecontei*, which were collected on three pine tree host plants that differ significantly in their needle architecture. Robin found evidence of ecological divergence between the three host types in female ovipositor (egg-laying organ) morphology, but not larval physiology. Furthermore, these host types are temporally isolated and exhibit partial habitat isolation due to female host avoidance. They do not, however, exhibit sexual isolation. Overall, these data suggest host shifts can cause ecological divergence between host types, but that this divergence may not lead to complete reproductive isolation.



**Emily Bendall and Kim Vertacnik** (Linnen Lab) gave a presentation “Selection on oviposition traits generates reproductive isolation between two pine sawflies” (Emily E. Bendall, Kim Vertacnik, Catherine R. Linnen) at the Evolution Meeting in Austin, TX this June. They examined a pair of sister species of *Neodiprion* pine sawflies differing in host use: *N. pinetum* specializes on a thin-needed host, while *N. lecontei* feeds on thicker, more resinous hosts. They found that these two species have behavioral and morphological oviposition traits that are adaptive to their respective hosts. These oviposition traits cause reduced hybrid fitness and result in reproductive isolation.



**Shishir Biswas** (Seifert Lab) was selected to give an oral presentation at the Molecular and Cellular Basis of Growth and Regeneration, part of the prestigious Keystone Symposia series (*Keystone Symposia: Molecular and Cellular Basis of Growth and Regeneration (A3). January 13, 2016; Breckenridge, CO*). Shishir’s talk, entitled “Comparative transcriptomics between *Acomys cahirinus* and *Mus musculus* reveals insights into genetic control of mammalian regeneration,” described how regeneration and scarring differ at the transcriptomic level using the African spiny mouse (regenerator) and lab mouse (non-regenerator).

**Jacqueline Dillard** (Westneat Lab) presented a paper entitled “Delayed Juvenile Dispersal and Female Promiscuity in a Socially Monogamous, Family Living Beetle.” at the **Entomological Society of America**, North Central Branch Meetings in Cleveland, OH. Jacqueline was awarded a \$200 travel grant from the Entomological Society of America to present her findings on promiscuity and parental care in the horned passalus, *Odontotaenius disjunctus*.

**Paul Hime** (Weisrock Lab) attended the 2016 Evolution Meeting in Austin, TX where he was a teaching assistant for the Society of Systematic Biologists' Phylogenetics Software School, gave a talk, "Phylogenomics of Amphibia and the nature of support and signal in big data sets," and co-authored another talk entitled, | *What the hellbender? SNP-based species delimitation in North America's largest salamander.*"

**Scott Hotaling** (Weisrock Lab) gave a presentation [**Hotaling S**, Giersch JJ, Muhlfeld CC, Ali O, Jordan S, Miller MR, Luikart G, Weisrock DW] entitled “Demographic model testing reveals a history of divergence with gene flow for a glacially-tied stonefly in a changing post-Pleistocene landscape and a meeting of the Society for Freshwater Science. He also presented [Foley ME, **Hotaling S**, Zeglin L, Giersch JJ, Finn DS, Tronstad LM, Muhlfeld CC, Weisrock DW] *Microbial diversity of alpine streams: a North American Perspective* as a poster at the Evolution Society meeting in Austin.

**Kara Jones** (Weisrock Lab) gave a presentation in June at the **2016 Evolution Conference** entitled *Genomic data reveals morphologically distinct salamander “species” are actually phenotypes*. The talk described initial findings that two sympatric salamander species are not actually separate species. The two species were originally described based on differences in morphology, but it turns out that in this case genetic divergence does not match morphological divergence. Instead, their morphological differences represent two distinct phenotypes which are somehow being maintained despite a lack of reproductive isolation.



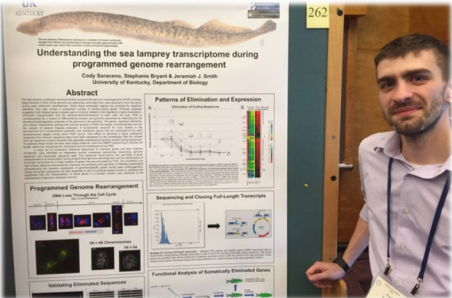
**Melissa Keinath** (Smith Lab) presented a poster entitled, "Characterization of a Large Vertebrate Genome and Sex Chromosomes using Shotgun and Laser Capture Chromosome Sequencing at the "Biology of Genomes" meeting at Cold Spring Harbor Laboratories May10-14. She received a \$200 fellowship to help cover the costs of registration along with the grad school and Ribble funds for travel. Melissa also was invited to give a 15-minute talk entitled "Sequencing Sex Chromosomes and Salamander Genomes" at the Midwest Ecology and Evolution Conference at Miami University in Oxford, OH on March 19, 2016. Her talk was specifically about our efforts to construct a linkage map for the newt, *Notophthalmus viridescens*, our work sequencing and assembling the axolotl genome and individual chromosomes, and what the downstream comparative studies taught us about the evolution of salamander sex chromosomes.

**Cole Malloy, Dlovan Mahmood, Nadera Dabbain, Warlen Piedade and Zana Majeed**, all of the Cooper lab, presented along with a suite of undergraduates, a total of 11 papers at the annual meeting of the Bluegrass Chapter for the Society for Neuroscience. Warlen and Cole won awards for their presentations.

In January, **Rose Marks** (McLetchie Lab) attended a workshop on desiccation tolerance in South Africa to give an invited talk. Her talk was called "*Variation in desiccation tolerance within a species: responses across developmental stages, the sexes, and habitats*". The talk was given at the **1th Annual Workshop on Desiccation Tolerance and Sensitivity Across Life Forms**, Cape Town, South Africa.



**Cody Saraceno** (Smith Lab) presented a poster entitled *Understanding the sea lamprey transcriptome during programmed genome rearrangement* at **Cold Spring Harbor Biology of Genomes Meeting**. During early embryogenesis, the sea lamprey undergoes programmed genome rearrangements resulting in the selective elimination of ~20% of the genome from all future somatic tissues. This deleted fraction contains hundreds of protein-coding genes that play roles in germline development, maintenance of pluripotency, and oncogenesis. Cody’s poster outlined previous work by our lab that characterized the function of some of these genes and their expression during early development, and also laid out a research plan aimed at assaying germline-specific genes for oncogenic potential using a zebrafish model of T-cell acute lymphoblastic leukemia (T-ALL).



**Kim Vertacnik** (Linnen Lab) presented at the **Evolution Conference** June 19-22, 2016 in Austin, TX “*Chemoreceptor gene family evolution in the phytophagous hymenopteran Neodiprion lecontei*.” Her talk emphasized that ecological specialization is an important driver of biodiversity; every life form is in some way a resource specialist. She shared some of her findings about the olfactory (smell) and gustatory (taste) chemoreceptor gene families in the redheaded pine sawfly, *Neodiprion lecontei*, including the number of genes and putative functions. This dataset is part of a larger project where Kim is comparing these gene families in insects that are plant generalists or specialists.

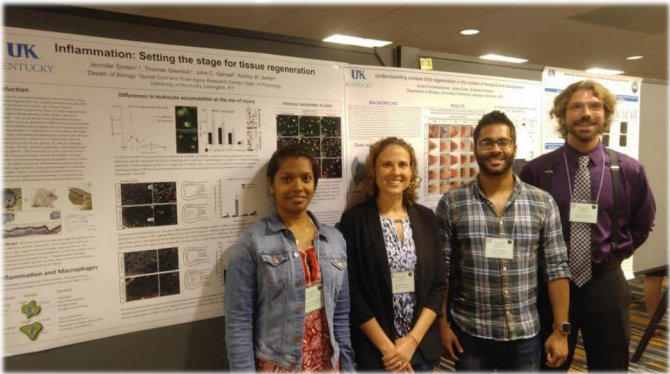
**Publications**

Harper, K.E., **R.K. Bagley**, K.L. Thompson, and C.R. Linnen. *In press*. “Complementary sex determination, inbreeding depression, and inbreeding avoidance in a gregarious sawfly”. *Heredity*.

**Summary:** This paper summarizes the work of undergraduate student turned lab tech, Katie Harper, who investigated the sex determination system and other related traits of the red-headed pine sawfly, *Neodiprion lecontei*. From her work we confirmed that *N. lecontei* has complementary sex determination, where diploid individuals usually develop into females, and haploid individuals into males. Under inbreeding, however, sibling/ matched matings may occur, leading to the creation of diploid males, which have reduced fitness compared to haploid males. As predicted in the case of complementary sex determination, we found that at least some populations of *N. lecontei* display inbreeding avoidance, and prefer to mate with non-siblings over siblings.

Gawriluk, T. R. Simkin, J., Thompson, K.L., **Biswas, S. K.**, Clare-Salzler, Z., Kimani, J.M., Kiama, S.G., Ezenwa V.O., Smith, J.J., and Seifert, A.W. (2016). Comparative analysis of ear-hole closure identifies epimorphic regeneration as a discrete trait in mammals. *Nature Communications* 1:55508 doi: 54.5472/ncomms55508

**Summary:** Shishir conducted transcriptomic analysis for an integrative study comparing regenerative ability across wild and captive rodents. This paper extends work from Dr. Seifert’s group investigating regeneration in African spiny mice. Specifically, this paper demonstrated that spiny mice undergo epimorphic regeneration to replace musculoskeletal tissue. This proves unites regeneration in these special mammals with other vertebrate regenerators such as salamanders, newts and zebrafish.





**Dillard, J. R., & Westneat, D. F.** (2016). Disentangling the Correlated Evolution of Monogamy and Cooperation. *Trends in Ecology & Evolution*, 31(7), 503-513. doi:10.1016/j.tree.2016.03.009

**Summary:** Altruistic societies, such as cooperative breeding and eusociality, are generally believed to evolve most often in ancestrally monogamous lineages because sexual fidelity between parents leads to high relatedness among siblings in cooperative family groups. This paper proposes several novel alternative hypotheses for this observed correlation between genetic monogamy and altruism. We note that cooperation between parents in a pair and cooperation among larger groups of adults are strikingly similar phenomena and are likely driven by similar selective pressures. Biparental cooperation and cooperative breeding also require similar adaptations to sociality that could "pre-adapt" monogamous lineages for more advanced cooperative behavior.

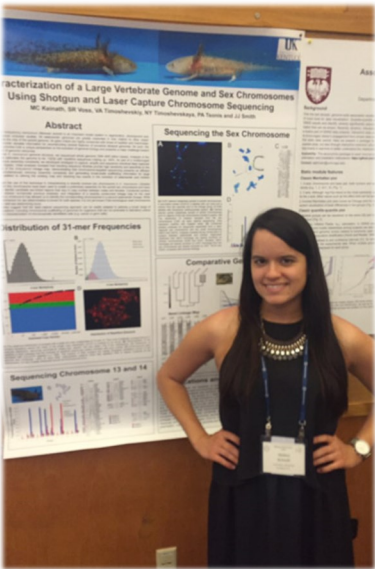
**Hotaling S, Foley M, Lawrence NM, Bocanegra J, Kappeler P, Yoder A, Weisrock DW** (2016) Species discovery and validation in a cryptic radiation of endangered primates: coalescent-based species delimitation in Madagascar's mouse lemurs. *Molecular Ecology*, 25, 2029-2045.



Tronstad LM, **Hotaling S**, Bish JC (2016) An assessment of longitudinal change in stream invertebrate assemblages of Grand Teton National Park, Wyoming. *Insect Conservation and Diversity*, 4, 320-331.

Jordan S, Giersch JJ, Muhlfeld CC, **Hotaling S**, Fanning L, Luikart G. Low genetic diversity and strong subdivision in an endemic alpine stonefly threatened by climate change. *PLoS ONE*, 11, e0157386.

**Hotaling S** (2016) Secrets of Grand Teton National Park. *Drive: The Magazine from Subaru*. ([read online here](#)).



**Keinath M.C., Voss S.R., Tsonis, P.A., Smith, J.J.** A Linkage Map for the Newt *Nothophthalmus viridescens*: Insights in Vertebrate Genome and Chromosome Evolution. *Developmental Biology*. Jun 6, 6450. doi: 54.5450/j.ydbio.6450.49.461

**Summary:** In this paper we introduce a method to rapidly build linkage maps for salamanders, which are known for their enormous genome sizes. We developed a dense meiotic map using RNA isolated from a single wild caught female and 28 of her offspring. The map was also used to reveal chromosome-scale conservation of synteny among the newt, the axolotl and the chicken. Large conserved segments were also identified between the newt and the African clawed frog. Our results shed new light on the ancestral amphibian karyotype and reveal specific events that shape the genomes of three amphibian model taxa and empower comparative studies of vertebrate biology and evolution.

Timoshevskiy, V.A., Herdy, J.R., **Keinath, M.C.**, Smith, J.J. Cellular and Molecular Features of Developmentally Programmed Genome Rearrangement in a Vertebrate (Sea Lamprey: *Petromyzon marinus*). *PLOS Genetics*. <http://dx.doi.org/10.1371/journal.pgen.1006103>

**Summary:** Prior to this paper, little was known regarding the cellular context or mechanism of programmed DNA loss in the sea lamprey. This paper presents analyses and new techniques that reveal several new cellular and molecular aspects of programmed DNA loss, such as the unique migration pattern of eliminated DNA during cell division, the packaging of this DNA in subcellular structures later in the cell cycle, and the epigenetic silencing through DNA and histone methylation. These analyses provide new insights into the mechanisms underlying programmed DNA loss but also suggest a functional link between programmed DNA loss and more conserved gene silencing pathways.

**Majeed, Z.R.,** Abdeljaber, E., Soveland, R., Cornwell, K., Bankemper, A., Koch, F. and Cooper, R.L. (2016). Modulatory action of serotonergic system in behavior and sensory-motor circuit physiology in *Drosophila melanogaster*. Neural Plasticity. Article ID 7291438, 23 pages <http://dx.doi.org/10.1155/2016/7291438> Impact Factor for 3.582 Journal Citation Reports released by Thomson Reuters (ISI) in 2015 .

**Summary:** The fundamental mechanisms of modulating neural circuits in relation to specific physiological actions and behaviors in organisms are an area of current interest for basic research as well as clinical treatments. Neural circuits change in activity by modulators such as serotonin (5-hydroxytryptamine, 5-HT) and this can alter how the central nervous system forms its synaptic connections. In this current study, we further investigated the 5-HT receptor subtypes that mediate the modulatory action of 5-HT in a sensory-CNS-motor circuit. We also used pharmacological as well as optogenetic approaches to modify the activity of the 5-HT pathways during CNS development of fruit flies. Our results demonstrate that dysregulation of 5-HT with either too much or too little 5-HT influences locomotion behavior. We also classified the 5-HT receptor subtypes involved in the neural circuit for locomotion.

**Marks, Rose A.,** Burton, James F., McLetchie, D. Nicholas. 2016 Sex differences and plasticity in dehydration tolerance: insight from a tropical liverwort. *Annals of Botany*. doi:10.1093/aob/mcw102.

**Summary:** This paper is on the topic of desiccation tolerance in *Marchantia infelxa*, and will likely constitute the first experimental chapter of her dissertation. We showed that females tolerate drying better than males, and also that plants grown in dryer habitats are more tolerant to drying.



**Purushothaman S,** Saxena S, Meghah V, Bhatti B, Poruri A, Meena Lakshmi MG, Sarath Babu N, Murthy CL, Mandal KK, Kumar A, Idris MM. Role of Annexin gene and its regulation during zebrafish caudal fin regeneration. *Wound Repair Regen*. 2016 Mar 12, doi: 10.1111/wrr.12429.

**Summary:** This study reveals the role of epigenetic regulatory mechanisms like histone H3 and H4 lysine acetylation and methylation during zebrafish caudal fin regeneration. H3K9,14 acetylation, H4K20 trimethylation, H3K4 trimethylation and H3K9 dimethylation along with their respective regulatory genes, such as GCN5, SETd8b, SETD7/9 and SUV39h1, were differentially regulated in the regenerating fin at various time points of post-amputation. This study reveals the significant upregulation of ANXA2a and ANXA2b transcripts and their protein products during the regeneration process. Chromatin Immunoprecipitation (ChIP) and PCR analysis of the regulatory regions of the ANXA2a and ANXA2b genes demonstrated the ability to repress two histone methylations, H3K27me3 and H4K20me3 in transcriptional regulation during regeneration.

**Zhu,Y.-C.,** Yocom, E., Sifers, J., Uradu, H. and Cooper, R.L. (2016) Modulatory effects on *Drosophila* larva hearts in room temperature, acute and chronic cold stress. *Journal of Comparative Physiology – B*. 2016 May 21. [Epub ahead of print] <http://www.ncbi.nlm.nih.gov/pubmed/27209390> (Impact factor 2.619).



**Summary:** Here we examined how an insect could survive through a cold shock or seasonal change with a cold snap in the weather. We focused on the modulation of physiological functions during cold shock and prolonged cold exposure in the fruit fly. We investigated cardiac function in response to modulators (5-HT-serotonin, Ach-acetylcholine, OA-octopamine, DA-dopamine and a cocktail of modulators) in acute cold shock and chronic cold shock conditions. We also measured by HPLC the levels of 5-HT and OA and found out they decreased in the hemolymph instead of increasing as expected with chronic cold exposure.

**Zhu,Y.-C.,** Uradu, H., **Majeed, Z.R.,** and Cooper, R.L. (2016) Optogenetic stimulation of heart rate at different temperatures and Ca<sup>2+</sup> concentrations. *Physiological Reports*. 4(3):e12695. doi: 10.14814/phy2.12695. (New part of American Physiological Society Press- no impact factor yet determined).**Summary:** Using a relatively new technique, referred to as optogenetics, we were able to excite heart cells with light. We expressed the light sensitive channelrhodopsin protein in larval *Drosophila* hearts and examined light-induced activation of cardiac tissue. This is a novel way to control cardiac function with an intact heart. Using the fruit fly allows us to test a proof of concept potentially possible for mammalian hearts.



# Outreach Efforts

**Robin Bagley** (Linnen Lab) made a visit to the **Glendover Girls Science Club** in April to talk about her work with pine sawflies and what it is like to be a graduate student in the UK Biology Department.

**Kaylynne Glover** (Crowley Lab) gave an evolution with religious context talk at **Dunbar High School** in May.

**Melissa Keinath** (Smith Lab) taught 5 classes at Eminence High School. She covered topics such as programmed genome rearrangement in the sea lamprey, sex determination and sex chromosome evolution.

**Allyssa Kilanowski** (Crowley Lab) volunteered to teach students at Julius Marks Elementary about stream ecology through a hands-on activity.

**Cole Malloy** (Cooper Lab) Presented life science activities at several Kentucky High Schools. “Modulators effect on crayfish fruit fly behaviors” to 3 classes at **Sayre High school** in Lexington and “Optogenetics and Arduino coding” at Pulaski County High School.

**Cole Malloy and YueChen Zhu**, (Cooper Lab) hosted the Biotechnology class from Pulaski High School. They showed them lab activities and gave a tour of campus.

**Megan Rhoades** (Osborn Lab) visited Glendover in March where she talked about the cardiovascular system. The students used ECGs to understand how the heart responds to exercise.

In June, several Biology Graduate Students, **Cole Malloy, YueChen Zhu** (Cooper Lab), **Dlovan D.mahmood, Warlen Pereira Piedade** (Famulski Lab) and **Ren Guerriero** (O’Hara Lab) ran animal behavior and health aspect activities for the Middle School Summer STEM-Blue Camp at UK.

## 4<sup>th</sup> Year Symposium

In April, the 2<sup>nd</sup> annual 4<sup>th</sup> year Graduate symposium was held at the Ecological Research and Education Center. Brittany Slabach, Scott Hotaling, Melissa Keinath, and Brandon Franklin presented their dissertation research to date, and the event was fleshed out by 16 other presenters of short talks, including first year students, post-docs, and 1 faculty member. Thanks to all the BGSA officers for organizing a fantastic day.



## Graduate Student Life Events

**Sruthi Purushothaman and Sandeep Saxena** (Seifert Lab) were married this July. They had a Twin Wedding. The first one was the South Indian Style (left picture) at Kochi , Kerala on the 3rd of July. The second wedding was the North Indian Style (right picture) at Udaipur, Rajasthan on July 13th.





Oh, the Places they Go!



Grand Teton National Park



"YOU'RE OFF TO GREAT PLACES!  
TODAY IS YOUR DAY!  
YOUR MOUNTAIN IS WAITING,  
SO....GET ON YOUR WAY!"

— Dr. Seuss