Faculty Research Interests

Michael Caldwell: I study the ways in which animals use vibrations traveling through surfaces, such as the ground or plant stems, to assess their world. Although we know far less about how animals use vibrations, as opposed to other sensory modalities like vision or hearing, we do know that vibrational information is important in the communication, foraging, and risk assessment behavior of hundreds of thousands of species.
Methods in my lab include the recording and playback of vibrational and sound signals produced by animals, video analysis of behavioral responses to these signals, and the measurement of vibrations as they propagate through body tissues and the environment.
I do not require any previous experience of students wishing to conduct 460 projects in my lab, but do expect a willingness to learn new techniques, including software tools, and a careful attention to detail. While most of my work focuses on vibrational communication in treefrogs, I would be excited to see student projects with a broader range of organisms in my lab.

Véronique Delesalle: **Prerequisite**: a semester doing a complete phage genome annotation in my lab.

Have you ever wondered about the factors that allow a pathogen to jump from one host to another? What makes a pathogen capable of invading lots of hosts or just a few hosts? These are ecological and evolutionary questions and my lab is answering these questions, using bacteriophages, viruses that "eat" bacteria, as the model pathogen. In particular, we want to understand:

- what factors determine a phage's host range (their ability to infect a few versus many bacterial strains, to be specialists versus generalists);
- how phages evolve as they encounter different bacterial strains to infect;
- the relative importance of mutation versus recombination (horizontal gene transfer) in the process of adaptation in phages; and
- the spatial and temporal scales at which these interactions take place (*e.g*., how does the diversity of phages and hosts change along these two dimensions).

We are working with two different bacteriophage systems:
1) the phages of *Bacillus subtilis.* This soil bacterium is one of the best-studied bacterial species and working with this species comes with all the benefits associated with model organisms. We are describing the diversity of phages that can lyse this bacterium, exploring the genetic factors that determine the host range of our phages and conducting experimental evolution studies.
2) the phages of plant pathogens. This work is done in collaboration with Dr. Koskella (UC Berkeley) with our contribution being the genomics/bioinformatic analyses

Rachel Loney (2019) "Does it Matter Who You Eat? Population Dynamics of Wild and Domesticated Bacteriophage on *Bacillus subtilis*"

Natalie Tanke (2017). "Assessing bacteriophage community diversity along an elevational gradient in Death Valley National Park"

Albert Vill (2016) "Comparative genomic analyses of a novel cluster of phages that differentially lyse strains of *Bacillus subtilis."*

Recent publications with student co-authors*:

Roth S.J., G.P. Krukonis, and V.A. Delesalle. Complete Genome Sequence of the *Pantoea* phage AH07. Accepted to Microbiology Resource Announcements October 11th, 2021; MRA 00819-21.

Delesalle, VA, NT Tanke*, AC Vill*, and GP Krukonis. 2016. Testing hypotheses for the presence of tRNA genes in mycobacteriophage genomes. Bacteriophage, 6:3, e1219441.

Peter Fong: My students and I study effects of pollutants on the behavior and physiology of aquatic animals. We work on emerging contaminants such as human pharmaceuticals released from wastewater treatment plants, pesticides, antifouling chemicals, and engineered nanoparticles. Our recent work has focused on the effects of antidepressants on model aquatic organisms like snails, clams, sea anemones, crayfishes, and the tadpole larvae of frogs. I invite enthusiastic students interested in aquatic animals, chemicals, and the environment to work with me.

Recent senior thesis students:

Isabelle Hanna (Spring, 2020). The effect of the antidepressant fluoxetine on bleaching (loss of symbionts) in the sea anemone *Aiptasia pallida.*

Kathleen Paul (Fall, 2017). The effect of antifoulant medetomidine and SSRI sertraline on development, behavior, and pigmentation in African clawed frog tadpoles (*Xenopus laevis*).

Amelia Graham and Marisa Hadley (ES 400 Senior Theses, Spring, 2016). A comparison of the effects of imidacloprid and methoxychlor on Rusty Crayfish (*Orconectes rusticus*) righting response.

Recent publications with student co-authors*:

Fong, P.P., Kelsey E. DiPenta*, Sarahrose M. Jonik*, and Courtney D. Ward*. 2019. Short-term exposure to tricyclic antidepressants delays righting time in marine and freshwater snails with evidence for low-dose stimulation of righting speed by imipramine. *Environmental Science and Pollution Research* 26(8): 7840-7846.

Fong, P.P., *Lambert, O.J., *Hoagland, M.L., and *Kurtz, E.R. 2018. Differential sensitivity to the antifouling chemical medetomidine between wood frog and American toad tadpoles with evidence for low-dose stimulation and high-dose inhibition of metamorphosis. *Environmental Science and Pollution Research* 25(20): 19470-19479.

*Barr, J.M., *Palmucci, J.R., *Lambert, O.J., and Fong, P.P. 2018. Exposure to the antifouling chemical medetomidine slows development, reduces body mass and delays metamorphosis in wood frog (*Lithobates sylvaticus*) tadpoles. *Environmental Science and Pollution Research* 25(11): 10630-10635.

Thompson, L.B. Carfagno, G.L.F., Andresen, K., *Sitton, A.J., *Bury, T.B., *Lee, L.L., *Lerner, K.T., and Fong, P.P. 2017. Differential uptake of gold nanoparticles by two species of tadpole, the wood frog (*Lithobates sylvaticus*) and the bullfrog (*L. catesbeianus*). *Environmental Toxicology & Chemistry* 36(12): 3351-3358.

Kazuo Hiraizumi: My research interest is in the role of genetic variation in adaptive evolutionary changes, population and quantitative genetics of gene regulation, the biochemical characterization of proteinases and peptidases, and neurochemistry and the genetics of mammalian play behavior. Projects involve a number of different techniques and approaches in molecular and cell biology, genetics, biostatistics, and/or neurophysiology.

Connor McLaughlin (2017). "Genetic variation for Dip-B gene expression in *Drosophila melanogaster.*

Chelsea Loughner (2015). "Analysis of Dip-B mRNA isoforms in *Drosophila melanogaster*."

Kelly Burke (2008). "Genetic analysis of late life phenotypes associated with genes on mouse chromosome 1 of a UM-HET3 sibling population."

Matthew Wendler (2006). "Identification of gene that codes for sulochrin oxidase in *Penicillium frequentans*." (Koren Deckman, co-sponsor)

Steven James: My students and I study a novel mechanism governing the integrity of the microtubule cytoskeleton. Microtubules are essential and universal rod-shaped polymers making up the cytoskeleton of all animal, plant, and fungal cells. Microtubules regulate cell architecture, they provide tracks along which cargoes are moved throughout the cell interior, and they form the spindle apparatus that faithfully separates chromosomes during nuclear division, *i.e*., mitosis.

The novel mechanism was revealed by our discovery of a gene, which we have named *wdA*. Mutations in *wdA* disrupt the microtubule cytoskeleton, causing microtubules to become unstable and leading to a lethal "mitotic catastrophe".

Students in my lab use techniques of molecular genetics, genetics, protein biochemistry, bioinformatics, fluorescence microscopy to unravel the function of the novel *wdA* microtubule stabilizer.

Meredith Brown (2021). "Does upregulation of β-tubulin rescue defects in a novel fungal regulator of microtubule stability?"

Rouwaida Nitiema (2021). “Mutations in two genes relieve defects in a novel fungal microtubule-stabilizing protein”

Claire Woodward (2020). “Mutations in the *wdA* regulator of microtubule stability rescues defects in the tubulin assembly pathway”

Katie Watson (2020). “The conserved C-terminus of the novel *wdA* β-propeller protein is nonessential”

Julia Palmucci (2018). “Mitotic catastrophe conferred by defects in a novel β-propeller protein in *Aspergillus nidulans*”

Elliott Rodriguez (2018). “A novel β-propeller protein causes mitotic defects and localizes to the cytoplasm and nucleus in *Aspergillus nidulans”*

Recent publication with student co-authors*:
James SW, Banta T, Barra J*, Ciraku L*, Coile C, Cuda Z, Day R, Dixit C, Eastlack S, Giang A, Goode J, Guice A, Huff Y, Humbert S, Kelliher C*, Kobie J*, Kohlbrenner E*, Mwambutsa F, Orzechowski A*, Shingler K*, Spell C, Anglin SL (2014). Restraint of the G2/M transition by the SR/RRM family mRNA shuttling binding protein SNXAHRB1 in Aspergillus nidulans. *Genetics* 198(2): 617-633.

Ryan Kerney: I am an organismal biologist specializing on the ecology, evolution, and development of amphibians. Current projects include research on the diversity of skeletal development, the formation of “vestigial” structures, symbioses between salamander embryos and green algae, limb development, lung development, and descriptive morphology. While this work is focused on a specific taxonomic group, it touches on many fields within biology.

Check out our lab site for more information: https://sites.google.com/site/kerneylabgc/

Jasper Leavitt (2015). “Examining the initiation of algal cell entry into an embryonic salamander host.”

Kenneth Anderson (2014). “Abundance and establishment of symbiotic bacteria in *Plethodon cinereus*.”

Matthew Spano (2014). “Bone development in metamorphosing *Xenopus tropicalis*.”

Recent publications with student co-authors*:

Burns J, Zhang H*, Hill E*, Kim E, Kerney R (2017). Endosymbiont fermentation and host modulation of immunity and nutrient sensing in a vertebrate-alga endosymbiosis revealed by de novo dual-RNA seq. *eLife.* 2017;6:e22054.

Kerney R, Whatley Z, Rivera S*, Hewitt D. (2017) The prospects of artificial endosymbioses. *American Scientist*. 105: 36–46.

J. Matthew Kittelberger: As a neurobiologist, I am interested in how the anatomy and physiology of nerve cells and circuits of interconnected nerve cells shape the myriad fascinating behaviors and perceptual abilities of animals and humans. Specifically, my own research focuses on the brain circuits involved in vocal communication behaviors in fish and birds (mainly the former). Students interested in working in my lab could be involved in a variety of projects using different techniques to study the anatomy, the neurochemistry, and/or the electrophysiology of these circuits in the context of how fish produce their courtship and territorial songs. Students should expect to spend at least 2 semesters on their project (with one of these ideally occurring over the summer), and should therefore begin planning for this project no later than spring semester of their junior year.

Elizabeth Heisler (2012). "The effects of dopamine antagonists on dopamine- induced inhibition of vocal output of a toadfish, *Poricthys notatus*."

Amanda Miller (2012). "Localization of dopamine receptor distribution in plainfin midshipman fish using fluorescent dopamine ligands."

Alex Allen (2010). "Dopaminergic modulation in midbrain vocal structures of midshipman fish: implications for shaping social behavior."

Geraldine Katherine Hickey (2010). "Differential catecholamine expression in the vocal circuits of male and female midshipman fish: Evidence for a role in context- dependent vocal production?"

Recent publications with student co-authors*:

Goebrecht, GKE*, Kowtoniuk, RA*, Kelly, BG*, & JM Kittelberger. (2014) Sexually- dimorphic expression of tyrosine hydroxylase immunoreactivity in the brain of a vocal teleost fish (*Porichthys notatus*). *Journal of Chemical Neuroanatomy*. 56: 13-34.

Jennifer Powell: Cells experience many different types of stress, including the stress of being attacked by pathogens, endogenous stresses such as the production of toxic metabolites or the accumulation of unfolded proteins, and environmental stresses such as changing temperature or salinity. The Powell lab focuses on how cells recognize stress, respond to stress, and integrate signals from multiple stressors. The tiny nematode *C. elegans* is an outstanding model system to answer these fundamental biological questions using powerful molecular genetic techniques.

The immune response is a special type of cellular stress response to infection by pathogenic microorganisms. Cells must detect the infection so they can respond accordingly. An exciting hypothesis is that cells do so by monitoring for signs of cellular damage that might occur as a result of an infection. One example of damage that does occur is oxidative damage – both from the Reactive Oxygen Species (ROS) produced by pathogens to attack the host cell, and by ROS produced by the host cells to fend off the pathogen. We propose that the host's immune system may also sense the resulting collateral damage as a trigger to activate or reinforce a defense response.

We also study the response to a brief extreme cold exposure. Following cold stress, we discovered that worms face a decision to allocate resources toward repairing the damage or to provide those resources to their offspring. The choice to transfer lipids to their germline is a reproductive strategy called terminal investment because it results in a survival advantage for the resulting progeny if they experience a subsequent severe cold shock, but it comes at the expense of the life of the parent. In addition to dissecting the molecular mechanisms of cold-induced terminal investment, we are studying the combined effect of cold and osmotic shock on *C. elegans*.

San Luc (2020). The conserved G-protein coupled receptor FSHR-1 associates BLI-3-mediated oxidative stress with the innate immune response.

Leah Gulyas (2019). Acute cold stress induces terminal investment in *C. elegans*.

Jennifer Giannini (2018). G-protein coupled receptor FSHR-1 displays interconnected roles in stress response and innate immunity.

Zoe Yeoh (2018). The relationship between *fshr-1* and *skn-1*, two genes involved with the innate immune response in *C. elegans*.

Recent publications with student co-authors*:

Gulyas L* and Powell JR (2019). Predicting the Future: Parental progeny investment in response to environmental stress cues. Frontiers in Cell and Developmental Biology. Jun 19; 7; 115. doi: 10.3389/fcell.2019.00115.

Robinson JD*, Powell JR (2016). Long-term recovery from acute cold shock in *Caenorhabditis elegans*. BMC Cell Biol. Jan 12;17:2. doi: 10.1186/s12860-015-0079-z.

Miller EV*, Grandi LN*, Giannini JA*, Robinson JD*, Powell JR (2015). The conserved G-protein coupled receptor FSHR-1 regulates protective host responses to infection and oxidative stress. PLOS ONE. Sep 11;10(9):e0137403. doi: 10.1371/journal.pone.0137403.

Alex Trillo: I use a combination of methods and variety of organisms to answer questions related to Ecology, Behavior and Evolution. Some of the current projects in the lab are:

1. The influence of eavesdropping bats on mating signal divergence and novel call emergence: We are interested in how eavesdropping predatory bats, such as the frog-eating bat *Trachops cirrhosus*, respond to sounds produced by their prey, and in how selection imposed by these predators interacts with female call preferences to affect the evolution and maintenance of mating calls. It is well known that the evolution of male mating calls is guided by the sexual preferences of females. But just as females more strongly prefer some call types to others, eavesdropping bats are also more strongly attracted to certain calls. This trade-off, between attractiveness to mates on one hand, and attractiveness to predators on the other, has the potential to shape mating call evolution. We are particularly interested in how this can drive the divergence of mating calls across populations and influence emergence of novel call types within a population. Student researchers conduct playback experiments, presenting a variety of acoustic stimuli to bats in flight chambers and in the field. These studies are carried on at the Smithsonian Tropical Research Institute in Panama during the summer.

2. Predator and parasite risk transfer in mixed species frog aggregations: We are interested in how mortality risk due to eavesdropping predators, such as the bat *Trachops cirrhosus,* and parasites, such as the midge *Corethrella spp.* gets transferred from one prey frog species to another in mixed species aggregations. We investigate whether calling near males of another species makes signalers more or less vulnerable to 'eavesdroppers'. We are particularly interested in how these prey species interactions drive calling site choice and calling behavior in mixed choruses of tropical frogs. Student researchers that work in this project conduct playback experiments, presenting a variety of acoustic stimuli to bats in flight chambers and in the field. These studies are carried on at the Smithsonian Tropical Research Institute in Panama during the summer.

3. Pre and post-copulatory sexual selection in insects: Sexually selected traits are often studied one at a time, in isolation from one another, and as if they were the product of a single selective force. In nature, however, multiple sexual traits can interact to affect individual fitness, and multiple selective forces can interact to shape the evolution of a single sexual trait. With these ideas in mind, I simultaneously examine variation in traits used during pre-copulatory processes, such as weapons, and traits used during post-copulatory processes, such as genitalia and testes in insects, such as the tortoise beetle *Acromis sparsa,* to determine how these primary and secondary sexual traits interact to affect male reproductive success.

I am also willing to supervise motivated students interested on conducting research on behavioral ecology and conservation. Students interested in doing research with me should count on spending more than one semester developing and working on their project.

Samantha Siomko (2017). "Odd one out: Is differential predator attention directed toward rare calls in frog mating mixed-choruses?"

Natalie Pitman (2017). "Assessment of the impact of copper (II) chloride on the multimodal predatory response in zebrafish (*Danio rerio*)."

István Urcuyo: My research interests are primarily in the field of Marine Biology and Ecology. Although my current research focuses on the biodiversity of tropical marine invertebrates in Central America, I am also willing to supervise motivated students interested on conducting research on marine environmental problems, marine resources or working away from campus on a marine-related topic. I also have a longstanding interest in cave biology and invertebrate fossils. Students interested in doing research and field work with me should start planning their projects early during their junior year and count on spending two semesters working on their project.

Emily Jankowski (2016). “Effects of thermal stress on nerite grazing activity.”

Jeffrey Romano (2016). “Analyzing the biodiversity of macro invertebrates and abiotic factors in the local p-caves of Franklin County, PA.”

Maria Wanner (2015). “Evaluating the phototaxis of subterranean and surface amphipods.”

Sean Pearson (2014). “Calibration of modern coral climate signals to ensure accuracy of Medieval climate reconstruction in the northeast Caribbean.”

Margaret Buell (2009). "Cytotoxicity of Nicaraguan Opisthobranch species against NIH3T3 mouse fibroblast cells."