Biological Sciences

Western Michigan University

2021 Newsletter

In this Issue:

Western Michigan University
College of Arts and Sciences
Department of Biological Sciences

Dear Friends and Alumni of the Department of Biological Sciences,

Well, it was another challenging year at WMU, yet our students, staff and faculty continue to thrive and although face coverings continue to be required in buildings on campus, our teaching laboratories and lecture halls are back to normal capacities and the majority of our courses are being taught in person.

Our undergraduate programs enroll 651 students and our graduate programs enroll 67 students, including 4 students in our new accelerated master's programs and 19 students in our new MA program. With current enrollments and 21 faculty, we are still among the largest departments at WMU.

Our research laboratories are also back to normal capacities, with students and faculty generating exciting research findings in the field and at the bench. Despite the challenges of operating during a pandemic, we had a number of faculty receive new external grants and currently have over $12.5 million in active grants for the department.

In December 2020, Dr. Rob Eversole retired after 31 years in the department. We wish him well in retirement. In 2021 we also saw the departure of our colleague, Dr. Jian Yao. We will miss Dr. Yao and wish him the best of luck in his new position. We were fortunate to be able to hire Ms. Detra Hervey, a part-time Administrative Assistant shared with the Department of Psychology. Welcome Detra!

With all the changes, there have been many accomplishments (see below) and our faculty, staff and graduate students have gone above and beyond in being flexible to meet everyone's needs. Biological Sciences is a thriving, productive and dynamic department that continues to serve our students and community.

Finally, I want to thank you, our alumni, donors and friends of the department, for your generous support of our students and programs. You have made it possible to give 6 new completion scholarships this fall, helping students finish their degree. We have also given our first Dr. Scott and Mary Hodges Scholarship to a pre-dental student. In all, we gave over $40,000 in student scholarships this last year. Your generosity enhances the teaching and research mission of our department by supporting scholarship and research by our outstanding students. Thank You Very Much!

I hope you enjoy this update from your department. As you read through this newsletter do not hesitate to contact me with any comments you may have concerning our successes and failures, and I would greatly appreciate any suggestions for ways we may improve the service we provide to our students, alumni and friends.

Go Broncos!

John Spitsbergen, Chair
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2021 Distinguished Alumni Achievement Award

Dr. Sridhar Chalasani, MD, FACS, MS

Dr. Sridhar Chalasani, MD, received an MS from the Department of Biological Sciences at Western Michigan University in 1994, working in the laboratory of Dr. Karim Essani.

Dr. Chalasani grew up in England and India and Graduated from Rangaraya Medical College in India. He is board certified in Colon & Rectal Surgery and started practicing Colon and Rectal Surgery in Battle Creek and Kalamazoo in 2002. He has served as the Chair of Surgery Section, as Vice Chief of Medical Staff and Chief of Medical Staff at Bronson Battle Creek Hospital and currently serves as the Director of the Clinical Practice, Digestive Health Clinical Practice Council for the Bronson Medical Group and as Chief of the Unified Medical Staff across the Bronson System.

Dr. Chalasani likes coming to work each day knowing that he will make a positive difference in his patients' lives. This is why he chose the medical field – to help people get better. Dr. Chalasani has a special interest in diverticulitis as well as colon cancer screenings and treatment. He also spends some of his free time educating the community on colon cancer awareness. When not helping patients, Dr. Chalasani enjoys spending time his family and taking photographs.

Welcome to our newly admitted Biological Sciences Graduate Students

Dr. Duncan's Research

By Bethany Khol

Dr. Jeremy Duncan has received an interdisciplinary grant for the purpose of furthering hearing and vision loss research. This grant will allow the purchase of a new confocal microscope for the imaging center here at Western Michigan University. Additionally, this grant will foster a collaboration between nine faculty with research programs aimed at helping elderly patients with hearing and vision loss. The purpose of this grant is to nurture research on the topic across campus—investigating the genetics, molecular biology, and societal influence of hearing and vision loss. The collaboration spans three colleges and several departments in the goal to develop data to be used for future external funding.

The hearing portion of the interdisciplinary grant encompasses three tiers of research. First is the molecular investigations including the work Duncan's lab is doing on the molecular biology of hearing development to inform potential therapies. Second is work with patients with hearing loss. Finally, is investigation into social impact of hearing loss and how sensory loss in the elderly population leads to disability. This collaboration will bring together research to better inform each field what the other fields need to move forward toward better therapies. In Dr. Duncan's words: "The research flows from bench to bedside to society and back."

The new confocal microscope will be up and running by the end of the year. This microscope will be an important asset for the entire WMU research community, and will increase the imaging capacity and speed available to researchers. This microscope is capable of visualizing smaller structures than the previous confocal microscope available to the department. Additionally, the light detectors are more sensitive, allowing them to see faint objects easier. The Duncan lab will be able to make use of this microscope by visualizing mouse tissue to see differences between different genetic mouse strains. The function of genes can be determined by the phenotype and appearance of the tissue.

The research in the Duncan lab is currently focused on two projects. First, is an analysis of the genetic profile of the hearing organ (cochlea) after deafness. Little is currently known about the cells that remain after a person loses their hearing, and how to transform the cells that remain back into cells needed for hearing. Second, is determining the gene regulatory network that drives the development of the neurons that are necessary to transmit hearing information from the inner ear to the brain The lab hopes to use this information to guide regenerative therapies. These projects will also push forward our knowledge of neuronal development and how neurons determine where to grow during development.

The Duncan lab uses qPCR to look at levels of different genes in a tissue. qPCR quantitatively measures the amount of expression of a particular gene in a specific tissue. This technique can be used to compare two different genotypes of mice by measuring what other genes are affected by up regulation or down regulation of a gene of interest. Additionally, fluorescent in situ can be used to visualize gene expression in cells. Histological imaging on the confocal can be used to visualize the effect of gene expression on a tissue. The lab uses mouse as a model organism to determine what genes involved sensory cells in adult and developmental cells. The purpose of these investigations is to eventually use gene therapy to regenerate sensory cells to reverse hearing loss. Studying the development of sensory tissue informs what can be done with adult cells to reverse damage.

Sydney Sheltz-Kempf, PhD Candidate

Dr. Duncan's Research, continued

The lab has a grant from NIH to support this research—funding three PhD students, a lab tech, and 5 undergrads currently contributing to this research. Dr. Duncan says, "I have a fantastic crew of graduate students and lab members. The work has been able to progress rapidly because of the skill and talent of the members of my lab."

Dr. Duncan originally became interested in hearing loss research during his PhD when he joined a lab doing hearing loss research. His original interest was in neuroscience, but quickly found that he enjoyed the topic and had a lot of questions to ask that had not been answered by other people. He stayed with the topic through his post doc and now has continued in his faculty position here at WMU. The research he and his lab does has broader applications to neuroscience as a whole by investigating how sensory cells form, make connections, and are maintained. Additionally, this work has clinical relevance to those with hearing and vestibular disorders and influences therapies for these disorders.

According to Dr. Duncan, the most exciting recent result from his lab was characterizing a histological effect of severe hearing loss that leads to a flat epithelium. The epithelium usually has a 3D shape, but it becomes flat in cases of severe hearing loss. The lab found that these cells don't express the same genes as any cell types in normal hearing ears. The lab can now reliably reproduce this severe hearing loss and can explore how to turn these non-sensory cells back into sensory cells. The future direction of the research in this lab is to use transcription factors delivered by a viral vector to over express certain genes in order to push these flat cells back into being sensory cells.

Overall, the work being done in the Duncan lab is taking exciting directions toward understanding and reversing hearing loss. The collaboration and equipment made possible by the interdisciplinary grant will allow this research to continue to flourish.

Dissecting Microscope

Paige Blinkiewicz, Research Technician

Lizzy Ketchum PhD Candidate, Dr. Jeremy Duncan, Paige Blinkiewicz, Sydney Sheltz-Kempf, PhD Candidate

Dr. Koestler's Research

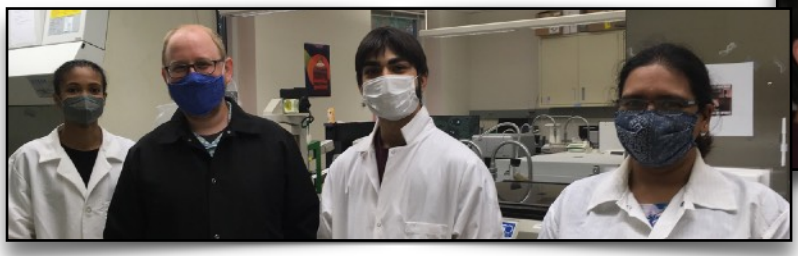
By Bethany Khol

Dr. Benjamin Koestler studies the bacteria *Shigella* at Western Michigan University. He is interested in how relationships between organisms evolve, such as the relationship between a pathogen and its host. Bacteria are good models for these evolutionary relationships because dozens of generations can be studied in a day, to see the evolutionary process on a faster timescale. *Shigella* evolved from commensal *E. coli*, and at some point in history, the beneficial bacteria took a path to become a global pathogen. The Koestler lab is examining this process of how a commensal organism with a positive effect on the host can evolve into a pathogen, which is why *Shigella* is their bacteria of interest. Hundreds of millions of people are infected with *Shigella* each year, which causes over a million deaths. Most of these deaths are children under the age of 5. While *Shigella* is not as big a problem in US, there has been a steep increase in multi-antibiotic resistant strains of *Shigella*. The CDC has labeled it as a priority for study in order to develop new therapies. *Shigella* researchers have access to excellent genetic tools and pathogenesis models, which helps labs like the Koestler lab. The Koestler lab uses these resources to investigate how the bacteria have evolved to recognize specific environments in body to cause disease. They are interested in signaling systems to sense environmental stimuli and communicate with each other.

Recently, the Koestler lab received funding from the National Institute of Allergy and Infectious Disease (NIAID). The goal of the grant is to investigate a novel way bacteria communicate with each other. The typical way bacteria communicate with each other is through quorum sensing. Quorum sensing is when bacteria secrete out small molecules and then sense those same molecules. When a large number of bacteria are present, the amount of that molecule increases to the point of changing gene expression. The novel method of communication used by *Shigella* is similar to quorum sensing, but uses formate, which is a metabolic byproduct, rather than using a signaling molecule.

This method of communication through formate sensing helps regulate virulence genes of *Shigella*. *Shigella* is an intracellular pathogen, which means it enters a host cell, replicates in the cell, consumes nutrients, and secretes formate. The formate then accumulates to the level where the bacteria can sense it, changing gene expression and ending with the replicated bacteria killing the host cell and being released into the body. The Koestler lab is looking into the specific molecular mechanisms used by *Shigella* to sense formate accumulation. The lab will use the grant to fund genetic screening to identify formate binding proteins. They will mix an isotope of formate with *Shigella* proteins to test whether there is binding between formate and the proteins. This data will shed light on whether there are any mutant strains that cannot respond to formate. These mutants will help identify the specific molecular mechanisms used to sense and respond to the formate accumulation that helps the bacteria communicate.

Candice Churaman, Phd Student



Candice Churaman, Dr. Koestler, Syed Daniyal , Ruchi Ojha

Syed Daniyal

Dr. Koestler's Research, continued

Another project currently being worked on in the Koestler lab is studying cyclic di-GMP signaling. Cyclic di-GMP is a signaling molecule that controls biofilm formation, motility, and pathogenesis in bacteria. Because cyclic di-GMP signaling is almost universally conserved, nearly all bacteria use it and have enzymes that make or degrade it. However, while it is well understood as a conserved signaling system, nothing is known about how this system specifically works in *Shigella*. The Koestler lab has just published a new paper that demonstrates that when the *Shigella* enzymes making cyclic di-GMP are mutated, *Shigella* becomes less able to invade host cells or form biofilm, which decreases its pathogenicity. However, these mutations also cause increased resistance to acid shock, which increases *Shigella*'s ability to survive stomach acid. These results suggest that *Shigella* may use cyclic di-GMP signaling to survive in different environments. For example, less cyclic di- GMP signaling is more beneficial in stomach to survive acid, but is less beneficial in the colon when the bacteria is trying to invade host cells.

Both of these projects use organoids to study *Shigella* pathogenesis. Since there is no animal model available that can be used to study *Shigella* infection, *Shigella* researchers rely on tissue culture. Organoids are a form of tissue culture that allows the growth of organ tissue obtained directly from clinical samples, and retains characteristics of those organs. In this case, researchers in the Koestler lab use human intestinal enteroids. These enteroids are formed from partially differentiated stem cells taken from a human colon biopsy. These cells are treated with the appropriate growth factors, allowing them to form mini-guts that contain all the differentiated cell types in a typical human colon. These enteroids allow the Koestler lab to get a detailed look at how *Shigella* interacts with humans in physiologically relevant system.

Candice Churaman & Dr. Koestler

Ruchi Ojha, PhD Student

Right now, the research is at the basic science level, but it has potential for future therapeutic application. Dr. Koester states, "My hope is to someday use this knowledge about how *Shigella* is sensing its environment to find a drug that tricks bacteria into thinking it is somewhere it is not." Biofilms contribute to a bacteria's ability to resist antibiotics because antibiotics can kill cells on the surface of a biofilm, but not in the center. If researchers could develop a drug that tricks bacteria into thinking it was in an area of the body where it doesn't need a biofilm, then antibiotics would be more effective at treating *Shigella* infections.

Dr. Koestler became interested in *Shigella* research as a post-doc studying under Dr. Shelley Payne at the University of Texas at Austin. He sought her out as a mentor because he wanted to learn about bacterial evolution and how bacteria interact with a host from her. He had previously studied cyclic di-GMP signaling in Vibrio cholerae for his PhD at Michigan State University. His post-doc allowed him to combine his interest in cyclic di-GMP with research in *Shigella*, which led to the work he is currently doing here at WMU.

One of the most exciting discoveries recently made in the Koestler lab was finding that cyclic di-GMP signaling can inhibits pathogenesis related phenotypes. This discovery gives direction between the signaling system and behaviors associated with infection. Dr. Koestler expresses his excitement for recent work in his lab. "I love all of our findings. Nothing brings me more joy than when students come to the office with new data." Dr. Koestler gives credit to his lab for the discoveries and data that have recently come out of the lab and that have led to the recent grant. He says, "I've got an incredible group of students who have made some awesome progress, especially in light of what COVID has thrown at us." The lab will continue to investigate the signaling mechanisms and communication methods of *Shigella*. Future directions of the research include figuring out the signaling pathways between cyclic di-GMP production and changes in behavior, and investigating the molecular mechanism that allows *Shigella* to recognize signals like formate.

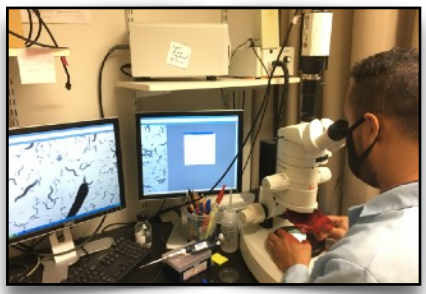
Dr. Hoppe's Research

By Bethany Khol

Muscle development research is a key to improving the lives of those with muscular dystrophy and other muscle disorders. As a part of this effort to understand muscle development, Dr. Pamela Hoppe uses *C. elegans*, a non-parasitic nematode worm, to investigate muscle development in her lab here at Western Michigan University. *C. elegans* muscle structure is similar to cardiac and skeletal muscle in vertebrates. Historically, worm studies have identified proteins that are now studied in other systems due to the similarity in structure. Additionally, many mutations in cardiac myopathies are myosin mutations which can be studied with *C. elegans*.

C. elegans are transparent and about 1mm in length, which makes monitoring their behavior and movement under a microscope simple. Their muscle structure can be viewed under polarized light, which allows the observation of how different genetic conditions affect muscle structure. Dr. Hoppe's lab is investigating the role of myosin A in thick filament assembly during muscle development. Thick filaments are a structure in muscle made up of the protein myosin, which interacts with the actin filaments to contract the muscle. Myosin A is the type of myosin found near the m-lines, which is a protein structure that anchors the thick filaments in muscle cells. Dr. Hoppe's investigations take a closer look at how exactly myosin A interacts with the m-line and how it interacts with other proteins near the m-line, such as UNC-82.

The lab uses genetic techniques and chimera proteins to determine which part of myosin A is responsible for interacting with the protein UNC-82. Previous studies in the lab done by a former grad student led to the hypothesis that UNC-82 may be responsible for allowing myosin A to assemble in a parallel formation. Parallel formation is where the myosin aligns itself so the head of the proteins is always facing one end of the filament while the tail is always facing the other. Typically, myosin A assembles in an anti-parallel formation to allow two thick filaments to assemble anti-parallel at the m-line. These interactions are investigated by creating genetic worm lines that either test the effect of the absence of a particular protein or test chimeric versions of the protein. Chimeric proteins are a mix of two different proteins and allow the investigation of the exact location on a protein that interacts with another protein by switching out different areas of interest with a similar protein that does not fill the same function. In this case, parts of myosin A are swapped for myosin B, which does not interact with UNC-82. Fluorescence imaging is then used to visualize the locations of proteins in these genetic mutants. The distribution of these proteins can then be used to infer the effect of the mutant protein on muscle development at the m-line.



Mohamed Abohajar

One current grad student in the lab, Mohamed Abohajar, is working on another project with UNC-82 kinase. When investigating the effects of a certain UNC-82 mutant on muscle development, the lab stumbled on a particular phenotype where the worms loose muscle mass and waste away due to the mutated UNC-82 protein. This mutant does not have the typical catalytic function that allows it to interact with myosin A. Mohamed is investigating how this mutant can cause muscle mass loss without affecting locomotion since it mimics muscle wasting in humans. So far, it appears that the mutant UNC-82 has a metabolic function separate from its catalytic function in organizing muscle thick filaments. If this proves correct these results may shed light on programed cell death or protein metabolism. Mohamed says that the thing he enjoys most about his project is "finding out how we as humans share similar genes with these animals and how results on these animals can be applied toward larger projects on human muscle diseases like muscle dystrophy."

The future direction of these projects includes trying to understand more about myosin filament assembly and how these filaments are organized with the m-line. Graduate students in the lab are doing work to solve the basic question: How do you build a myosin filament and attach it properly to an organized structure? As Dr. Hoppe said, "These are basic things we don't understand as well as we should," which is why the lab seeks to answer this question. Dr. Hoppe's lab emphasizes thinking about how protein structure affects the molecular biology of a genetic organism, and is a great opportunity for students to learn molecular biology, genetics, and microscopy.

Jacob Mastenbrook, Dr. Pam Hoppe, Bethany Khol

Dr. Beane's Research

By Bethany Khol

Dr. Wendy Beane and her lab here at Western Michigan University study planaria. Planaria are a genus of worms about 1cm in length. They are flat and brownish in color. These worms are known for being able to completely regenerate damaged tissue into functional tissue. They can be cut in half and each half will generate into a whole worm. The Beane lab studies what signaling controls regeneration and tissue growth after injury. They investigate the signals after injury that tell planaria to replace damaged tissue with functional tissue rather than scar tissue. They use RNAi to knock out genes to see the effect on tissue repair and use pharmacological inhibitors to test the effects of blocking certain signals on tissue repair. They use various forms of staining to visualize the effects of inhibitors, activators, and genetic manipulation on gene expression and signaling.

Luke Kinsey, PhD Candidate

Recent investigations have shown that some of these signals can be manipulated by weak magnetic fields, possibly by quantum effects. Quantum effects are sub-atomic interactions. In planaria, exposure to magnetic fields can change the activity of stem cells. Some field strengths increase the activity of stem cells while others inhibit it. To test the effect of magnetic fields, the lab has an enclosure of a specific type of metal that blocks magnetic fields. This box blocks out the environmental magnetic fields so that they can add back a magnetic field of choice through coils inside the box. The main questions of these investigations are whether these effects are occurring quantumly and what exactly is changing in the cell's signaling in response to the magnetic field. The difficulty with this new direction in the lab's research is that the way quantum activity is proved is not the same as the way biological data is tested. To accommodate this challenge, the Beane lab is collaborating with a theoretical physicist to design experiments to answer what exact molecule is being effected by the magnetic field. The research in the lab shows what the effects of magnetic fields are and what changes. The research by the physicist models that data and manipulates different molecules to test what change produces the experimental data.

In addition to the collaboration with the theoretical physicist, the Beane lab is now a part of a Research Coordination Network (RCN). This RCN is a grant for Instrumentation for Quantum Biology (I-QuBio) starting in 2021 and covering 5 years. RCNs do not fund research. Their purpose is to connect people in new, advancing areas that don't have an established community and are aimed at bringing a community of interdisciplinary scientists together. This particular RCN brings together 60 core members of the network from the US, UK, South America, Japan, and many other international regions. This network is led out of UCLA and includes five leaders of different disciplines: two at UCLA, one at WMU (Dr. Beane), one at University of Michigan, and one at Howard University. There are five main Thrusts of the I-QuBio RCN:

1. Microscopic electron and nuclear magnetic resonance methods. (Headed by UCLA)
2. Quantum imaging. (Headed by UCLA)
3. Ultrafast spectroscopy. (Headed by U of M)
4. Biological methods. (Headed by Dr. Beane at WMU)
5. Theory of quantum-enhanced measurement. (Headed by Howard University).

The focus of the RCN grant is the study of subatomic particles and their biological effects. These effects include nanoscale interactions like nuclear spin. Traditionally, most quantum research is done on individual atoms in dry conditions and extreme cold temperatures, but recent research suggests that organisms have the ability to interact with their environment on a quantum level, even though organisms are warm and need moisture. For example: birds who migrate using magneto reception have the ability to sense the magnetic fields to tell them where to go; pigments sense photons on a quantum level during photosynthesis; planaria stem cells respond to magnetic fields. Maybe these effects are more widely spread in biology than a few specialized cells.

Samantha Hack, PhD Student

Dr. Beane's Research - continued

To investigate this question, physicists, chemists, biologists, and engineers are all needed to add their expertise. All these people need to be talking to each other and collaborating. To accomplish this task, the I-QuBio RCN is working to establish a dialogue among experts in these areas. The money from the grant will be used to build conferences for each of the main areas and to promote ways people can connect and start talking to each other. The heads of the five main Thrusts will organize core members in their discipline through conferences and other networking, then connect that discipline to the I-QuBio RCN as a whole. The grant is technically orientated at instrumentation and methods, but the intent is not just to build better instruments. It is to establish a community around quantum biology, so the community can establish what is needed going forward.

Sam and Luke

In addition to the recent establishing of the I-QuBio RCN, Dr. Beane has received a Presidential Innovation Professorship award that provides funding for 3 years, starting in 2021 for the purpose of "Promoting Advances in Quantum Biology Through Interdisciplinary Exchange." She will be using this funding to establish the Quantum Biology Interdisciplinary Trainee Exchange Program (Q-BITE program). This program will primarily be for graduate students and post-docs. It will be patterned after a visiting scientist program—something faculty have access to that trainees do not. Faculty have the ability to take a sabbatical to learn a new disciple or technique, but these opportunities do not currently exist for trainees. Dr. Beane sees a need for interdisciplinary exchanges for graduate students for quantum biology to encourage interdisciplinary cooperation in this area. The funding for first 3 years from this professorship will cover expenses for grad students to be placed in a lab in a new discipline to them. For example, a biology student may spend time in a physics lab or a chemistry student may spend time in Dr. Beane's biology lab.

There will be two kinds of experiences: "a week in the life of" or "two weeks to learn a technique." In the first kind of experience—a week in the life of—students are not expected to learn a specific thing, but will learn how a lab in a different discipline operates and network with people they would not normally interact with. As part of the requirements, the guest student will go to lab meetings and departmental seminars. Additionally, they will give a talk on their work to the department they are visiting and will have an informal round table for that department to ask questions of the guest about their research.

In the second kind of experience—two weeks to learn a technique—the guest student will spend time learning a specific technique that they do not have in their discipline. For example, a physicist may learn RNAi or a biologist may learn how to use an ultra-fast spectrometer. Students in this experience will also have access to lab meetings and departmental seminars to gain experience interacting with scientists in a different discipline.

The professorship will support transportation and housing costs for three years. If stable funding cannot be found at the end of these three years, Dr. Beane will leave the website portal active to continue facilitate communication and collaboration for student exchanges, but individual labs will have to fund the expenses on their own. Hopefully this effort will kick start a long-standing resource for trainees interested in quantum biology. Overall, the two funding sources synergize well. These two collaboration efforts are unique and in the words of Dr. Beane, have the opportunity to "reenergize the field of quantum biology."

The research and collaborations in the Beane lab are an exciting new frontier in quantum biology. Additionally, multiple of her graduate students have recently received nationally competitive opportunities including conferences and awards. Dr. Beane expresses her excitement about the future of her lab and research by saying, "Our lab is nationally competitive. We have cool research going on, grants coming in, and students being successful—but because of COVID we are not able to bring in more people. We are in need of talented, initiative self-starters." The effects of the current pandemic are widespread and heavily impact current research, but despite these limitations, research at WMU —such as in the Beane lab—continues to excel.

Dr. Gill's Research

By Bethany Khol

Dr. Sharon Gill and students in her lab research animal communication at Western Michigan University. Their focus is on the sounds that animals make and how these sounds combine to form a soundscape in the environment. A soundscape is the collection of all the sounds in an environment. These sounds include organismal sounds like bird calls, geophysical sounds like wind and rain, and human sounds like voices or machinery.

Yellow Warbler Nest Building
Photo by Karla Kelly

Research in the Gill lab is currently funded by the National Science Foundation, through a collaborative grant with a professor at University of Illinois Urbana-Champaign. The purpose of the collaborative research is to investigate the cognitive processes underlying the perception of alarm calls of yellow warblers and other species. Yellow warblers are unique among birds in that they produce a specific call that communicates the presence of brown-headed cowbirds—bird parasites that lay eggs in the nests of other species. This call is similar to the way humans speak; just hearing this sound communicates the specific type of threat, much in the same way that words have meaning. The research by the Gill lab is working to understand why this specific call exists, the neurobiology of the signal, how this alarm call is learned, and how the call impacts other behaviors associated with defending nests against this threat to reproductive success. A number of publications have come out recently focusing on exploring how yellow warblers respond to cowbirds and how other species respond to yellow warbler alarm calls.

Four graduate students and a research assistant work on different projects relating to bird songs, calls, and the soundscape. These projects range from studies on individual calls of birds to songs within bird communities to soundscapes as a whole. Masters students Karla Kelly and Katelyn Ray aim to understand alarm calls and different patterns of alarm calling, focusing on yellow warblers and red-winged blackbirds—common species of birds in Michigan that have a widespread distribution. These two species breed in the same habitat, making them good models for how different species interact with and potentially learn about the potential threats from each other's alarm calls—particularly because red-winged blackbirds eavesdrop on the yellow warbler's special call for cowbird threats. Research assistant Eric Branch is analyzing how far alarm calls can be detected in the environment, which helps to understand who might be listening to the calls within the bird community.

Yellow Warbler Nestlings
Photo by Karla Kelly

Research by doctoral candidate Joanna Sblendorio focuses on understanding signal space—a multi-dimensional space that includes the acoustic niches of each species. Animal sounds occur in a complex of other sounds, making signal space an important resource that animals use to communicate with each other, but since different species all use it to communicate, acoustic niches of different species can overlap. This project investigates which species' songs overlap and how different species share that signal space to all communicate effectively.

Masters student Parks Marion also considers the community of sounds and asks how disturbances due to predators and cowbirds affects the entire community of birds. If alarm calls are detected, how does the collective community respond?

Joanna Sblendorio, PhD Candidate

Dr. Gill's Research - continued

Do all species respond to predator sounds such as the calls of a hawk in the same? How does timing and space effect use of the soundscape? Do human noises like cars affect communication in the soundscape? These are all questions being asked and answered by the lab. All the various projects in the Gill lab are well integrated and focus on animal communication, though the scale differs.

All raw data for these integrated projects are collected in field during the summer and analyzed in the lab during the academic year. The researchers use "directional" field microphones to record the songs and calls of target individuals. Other types of recording systems are used to record the whole soundscape and these often remain outside for months at a time capturing diversity of sounds. These recordings generate terabytes of data on sound recording. The lab uses sound analysis programs to extract measurements of sound, such as duration or pitch of the sound, and to calculate acoustic diversity within soundscapes.

To understand why birds use specific sounds, whether songs or calls, the researchers also use playback experiments in the field. In these experiments, songs and calls of particular species are played through speakers to individual birds or bird communities of interest. The reaction of the birds is then observed and quantified to understand the meaning of the signals and their effects on bird species. Some projects individually mark birds to keep track of the ones doing experiments. Recently, the lab has set up trail cameras to capture the behavior of female yellow warblers at nests after they've experienced playbacks of alarm calls.

A variety of sites across Southwest Michigan are used for this field research. Many of the sites used belong to the Southwest Michigan Land Conservancy, but other sites include state parks, WMU property, and—most recently—private property owned by Pfizer.

While it may seem that studying bird songs and calls, and soundscapes is disconnected from human experience, understanding why and how animals do what they do in nature helps us understand our own relationship with nature. What we do in our environment has an effect on nature. Other research performed by the Gill lab compares the behavior of animals in human-disturbed, noisy areas to animal behavior in undisturbed and quiet areas to understand how noise affects communication. Because calls and songs are critical behaviors for reproductive success and survival, noise and environmental change more broadly may affect the persistence of bird populations and species. This research gives a quick snapshot of what is going on with these animals and how rapidly they may change their behavior in response to changes in noise levels. Humans also are negatively affected by elevated noise, not only in terms of learning and health, but also in our enjoyment of nature. And birds are key parts of the experience of nature; losing them and their sounds and calls will change of experiences and connections to nature.

The research being done by Dr. Gill and the members of her lab is an important step towards understanding animal behavior and our interactions with the environment. When asked what she would like people to know about her lab, Dr. Gill replied, "I would like people to know how grateful I am for the students I am working with. It is such a pleasure to work with students and see them develop as scientists and follow their own paths in science."

Blue Winged Warbler
Photo by Joanna Sblendorio

Tree Swallows Mobbing
Photo by Parks Marion

Parks Marion, Master's Student

The majority of faculty members in our department have active funding for their research programs. Included below is a list of current external grants, publication in scientific journals, and presentations by faculty and students at scientific conferences. As you can see, our faculty and students are active in publishing in top scientific journals and in giving presentations at national and international scientific conferences - many were virtual this year. We are convinced that a strong and vibrant research environment enhances our student's educational experience and adds value to a degree from our department.

Current Grant Funding

Todd Barkman (Co-PI, Andre Venter PI)
Title: Mechanisms and Applications of Protein Analysis by Desorption Electrospray Ionization-Mass Spectrometry (DESI-MS)
Source: National Science Foundation

Wendy Beane
Title: Molecular mechanisms regulating neural regeneration in planarians
Source: National Science Foundation CAREER Award

Wendy Beane (co-PI)
Title: RCN: Instrumentation for Quantum Biology (which aims to set up a formal community of interdisciplinary and multi-country researchers in the emerging field of Quantum Biology)
Source: National Science Foundation

Devin Bloom
Title: Systematics and Evolution of Migration in Clupeiformes (Herring, Sardines, Shads, Anchovies and Their Allies)
Source: National Science Foundation, Division of Environmental Biology

Devin Bloom
Title: Ecology of Dam Removals on the Kalamazoo River.
Source: Fisheries and Wildlife Service

Jeremy Duncan
Title: Determining the molecular landscape necessary for hair cell development.
Source: National Institutes of Health (NIDCD)

Jeremy Duncan
Title: 2021 WMU Interdisciplinary Team Excellence Enhancement Grant
Source: Western Michigan University, Office of the President

Sharon Gill (Co-PI Maarten Vonhof)
Title: Examining Impacts of Military Noise on Bird Communication and Singing Behavior
Source: Department of Defense, EQ1 Basic Research Program

Sharon Gill
Title: Referential alarm calling as a window into the mechanisms and evolution of a complex cognitive phenotype.
Source: National Science Foundation

Dave Karowe
Title: Research Experience for Undergraduates (University of Michigan Biological Station)
Source: National Science Foundation

Ben Koestler
PI on NIH Grant with Title: Identifying the formate-sensory mechanism in Shigella flexneri

Cindy Linn
Title: Evidence of BrdU positive neurons in adult mammalian retina after treatment with an alpha7 nAChR agonist
Source: National Institutes of Health, National Eye Institute

Cindy Linn
Title: Neurogenesis and Recovery of Visual Function After Blast Exposure
Source: Department of Defense

Hector Quemada
Title: Support for FNIH Gene Drive research coordination
Source: Foundation for the National Institutes of Health (FNIH) and the Bill and Melinda Gates Foundation

Silvia Rossbach
Grant from Enbridge Energy regarding the project "Characterization of Microorganisms Involved in Hydrocarbon Degradation at a Crude Oil Spill Site".

Dave Rudge, Co-PI (PI Heather Petcovic)
Title: MI STAR
Source: Michigan Technological University

Tiffany Schriever (Co-PI Devin Bloom)
Title: Tracking biodiversity, community assemblage, and gene flow among interdunal wetlands in the Great Lakes
Source: Michigan Sea Grant Core Research

Maarten Vonhof
Title: Field Application of Chitosan to Halt the Progression of White-Nose Syndrome in Bats
Source: National Fish and Wildlife Foundation

Presentations

(Bold = Biological Sciences Faculty, underlined = Biological Sciences Graduate Student, *italicized = Biological Sciences Undergraduate Student)*

Todd Barkman. Evolution of caffeine biosynthesis in flowering plants. Botanical Society of America, 2021.

Wendy Beane. *Using Quantum Phenomena to Control ROS-Mediated Stem Cell Proliferation.* Cell Bio Virtual 2021, the joint meeting of the American Society for Cell Biology (ASCB) and European Molecular Biology Organization (EMBO), (Virtual Talk).

Wendy Beane. *Lessons from Planaria: Separating Wound Healing from Regeneration, and Quantum Control of Stem Cells.* Biomedical Engineering in Regenerative Medicine Seminar, Department of Medical Engineering, WMU Stryker School of Medicine. November 2021, (Virtual Talk).

Wendy Beane. *Using Planaria to Understand Animal Shape.* Grinnell College Stem Cell Biology Seminar, November 2021, (Virtual Talk).

Wendy Beane. *Of Magnetic Fields and Flatworms.* Biophysical Society (BPS) Networking Event: Quantum Biology: what it is and opportunities to collaborate. October 2021, (Virtual Talk).

Wendy Beane. *Controlling Tissue Growth through Quantum Phenomena.* QBBS: Quantum Biology & Biotechnology Symposium 2021, Australia's Commonwealth Scientific and Industrial Research Organization (CSIRO), Virtual Talk.

Wendy Beane. *Radicals and Regeneration: A Quantum Approach to Manipulating Stem Cell Activity*. Leverhulme Quantum Biology Doctoral Training Centre (QB-DTC) Seminar Series, University of Surrey, UK. May 2021, (Virtual Talk).

Wendy Beane. *Quantum Control of Stem Cells*. National Academy of Sciences (NAS): Quantum Concepts for Biological Imaging and Sensing Workshop, session on "Bioelectromagnetic Fields." Virtual Talk.

Wendy Beane. *Manipulating Quantum Spins to Control Stem Cell Activity.* International Big Quantum in Biospins Meeting. Sponsored by UCLA's Quantum Biology Tech (QuBiT) Lab. October 2020, (Virtual Talk).

Hack, Samantha and **Beane, Wendy**. *The planar cell polarity pathway is required to terminate adult neurogenesis in vivo.* Annual Meeting of the Society for Neuroscience (SFN), 2021 (Virtual meeting).

Hack, Samantha and **Beane, Wendy**. *The Terminator: The Planar Cell Polarity Pathway is Back to Halt Tissue Growth.* Annual Meeting of the Society for Developmental Biology (SDB), 2021 (Virtual meeting).

Hack, Samantha and **Beane, Wendy**. *Knowing When to Quit: The Planar Cell Polarity Pathway and Regeneration.* Flatworm Friday Monthly Seminar Series, June 2021 (Virtual talk).

Kinsey LJ, Van Huizen AV, **Beane WS.** *Weak Magnetic Fields: A Quantum Approach to Controlling Stem Cells.* Bioelectromagnetic (BioEM) 2021 Annual Meeting, Ghent, Belgium (Hybrid meeting, Virtual talk).

Kinsey LJ, Van Huizen AV, **Beane WS.** *Manipulation of Stem Cells & Tissue Growth: An approach in the Quantum.* 2021Annual Meeting of the Society for Developmental Biology (SDB), (Virtual meeting).

Kinsey LJ. *Weak Magnetic Fields: A Tool to Manipulate ROS-Mediated Stem Cell Proliferation and Tissue Growth.* Paris Redox 2020 Meeting. Paris, France (Hybrid meeting, Virtual talk).

Van Huizen AV, Kinsey LJ, *Greene JM*, **Beane WS.** *Reactive Oxygen Species Signaling: A Therapeutic Target For Wound Healing And Regeneration.* 2021 Wound Healing Society (WHS) Annual Meeting, (Virtual talk).

Presentations - continued

(Bold = Biological Sciences Faculty, underlined = Biological Sciences Graduate Student, *italicized = Biological Sciences Undergraduate Student)*

Maser, T.L., **Christine Byrd-Jacobs**, A.R. Venter. 2021. Chemical profiling of zebrafish olfactory epithelium regeneration after chemical insult using desorption electrospray ionization mass spectrometry. American Society for Mass Spectrometry Annual Conference.

Ellen Badger Hanson and **Kathryn M. Docherty.** Exploring the Effects of Prairie Restoration Management on Soil Microbial Carbon Storage. Michigan Space Grant Consortium Research Meeting, Calvin University, Grand Rapids, October 2021.

Christian Smith and **Kathryn M. Docherty.** Altitude does not filter airborne bacterial communities implicating local land use change effects surrounding region. Michigan Space Grant Consortium Research Meeting, Calvin University, Grand Rapids, October 2021.

Jacqueline T. Eng and Quanchao Zhang. Investigating the potential impact of climate change on community health: bioarchaeological analysis of Neolithic and Bronze Age samples from Qinghai Province, China. Poster presented (virtually) at the 48th Annual Meeting of the North American Paleopathology Association, April 2021.

Jory Nagel and **Jacqueline T. Eng**. Testing the accuracy and precision of 3D laser scan technology. Poster presented (virtually) at the COD Undergraduate Research Symposium of the 90th Annual Meeting of the American Association of Physical Anthropologists, April 2021.

Ojha, R and **Benjamin Koestler**. "Role of *Shigella flexneri* DGCs in pathogenesis". Midwest Microbial Pathogenesis Conference, September 2021, poster. Michigan State University, East Lansing, Michigan.

Ojha, R and **Benjamin Koestler**. "Characterizing the role of *Shigella flexneri* diguanylate cyclases in pathogenesis. Michigan-American Society of Microbiology, oral, March, 2021. Online conference.

Webster SE, Sklar, NC, Linn DM, Otteson D, **Linn CL**. 2021. Regeneration of retinal neurons using an a7nAChR agonist in adult murine disease models. *ARVO abstract.* Virtual conference.

Linn DM, Spitsbergen JB, Webster SE, **Linn CL**. 2021. Regeneration and functional ERG recovery in a mouse glaucoma model after treatment with an alpha7 nicotinic acetylcholine receptor agonist. *SFN Abstract,* Chicago Ill.

Spitsbergen JB, **Linn CL**. 2021. Neurogenesis and functional recovery of adult retinal neurons in mice using an alpha7 nAChR agonist after blast exposure. *SFN abstract,* Chicago Ill.

Alberto Cintrón-Colón and **John M. Spitsbergen**. Exercise to the Rescue: Effects of Aging and Long-Term Exercise on Structural Plasticity of Motor Neurons and GDNF Expression in Spinal Cord. Annual Kalamazoo Community Medical and Health Sciences Research Day, 2021.

VanGyseghem, Juliana, M. and **John, M. Spitsbergen.** The Effects of Exercise on GDNF and Estrogen Concentration in Male and Female Rats. Annual Meeting of the Society for Neuroscience, 2021.

Alberto Cintrón-Colón, *Jake Fanizza* and **John M. Spitsbergen**. Effects of sedentary aging and exercise on structural plasticity of motor neurons and NMJ structures. Annual Meeting of the Society for Neuroscience, 2021.

Outreach activities

Sharon Gill gave a talk on Artbeat on WMUK discussing her STEM to STEAM initiative

Samantha J. Hack:

- Skype a Scientist: Spring Lake Park Middle School (Minnesota)
- Skype a Scientist: York Early College Academy (NYC)
- Skype a Scientist: Open Roads Elementary School (ON, Canada)

Ellen Badger Hanson. Meet a Scientist: Cells and Microbes. Madison Wohlfert's 7th and 8th grade sciences classes. Lincoln Junior High, Plymouth, IN. February 2021.

Tiffany Schriever gave a talk on Michigan Wildlife for the Ladies' Library Association of Kalamazoo.

Faculty Awards

Wendy Beane was awarded a 2021-24 Presidential Innovation Professorship and the Dr. Darrell R. Latva Biological Sciences Teaching Excellence Award.

Student Grants and Awards

(Bold = Biological Sciences Faculty, underlined = Biological Sciences Graduate Student, *italicized = Biological Sciences Undergraduate Student)*

Graduate Student Awards

Nicole Stewart – Charles River Research Life Science Award – MS level

Josh Paris – Charles River Research Life Science Award – MS level

Alberto Cintron-Colon – Charles River Research Life Science Award – PhD level

Alberto Cintron-Colon - Outstanding Teacher Award from Kalamazoo Valley Community College

Victor de Brito - 2021 Raney Fund Award and Cashner Student Award, American Society of Ichthyologists & Herpetologists

Samantha Hack - selected as a participant in the Frontiers in Stem Cells and Regeneration course at the Marine Biological Laboratory in Woods Hole, MA (a week long hands-on experience with experts from across the country that is very competitive).

Ellen Badger Hanson - Summer Research Fellowship, Kellogg Biological Station

Ellen Badger Hanson and Christian Smith - Michigan Space Grant Consortium award to support their summer 2021 research

Alex Kolstoe - Hazel Wirick Scholarship – Awarded through Kalamazoo Garden Club

Morgan Morin - Society of Wetland Scientists Research Grant, the SWS North Central Chapter Grant, and Society for Freshwater Science General Endowment fund grant

J. Peter Quakenbush - 2021 GCA Award in Tropical Botany

Deon Turner - Sunshine Wong Award and invited to present at the Annual Meeting of the Midwest Association for Toxicology and Therapeutic Drug Monitoring.

Sarah Webster - Distinguished Biological Sciences Graduate Student

Graduate Student Awards - continued

(Bold = Biological Sciences Faculty, underlined = Biological Sciences Graduate Student, *italicized = Biological Sciences Undergraduate Student)*

Graduate College Student Research Grant
Adam Austin
Parks Marion
Morgan Morin
J. Peter Quakenbush
John Rozofsky
Nicolette Sexton

Graduate College Research Presentation
Jake Spitsbergen - 2nd Place
Makayla Long - 3rd Place
Alberto Cintron-Colon - Honorable Mention
Ruchi Ojha - Honorable Mention

Virtual Conference Grant:
Alana Van Huizen

Biological Sciences Travel Fellowship
Alberto Cintron-Colon
Samantha Hack
Ellen Badger Hanson
Nicolette Sexton
Julianna VanGyseghem

Department Nomination for Graduate Research and Creative Scholar Awards - WMU-Graduate College
Halle Nienhaus – Masters Student Teaching Award
Makayla Long – Accelerated Masters Student Teaching Award
Zach Whitacre - Masters Student Research Award
Lindsey Dehaan – Accelerated Masters Student Research Award
Luke Kinsey - Ph.D. Student Teaching Award
Alberto Cintron-Colon - Ph.D. Student Research Award

Other Student Awards

Caroline Wolf - Presidential Scholar in Biological Sciences
Tashifa Fayyaz - Distinguished Senior in Biomedical Sciences
Grace Filpi - Merrill Wiseman Award in Microbiology
Megan Nippa- Distinguished Senior in Biology
Lee Honors College Research and Creative Support Scholarship
Laura Otto - Hazel Wirick Scholarship – Awarded through Kalamazoo Garden Club
Hope Welter- Distinguished Pre-Professional in Biological Sciences
Charles River Outstanding Undergraduate Research Award
Cami Dubois - Colin J. Gould Memorial Scholarship
Grace Filpi - Frank Hinds Zoology Award
Clay Lewis (mentor **Todd Barkman**) was awarded an Environment Research Grant for 2021 from Pierce Cedar Creek Institute
Carly Magiera-Pullen – Dr. Scott and Mary Hodges Scholarship (pre-Dental)
Cora Paul - Margaret Thomas Du Mond Award
Katherine Opria and Alyssa Park, two Kalamazoo Area Math and Science Center students in **Yan Lu**'s lab, won the first place for Best Group Project at the Southwest Michigan Science and Engineering Fair. Katherine and Alyssa worked on a research project entitled "Public Perception and Accuracy of GMO (Genetically Modified Organisms) Labels in the Southwest Michigan Area".

Student Awards - Continued

(Bold = Biological Sciences Faculty, underlined = Biological Sciences Graduate Student, *italicized = Biological Sciences Undergraduate Student)*

Other Student Awards (Continued)

Biological Sciences Completion Scholarships - helping undergraduates finish their degree
Allana Cummings
Kevin Dorsey
Altemme' Bjorlie
Darrian Payne
Myesha Underwood
Isaac Shaw

Emergency Funding
One student

Funding to help cover Enrollment Fees
38 Graduate Students on a Biology assistantship in Fall 2021 semester
36 Graduate Students on a Biology assistantship in Spring 2022 semester

Papers

(Bold = Biological Sciences Faculty, underlined = Biological Sciences Graduate Student, *italicized = Biological Sciences Undergraduate Student)*

O'Donnell, A. J., R. Huang, *J. Barboline* and **Barkman, T. J.**. 2021. Convergent biochemical pathways for xanthine alkaloid production in plants evolved from ancestral enzymes with different catalytic properties. Molecular Biology and Evolution. In press (online at https://academic.oup.com/mbe/advance-articles).

Hack SJ†, Kinsey LJ†, **Beane WS.** (2021) An Open Question: Is Non-Ionizing Radiation a Tool for Controlling Apoptosis-Induced Proliferation? *Int. J. Mol. Sci.* 2021, 22, 11159. https://doi.org/10.3390/ijms222011159 †Contributed equally.

Calvo-Ochoa, E., **Byrd-Jacobs, C.A.** & Fuss, S.H. Diving into the streams and waves of constitutive and regenerative olfactory neurogenesis: insights from zebrafish. Cell Tissue Res (2020). https://doi.org/10.1007/s00441-020-03334-2

Piller, K.R., **Bloom, D.D.**, Lyons, J., Mercado-Silva, N. 2020. Systematics and taxonomy of Chapalichthys (Cyprinodontiformes: Goodeidae), a small genus of live-bearers from central Mexico. *Copeia*. 108 (4): 1004-1011.

Armbruster, J., Lujan, N., **Bloom, D.D.** 2021. Redescription of the Guiana Shield darter species Characidium crandellii and C. declivirostre (Crenuchidae) with descriptions of two new species. Ichthyology & Herpetology.109 (1): 102-122.

Spring, A. Domingue, K., Kerber, T., Mooney, M., Hale, R., Lemmer, K., **Docherty, K.M.**. (2021) Land use effects on airborne bacterial communities are evident in both near-surface and higher-altitude air. Diversity (Accepted Feb 15, 2021).

Yang, Y., Gao, Y., Ding, J., Yuan, M., Chiariello, N., **Docherty, K.M.**, Field, C., Gu, B., Qi, Q., Gutknecht, J., Hungate, B., Roux,X., Niboyet, A., Shi, Z., Gao, Q., and Zhou, J.,(2021) Long-term warming in a Mediterranean-type grassland affects soil bacterial functional potential but not bacterial taxonomic composition. npj Biofilms and Microbiomes. Accepted 1/7/21

Papers - Continued

(Bold = Biological Sciences Faculty, underlined = Biological Sciences Graduate Student, *italicized = Biological Sciences Undergraduate Student)*

Duncan J.S., Sheltz-Kempf S.N., Elliott K.L., (2021) Morphological and Molecular Ontogeny of the Auditory System, Evolution of Neurosensory Cells and Systems, CRC Press.

Eng J.T. & Aldenderfer M. (2021). Interdisciplinary approaches to reconstructing early population history in the high Himalayas of Nepal. Bioarchaeology International, 4(2), 130-149. https://doi.org/10.5744/bi.2020.1068
Berger, E., Brunson, K., Kaufman, B., Lee, G.-A., Lui, X., Seblliaud, P., Storozum, M., Barton, L.,

Eng, J.T., Feinman, G., Flad, R., Garvie-Lok, S., Hrivnyak, M., Lander, B., Merrett, D. C., & Ye, W. (in press). Human adaptation to Holocene environments: perspectives and promise from China. Journal of Anthropological Archaeology. https://doi.org/10.1016/j.jaa.2021.101326

Kana, S. and **Essani, K**. Immuno-oncolytic viruses: Emerging options in the treatment of colorectal cancer. Molecular Diagnosis & Therapy (accepted for publication 2021)

Gill, S.A., Grabarczyk E.E., & D. Potvin. 2021. Human impacts on avian communication. In: D. Proppe (ed). Songbird Behavior and Conservation in the Anthropocene, CRC Press.

Lawson, S.L., J. K. Enos, N. C. Mendes, **Gill**, **S.A.** & M.E. Hauber. 2021. Pairing status moderates both the production of and responses to anti-parasitic referential alarm calls in male yellow warblers. Ethology (accepted).

Lawson SL, Enos JK, Antonson ND, **Gill S.A.**, Hauber ME. 2021. Do hosts of avian brood parasites discriminate parasitic vs. predatory threats? A meta-analysis. Advances in the Study of Behavior. 53:63-95 10.1016/bs.asb.2021.03.002

Lawson SL, Enos JK, **Gill S.A.**, Hauber ME. 2021 Eavesdropping on referential Yellow Warbler alarm calls by Red-winged Blackbirds is mediated by brood parasitism risk. Frontiers in Ecology and Evolution (in press).

Lawson SL, Enos JK, *Wolf CS*, Stenstrom K, Winnicki, SK, Benson TJ, Hauber ME, **Gill, S.A.** 2021 Referential alarm calling elicits future vigilance in the host of an avian brood parasite. Biology Letters, 20210377. https://doi.org/10.1098/rsbl.2021.0377 (Caroline Wolf, who graduated a year ago and who was our Presidential Scholar, is an author on the last paper).

Thomas Groves and **Jellies, J.** Spectral Responses Across a Dorsal-Ventral Array of Dermal Sensilla in the Medicinal Leech. Journal of Comparative Physiology A, 2021 https://doi.org/10.1007/s00359-021-01508-z

Ojha, R., *Dittmar, A. A.*, Severin, G.B., and **Koestler, B.J.** "*Shigella flexneri* Diguanylate Cyclases Regulate Virulence." Accepted for publication, Journal of Bacteriology.
* Selected by editor as a Spotlight Article.

Paris J, Sklar N, **Linn C.L.**, 2021. BrdU positive cells induced in a genetics mouse model of glaucoma. J. Ophthalmology and Visual Science. 6(1): 1046.

Sarah E. Webster, Nathan C. Sklar, Jake B. Spitsbergen, Megan L Stanchfield, Mark K. Webster, David M. Linn, Deborah C. Otteson and **Linn, C.L.** Stimulation of alpha7 nAChR leads to regeneration of damaged neurons in adult mammalian retinal disease models. *Exp. Eye Res*. 201: 108717.

Lu Y, Liu L-N, Roston RL, Soll J, Gao H (2020) Editorial: Structure and Function of Chloroplasts - Volume II. Front Plant Sci 11: 620152

Satyanarayan MB, Zhao J, Zhang J*, Yu F, **Lu Y** (2021) Functional relationships of three NFU proteins in the biogenesis of chloroplastic iron-sulfur clusters. Plant Direct 5: e00303 (*Jessica Zhang KAMSC)

Anderson SA, Satyanarayan MB, Wessendorf RL, **Lu Y**, Fernandez DE (2021) A homolog of Guided Entry of Tail-anchored proteins3 functions in membrane-specific protein targeting in chloroplasts of Arabidopsis. Plant Cell. Accepted

Papers Continued

Li T, Yang H, **Lu Y**, Dong Q, Liu G, Chen F, Zhou Y (2021) Comparative transcriptome analysis of differentially expressed genes related to the physiological changes of yellow-green leaf mutant of maize. PeerJ 9: e10567

Carol L. Beaver, Estella A Atekwana, Barbara A Bekins, Dimitrios Ntarlagiannis, Lee D Slater, **Rossbach, S**. Methanogens and their Syntrophic Partners Dominate Zones of Enhanced Magnetic Susceptibility at a Petroleum Contaminated Site. Frontiers in Earth Science, section Geomagnetism and Paleomagnetism (accepted 02-23-2021)

Dai, P., Williams, C.T., Witucki, A. & **Rudge, D.W.** Rosalind Franklin and the Discovery of the Structure of DNA: Using Historical Narratives to Help Students Understand Nature of Science.

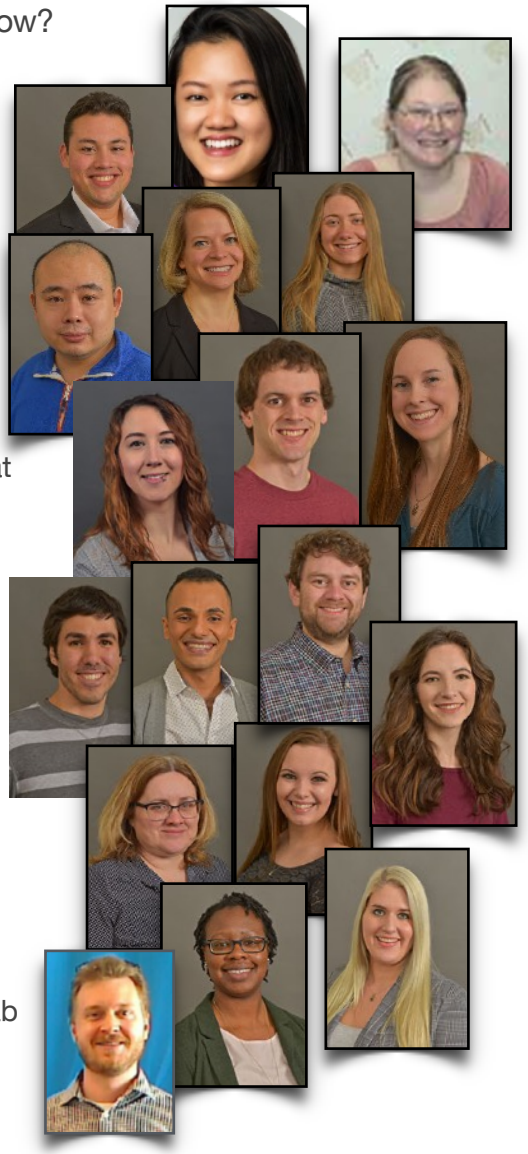
Alberto F. Cintrón-Colón, Gabriel Almeida-Alves, Juliana VanGyseghem, **Spitsbergen, J.M.**. GDNF to the rescue: potential treatment for peripheral nerve injuries. Neural Regeneration Research (accepted for publication 02/04/2021).

Honoring Recent Graduates

The following students graduated since Summer 2020. Where are they now?

Masters graduates

Mamoon Ali - Research Scientist at University of Pennsylvania
Nassr Alnemer
Carol Beaver - Laboratory supervisor at WMU, en route to a PhD at WMU
Jacob Blanchard - Lecturer and Research Fellow, Biology
Ave Maria University
Jennifer Brenneman
Troy Burtchett - en route to a PhD at Michigan State University
Alberto Cintron-Colon, en route to a PhD at WMU
Nicole Dubs - Research scientist at Vestaron
Thomas Groves - en route to a PhD in Bio Sci at WMU, Affiliate instructor at GVSU, Director of IACUC at Hope College
Pornkamol Huang - working at Forensic Fluids Labs
Amy Janik
Sadia Kana - en route to a PhD at Dartsmouth College
Zakiya Kelley - Research technologist at St. Jude.
Elizabeth Ketchum - en route to a PhD at WMU
Luke Kinsey - en route to a PhD in Bio Sci at WMU
Albert Lam - at Albany Molecular Research Inc. in Buffalo, NY doing protein biochemistry
Danielle Linihan - Working at Charles River Laboratories
Emily Manzon - gene editing at Precision BioSciences in Durham, NC.
Jeffrey Minehart - Medical Scribe for iScribeMD
Halle Nienhaus - Fisheries Field Crew Lead at U.S. Geological Survey in Bozeman, Montana
Joshua Paris - Instructor at Kalamazoo Valley Community College
Ari Pollard - Working at Charles River Laboratories
Michelle Ray - Working at Homer Stryker School of Medicine - Rothstein Lab
Sydney Sheltz-Kempf - en route to a PhD in Bio Sci at WMU



Masters graduates - continued

Megan Stanchfield - en route to a PhD at Vanderbilt
Nicole Stewart - Wetland Scientist/Ecologist at Fishbeck
Zach Stoner - working at Charles River
Deon Turner - Working in Toxicology associated with the Coroner's Office at Homer Stryker School of Medicine.
Aaron Wenger - en route to a PhD in Science Ed at WMU
Zachary Whitacre - Working at Kalamazoo Nature Center
Sarah Woods

Accelerated Masters graduates

Allison Deemter - Biology instructor at KalamazooValley Community College and Neuropathology Researcher for Homer Stryker School of Medicine
Paige Blinkiewicz - research associate at WMU
Lindsey DeHaan - en route to a PhD in Earth and Environmental Sciences at the University of Michigan
Makayla Long - COVID Lab Technician, applying to med school in spring 2022.

PhD graduates

Sarah Almuhanna - Faculty at Clinical Laboratory Sciences in Saudi Arabia
Gabriel Almeida Alves - Laboratory supervisor for the Healthcare Labs run by the Little River Band of Ottawa
Tatiana Petrachkova - Research scientist in Ukraine
Alanna Van Huizen - Postdoctoral Fellow at St. Jude Children's Research Hospital in Memphis TN.
Suzanne Var - PNI Postdoctoral Fellow at University of Minnesota Twin Cities
Sarah Webster - Postdoctoral Fellow at Homer Stryker School of Medicine

Interested in supporting the work of our faculty and students?

We appreciate your financial investment. We started new funds in early 2020 that help fund student research, helping purchase lab supplies and equipment. These are not endowments and 100% of each contribution will benefit students immediately.

Our alumni and friends come from far and wide. Not all can do something to support the department. But if you can invest in our work with a donation, it will benefit someone's future. They will remember how their future in the sciences was made financially possible.

Please visit our website to learn more about how you can help. (https://wmich.edu/biology/giving)

Thank you!