



Recent Zoology Highlights and Accomplishments

Greetings to all friends of the Department of Zoology. I am proud to have this opportunity to bring you up to date regarding the accomplishments of Zoology faculty and students since the last newsletter. Here we offer just a few highlights.

I am pleased to report that the Department of Zoology has weathered the economic woes of the past couple of years in relatively good shape. In large part this is due to the careful planning of central administrators, who had the foresight to anticipate the direction the economy was going, to spread budget cuts over multiple years, and to keep the academic mission of the university as protected as possible.

Credit is also due, however, to the hard work of departmental faculty. Our faculty members have contributed to several highly successful research initiatives, illustrating both the breadth of our research strengths and our overriding emphasis on integration among scientific disciplines.

Some examples:

Long-Term Ecological Research — MSU's long-running LTER site, funded by the NSF since 1988, was recently renewed under the leadership of Steve Hamilton (who is jointly appointed at the Kellogg Biological Station). This project explores how field crop management affects both natural and agricultural ecosystems.

Water Science — Jan Stevenson is co-director of the MSU Center for Water

Science. Under his leadership, CWS faculty from multiple departments (including Elena Litchman, Steve Hamilton, and Nathaniel Ostrom in Zoology) have been instrumental in winning grant support to study both scientific and policy questions regarding water in the Great Lakes region and beyond. Recognizing the success of CWS, the university has decided that water will be one of its signature areas for investment in the coming years.

Gene Expression in Development and Disease — this initiative spans multiple biology departments, and includes Alex Shingleton and Ian Dworkin, who study the genetic changes underlying changes in size and shape in animals.

Evolution in Action — one of the most exciting events in the past two years was the announcement that MSU was picked by NSF to establish a Science and Technology Center called BEACON (Bio-computational Evolution in Action Consortium). Zoology is the single biggest department in BEACON in terms of faculty participation, and two of the PIs (Rich Lenski and Kay Holekamp) are in Zoology.

GK-12 — This NSF graduate training program was spearheaded by Tom Getty and other faculty members at the Kellogg Biology Station. It focuses on training



Fred Dyer

biology graduate students to enhance the impact of their research in K-12 settings.

As for teaching, we continue to be proud of the diversity and quality of our undergraduate program. Although we serve well over 600 majors with a relatively small faculty, we offer more laboratory courses than any other biology major at MSU, as well as several

writing-intensive courses. We have expanded our set of high-quality online courses. For his work in developing an online version of ZOL 355 (Ecology), Stephen Thomas won, for the second time, the AT&T award for best online course.

In addition to course offerings, we have expanded opportunities for students to augment their education through summer internships (which accommodate over 60 Zoology students each summer), study abroad (including courses in Kenya, Uganda, Indonesia, and the Galapagos Islands), and laboratory research.

Finally, I encourage you all to stay in touch with the Department of Zoology, whether you are a current student yet to forge your own path in the world or a long lost alum. Please feel free to write me directly, or to get in touch via the web site: zoology.msu.edu. ☺

Fred Dyer, Ph.D.
Chair, Department of Zoology
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H. David Moehring ('60) retired from UC Davis Department of Orthopedic Surgery in 2009. He is working as a volunteer clinical faculty member at UC Davis and doing medical volunteering, having served in Nepal, Pakistan, and, most recently, Bhutan.

Wendel Johnson ('63 MS '65) retired from the University of Wisconsin-Marquette after 41 years of teaching zoology, botany, environmental sciences and ecology.

Larry Brickman ('65) practiced general, vascular and trauma surgery in Huntington, New York for 30 years before becoming Clinical Associate Professor of Surgery at Charles E. Schmidt College of Medicine, Florida Atlantic University. He is also the Director of the Clinical Surgical Clerkship at the university hospitals.

Richard Blum ('65) has been practicing orthopedic surgery for the past 35 years in Milford, CT.

Karel Rogers ('69, MAT '72, PhD '75) retired as Grand Valley State University professor of biology in 2007. She is married after 25 years of being single and published a book *Thinking Green: Ethics for a Small Planet*.

Max Terman (MAT '69, PhD '73) has published a Civil War novel *Hiram's Honor: Reliving Private Terman's Civil War*. It is based on the experiences of an ancestor captured at Gettysburg and sent to Andersonville.

Peter Stewart ('72) retired from Kmart after 34 years and is teaching middle school science in Jacksonville, NC.

N. Kevin Krane ('72) was presented with the Career Educator Award from a division of the Association of American Medical Colleges. He is a professor of medicine and Vice-Dean for Academic Affairs at Tulane University School of Medicine.

Ajit Sodhi (PhD '73) is a professor of biotechnology at Banaras Hindu University in Varanasi, India.

Bruce Fenderson ('74) is a professor of pathology, anatomy & cell biology at Thomas Jefferson University in Philadelphia, PA and was chosen by students of Jefferson Medical College Class of 2012 to receive the annual Award for Professionalism.

Allen Kurta ('75, M.S. '80) is a professor of biology at Eastern Michigan University with more than 75 peer-reviewed scientific articles and is author/editor of the recent book *Bats of Michigan*.

Larry B. Crowder (MAT '75, PhD '78) has recently moved to Stanford University as a professor of biology at Hopkins Marine Station, science director for the Center for Ocean Solutions, and senior fellow with the Woods Institute.

Larry A. Reichard (MS '77) is division chair for science and technology at Metropolitan Community Colleges-Maple Woods and served as president of the Missouri Academy of Science.

Larry Malerba ('80) published the book *Green Medicine: Challenging the Assumptions of Conventional Health Care* in 2010 and is a featured author at Natural News and a regular contributor to Huffington Post.

Carleton Wilkerson ('91) is operating New York City Wild (www.nycwild.com) - a photographic and artistic record of natural New York City and other areas in Brooklyn, Staten Island, Queens, the Bronx and Manhattan.

Jon Trelfa ('93) opened Trelfa Labs, Inc. - an independent food safety company specializing in the microbiological examination of foods, food safety consulting, HACCP consulting, ServSafe training, and food safety auditing.

Kathleen Ham ('00) recently was named an assistant professor of soft tissue surgery at The Ohio State University, Department of Veterinary Clinical Sciences.

Kristin Beeson ('06) received her DVM from MSU in 2011 and is starting an internship in small animal medicine in Charlotte, NC.

Cassie Bradley ('06) received an MS in marine science from the College of William & Mary and received a Sea Grant fellowship with the Great Lakes Commission in Ann Arbor.

Bryan Voss ('06) received a DVM from Ross University in 2011.

Ryan Alderson ('06) has been with MPI Research in Mattawan for 4 years and is a board certified histotechnologist as well as a Certified Laboratory Animal Technologist.

Alvin Makohon-Moore ('10) is at the Johns Hopkins University School of Medicine working toward a PhD in pathology. 🍀

An Unlikely Career for Zoology Alumnus

Alan Pfau (B.S. Zoology '80) came to MSU with a love of science. Inspired by a high school biology teacher and an intense interest in predator-prey relationships, Pfau pursued a zoology degree and dreamed of following in the footsteps of Durward Allen on Isle Royal.

"When I graduated, the job market was tight and I applied across the country," says Pfau, who was recently elected to the Board of Directors of the College of Natural Science Alumni Association. "I just wanted to do something involving science where I could apply the scientific process and have never-ending possibilities of learning."

Pfau's professional career would begin shortly after graduation, yet the job was a far cry from Isle Royal. Like many alumni, Pfau never would have predicted his career path which, while based in fundamental science, was definitely not a traditional path for a zoology major.

Pfau joined the research and development division of Chem-Trend – a chemical manufacturing company in Howell, Michigan. His position had little to do



Alan Pfau on the shore of Lake Superior on Isle Royal.

with zoology, but everything to do with science.

Pfau recently celebrated 30 years with Chem-Trend. As a research scientist in the analytical lab, he helps in all aspects of instrument acquisition and growth for the analytical capabilities of the global company. His primary focus is on using analytical techniques in both discovery and the symbiotic relationship with research and development, and he works in an analytical laboratory with a range of equipment in all types of

microscopy, spectroscopy, chromatography and thermal analysis.

"I have always enjoyed microscopy and view it as a hobby," Pfau says. "There is a lot of joy in taking a technique and applying it to the work environment, and my career has been doing just that."

Pfau credits MSU and his zoology major for providing him the framework needed to excel. The critical thinking and fundamental skills learned during his

years at MSU provided the foundation for him to continue to grow.

As a third-generation Spartan, Pfau followed in the footsteps of his father and grandfather. Both were farmers who attended MSU for the agricultural programs.

"I grew up in rural Michigan and in a family focused on agriculture," Pfau says. "There was never any doubt that I wouldn't attend MSU. It is part of our family history."

The family tradition continues as Pfau's son is currently an English major at MSU. "I tell my son never to close the door to any opportunity as you may find yourself down a path you didn't know exist," Pfau says. "Your skills and ability to learn will take you down many different paths."

The path for Pfau led to an analytical chemistry career at a global company. And while he never landed his dream job on Isle Royal, he and his wife Barbara have vacationed on the island where they spent time watching the wildlife and discussing the work of Durward Allen. 🐾

Humboldt Award Presented to Alumnus



Hal Caswell

Hal Caswell (BS Zoology '71, PhD '74), a senior scientist at Woods Hole Oceanographic Institution, was awarded a 2010 Humboldt Research Award by the Alexander von Humboldt Foundation in Bonn, Germany.

After graduating from MSU, Caswell spent six years at the University of Connecticut before joining Woods Hole in 1981. He is well known for his work on population dynamics and demography. His recent research is focused on developing models for studying threatened species, such as right whales, albatrosses, and polar bears.

The Humboldt Foundation grants the prestigious research awards annually to promote academic collaborations among top scholars and scientists.

Online Bird Call Database

A growing online library offers free downloads of bird sounds, photos and information from around the world.

The Avian Vocalizations Center (AVoCet) is led by Pamela Rasmussen, assistant professor of zoology and assistant curator at the MSU Museum.

AVoCet features sonograms that visually chart the sounds, photos of birds recorded, Google Earth maps of recording locations and links to other online sound collections.

Currently there are 11,516 recordings from 3,605 species in 55 countries - with more added every week. The recordings are made around the world by 65 people, including local ornithologists, professional guides and MSU students from Rasmussen's study abroad and ornithology courses.

Oriented to the scientific community, AVoCet maintains rigorous scholarly standards. Whenever possible, recordings are accompanied by photos and sighting observations that enable independent evaluation. Scientists can then accurately map avian biodiversity and perhaps identify new species. 📍

<http://avocet.zoology.msu.edu/>

Zoologists in Water Research at MSU

Faculty from the Department of Zoology play a major roles in the MSU Center for Water Sciences - a research excellence center established in 2005 to explore linkages between ecological and human health.

The interdisciplinary research teams are investigating topics ranging from antibiotics in water and development of microbial resistance to viral pathogens and waterborne disease. They are also examining the complexity of natural and human influences on biodiversity, valued attributes of aquatic ecosystems within watersheds, and the effects of contaminants with global origins.

Jan Stevenson, professor of zoology, is co-director of the center. Stevenson is working with the Environmental Protection Agency to develop national assessment protocols for streams, lakes and wetlands, as well as management strategies to minimize algal blooms. A recent national assessment of lakes shows that about half of U.S. lakes are significantly compromised by human activities.

Other zoology faculty members, including Elena Litchman and Nathaniel Ostrom, are also concerned with the effect of human activities on bodies of water.

Litchman, associate professor of zoology, is studying invasive microbial invaders in the Great Lakes. Litchman's research focuses on a microscopic alga which likely reached the Great Lakes from cargo ships when the ships dumped ballast water into the lakes.

"Invasive microbes have many of the same traits as their larger, 'macro' counterparts and have the potential to significantly impact terrestrial and aquatic ecosystems," said Litchman. "Global change can exacerbate microbial invasions, so they will likely increase in the future."

Ostrom, professor of zoology, leads a research program focused on the application of stable isotopes and other approaches for understanding the biogeochemical cycling of carbon and nitrogen in ecosystems. His research extends from the Northern Gulf of Mexico to Antarctica, where he is determining rates of nitrification, denitrification, and anaerobic ammonium oxidation among the microbial community isolated from the surface for at least 2,000 years. In the Gulf, his research examines the oxygen-starved region labeled "the dead zone" for its hostility to marine life. With last year's oil spill, he is researching the effects of the spill on enhancing hypoxia. 📍



Ecology Studies to Continue

The Long-Term Ecological Research (LTER) Program at MSU's Kellogg Biological Station recently received a \$5.6 million NSF renewal grant to continue examining the ecology of major U.S. row crops. LTER is part of a national network of sites studying ecosystems as they develop over time. Scientists at KBS, including several zoology faculty members, study systems and compare them to the ecosystems of the surrounding natural forest and fields. 📍

On the left: Biofuel crops – including poplar, switchgrass, Miscanthus and restored prairie grass – are being grown and tested by MSU LTER scientists to determine the productivity and environmental benefits of various biofuel cropping systems.

African Carnivore Research Expands



MSU doctoral student Meg Wallen photographed this spotted hyena mother and cub in February. Wallen will be joined by other international students as part of a recent IRES grant.

Visit the Notes From Kenya blog at: msuhyenas.blogspot.com.

For more than two decades, Kay Holekamp, professor and director of the EEBB Program, has been studying spotted hyenas in the Masai Mara National Reserve in Kenya, and a recent NSF grant is expanding the program to include carnivores inhabiting the Mara-Serengeti ecosystem.

The recently awarded International Research Experiences for Students (IRES) grant is funding four undergraduate students from universities across the US. The students are conducting research alongside Holekamp and her researchers at their two research camps in southwestern Kenya where they are spending eight weeks developing and executing field research projects on carnivores other than the spotted hyenas - lions, cheetahs, leopards, small cats, genets, mongooses, jackals and wild dogs.

The students' research is addressing behavior, conservation and physiology ranging from the evolution of their cognitive abilities to anthropogenic effects on their stress physiology.

In addition to working alongside Holekamp and her team of MSU students, the IRES students are trained by the Kenyan Wildlife Service (KWS) staff scientists. At the conclusion of

their two-month experience, they will present their findings at the Carnivore Researchers Conference held annually at the KWS headquarters in Nairobi.

The grant supports a training partnership between Holekamp and other Kenyan and American scientists.

"These collaborations provide unparalleled research opportunities of several carnivore species that remain poorly understood," Holekamp says. "We anticipate the IRES students to uncover new findings related to the basic mechanisms by which African carnivores interact with their environments and each other."

The competition was fierce for the first four IRES positions, who were selected from among over 350 applicants, and the four students participating in the inaugural program are from Harvard, Arizona State University, University of Montana and MSU. The program is funded for 3 years and will continue to grow collaborations between Kenyans and Americans while contributing significantly to the development of a generation of global scientists who are united in their desire to understand and protect the natural world. 🌍

Active Year for ZSA

The Zoology Student Association (ZSA) enjoyed an active year of organized guest speakers, fundraisers and field trips for the 80 members, according to ZSA President Courtney Ploehn, a senior from Battle Creek.

In the fall, ZSA visited Critchlow Alligator Sanctuary in Athens, Michigan. Students learned about basic care of the animals along with hands-on activities.

Students traveled to the Cincinnati Zoo and the Newport Aquarium in Kentucky during the spring semester. The trip included an overnight stay at the zoo with animal interactions and a night hike through the grounds.

"Through our connections to alumni, we got in touch with Julie Cremer and got the opportunity to go into the Cheetah facility for a behind the scenes tour," Ploehn said.

The ZSA also raised money and awareness for animal causes. The Beggin' for Bones fundraiser collected more than \$200 to support the Capital Area Humane Society. ZSA continued its Earth Day tradition of raising awareness about companion animal overpopulation. The students also attended a documentary about African cats to support the African Wildlife Foundation. 🌍

Grant Connects Students

As part of the NSF's Graduate STEM Fellows in K-12 Education (GK-12) program, a grant is supporting fellowships and training for graduate students and is led by Tom Getty, professor of zoology. The GK-12 Bioenergy Sustainability Project is at Kellogg Biological Station and has 10 graduate students working with 12 school districts integrating current scientific research into the schools. 🌍

Student Uses Fruit Flies and Mantis to Study Evolution

To most people, fruit flies are often bothersome and annoying. For Michael DeNieu, a zoology PhD

candidate, these tiny insects are important research subjects as they are working, or more specifically surviving, to provide unique information on behavioral evolution and species adaptation.

"I was interested in the intersection between evolution and behavior, and understanding how behaviors evolve," says DeNieu.

His interests led him to MSU and Ian Dworkin, professor of zoology.

Dworkin's genetic and genomic approach to the study of phenotypic evolution was a perfect fit for DeNieu's research.

DeNieu studies the anti-predation behavior of *Drosophila* flies using the Chinese mantid - also called the praying mantis - as a predator.

"This project examines a complex behavior because of the ways flies avoid predation by the mantids," DeNieu says. "There are many different strategies the flies use. They reduce locomotion so they don't encounter the predator. They become faster and improve flight performance so they can escape more effectively. There are a lot of different inputs that have affected how they have evolved."

While the behavior is complex, DeNieu's experiment is straightforward. He places 25 flies in a 24 oz. plastic cup with 5 mantids and a plastic aquarium plant for the mantids to use as a perch. DeNieu waits to see how many of the flies survive.

He normally harvests 200-300 survivors from the 500 flies he originally used. The

survivors are placed in a tank to breed the next generation for the containers. Each generation takes 17-18 days to

come to maturity and then the process is repeated. Along the way, the survivors from each generation are stored for later genotyping.

DeNieu is currently on his 55th generation of flies and will continue the experiment for the next two years. He hopes to study 100 generations for his dissertation.

DeNieu's work is part of several experimental evolution projects in Dworkin's lab focused on the evolutionary genetics of behavioral and morphological traits.

"Specifically, we want to identify individual genes that are part of the evolutionary response to predation so

we can see how the genetic changes contribute to survival," DeNieu says.

The fruit fly experiments help DeNieu and Dworkin see how small changes in natural variation for size and shape affect fitness.

DeNieu credits the cadre of undergraduate students who assist in the lab with making it possible. "A lot of what we do requires many people and it just works better with more hands," he says.

One undergraduate student is conducting a similar experiment using jumping spiders as the predator. While the Chinese mantid is an ambush predator that waits for prey, the jumping spider is a hunter and actively seeks prey.

The project is also used as an educational teaching tool. DeNieu takes the mantids that have outgrown their usefulness to the College of Veterinary Medicine's afterschool science club where the mantids help teach children about evolution and predation. 🌱



Michael DeNieu displays one of the mantids used to study evolution in the Dworkin Lab.

National Research Center Studies Evolution in Action

Last year, the National Science Foundation awarded MSU a prestigious Science and Technology Center focused on the study of evolution in action. Known as BEACON, the center is funded by a \$25 million grant and focuses on evolution as an ongoing process - using real organisms in laboratories and field sites, and using "digital organisms" undergoing evolution on computers.

Many faculty from the Department of Zoology are involved in BEACON. The executive committee includes professors Tom Getty, Richard Lenski and Kay Holekamp. Other zoology faculty involved are Janette Boughman, Ian Dworkin, Fred Dyer, Heather Eisthen, Elena Litchman, Barbara Lundrigan, Kim Scribner, Alex Shingleton, James Smith, and Barry Williams.

BEACON is the only one of NSF's 17 Science and Technology Centers focused on evolution. By bringing together biologists, computer scientists, and engineers, BEACON is studying evolution as it happens and then applying the knowledge to engineer better solutions to real problems. For the details on research being done, go to beacon-center.org. 🌱

Boughman and Her Fish Adjust to Their New Home at MSU

Most newly hired faculty arrive at universities with textbooks and enthusiasm. Janette Boughman recently arrived at MSU with truckloads of large aquariums and hundreds of stickleback fish.

Boughman, associate professor of zoology, has spent years breeding the fish and the moving operation from Wisconsin required extensive planning, careful maneuvering and numerous trips.

For Boughman, her career didn't initially involve fish and hundreds of aquariums. She earned her PhD at the University of Maryland studying the communication system of bats. As her interest turned to the evolution of communication, she began working with stickleback fish.

Stickleback fish offer many advantages for researchers, according to Boughman. The small fish are more manageable and much is already known about their behavior, ecology and evolution. This wealth of information provides a firm foundation for exploring the evolution of their communication system and how it is used in their sexual selection behaviors.

"Sticklebacks communicate mainly through visual cues," says Boughman. "But the visual signals males use to communicate with females and attract them for mating vary. Some males turn red or blue during the mating season, but in other places, no red males exist."

Boughman's research has revealed that the color of the water influences the color of the fish. Fish in red water lakes - red from decaying organic matter - turn black to be more visible to females.

Other research projects done in Boughman's lab include looking at how

the ratio of males to females influences the choosiness of females and whether there are genetic incompatibilities between stickleback species.

Located in Giltner Hall, Boughman's lab is home to three post-doctoral researchers, two graduate students, and many undergraduate students. She has been amazed by the response to calls for undergraduate researchers. One email asking for help brought over 80 applications.

Undergraduate students help take care of the fish, set up experiments, take measurements, and collect behavioral data.

Currently, one student is helping generate a new genetic line of fish. She physically makes the genetic crosses, raises the offspring, and keeps track of all the data.

One reason Boughman joined MSU was to be involved with BEACON, the NSF Center for the Study of Evolution in Action. She is working on an evolutionary

robotics project with two MSU professors, Xiaobo Tan, an electrical engineer, and Phil McKinley, a computer scientist.

Boughman works with McKinley to use evolutionary computing to evolve behaviors and morphologies for the robots. The robots are then able to accomplish certain behavioral tasks, like mimic predator behavior. Tan then uses this information to program the robots.



Sonya Williams, research technologist, feeds the stickleback fish in one of the hundreds of tanks in Boughman's lab. The stickleback fish provide the researchers data on evolution and behavior.



Janette Boughman

"We get robots which can do fish-like behavior," Boughman says. "We hope to have the fish and the robots interacting so that I can do behavioral experiments where I can use a robot as a control."

Boughman's research area is very broad. She does field work, behavioral lab work, morphological lab work and genetics. However, she notes that the study of something as complex as evolution requires a wide net. And for the newest member of the zoology faculty, MSU has become a welcome home for Boughman and her stickleback fish. 🐟

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Students Explore and Study in the Galapagos



MSU students retrace Darwin's footsteps during the popular study abroad program *Biology in the Galapagos Islands* led by Richard Hill, professor of zoology. In these pictures (clockwise from left), Jake Gunn stands among prickly pear cactus trees, Jake Gunn takes a break from swimming with Galapagos penguins, and Alex Martin snorkels alongside a sea turtle. The program provides students with opportunities to study the vertebrate and invertebrate animals of the islands on land and sea, and chances to see Darwin's finches, marine iguanas, teeming flocks of coastal birds, and other unique animals and plants. 🐢

Award-Winning Zoology Students

The Outstanding Undergraduate Academic Achievement and Promise in Zoology Award was presented to seniors Nathan Parker and Vincent Cracolici. Parker is entering a doctoral program at Princeton University and Cracolici is entering the MSU College of Human Medicine this fall.

The Jeffrey Boettcher Travel Fund Award was presented to senior Aaron Florn. Florn is spending summer in the Galapagos and in Curacao before attending graduate school.

The Dr. Marvin Hensley Endowed Scholarship in Zoology was awarded to senior Sean Dryer. He is spending the summer conducting field research in Kenya with Professor Kay Holekamp.

Junior zoology major Susanna Rori received the College of Natural Science Dan Bolin Undergraduate Award for outstanding leadership qualities, community service and academic ability.