WINTER 2022

DEPARTMENT OF

Integrative Biology

MSU College of **Natural Science** | *Newsletter for Alumni and Friends*

Forecasting the future to protect monarchs

6

Some experts estimate that the eastern monarch population size has been reduced by more than 80 percent since the 1990s. MSU integrative biologist Elise Zipkin and her team are developing new approaches to help protect these endangered insects.

CHECK OUT OUR ONLINE VIDEO

INSIDE

I am especially pleased to have the opportunity to introduce this year's newsletter.

This is my 10th and final year as integrative biology department chair. There is currently a national search underway. In 2023, there will be a new chair who will introduce themself and the next newsletter. In the meantime, we have a lot of stories to share, and room for only a few.

The Alumni Class Notes section on page 3 provides updates on the careers of several of our former students, as well as news on the passing of one of our former colleagues, Charles Robert (Bob) Peebles.

> **"This is my 10th and final year as department chair. In 2023, there will be a new chair who will introduce themself and the next newsletter. In the meantime, we have a lot of stories to share. . ."**

Significant personnel changes in the department since the last newsletter include the retirements of Nathaniel Ostrom and Susan Hill, and the addition of new colleagues Kelly Aho, Anne Bronikowski, Chris Kozakiewicz, Jim Moran and Alisha Shah. You can read more about them on page 4. In addition, Louise Mead, education director for MSU's BEACON Center, has moved her appointment into IBIO, where she now serves as graduate director while continuing her teaching, research and other service.

Our faculty, staff and students continue to impress. You can read about some of the recent honors, awards and accomplishments they have received on page 5. These include Sarah Evans being invited to join the prestigious Earth Leadership Program, Julia Ganz receiving an NSF Early CAREER Award, Elena Litchman being selected as the 2021 G. Evelyn Hutchinson Award, Elise Zipkin receiving a Senior Fulbright Scholar Fellowship and Ph.D. student Sam Ayebare, who received a Russell E. Train Fellowship from the World Wildlife Fund. Recipients of college-level awards include Heather Eisthen, Junior Faculty Mentoring Award; Susan Hill, Undergraduate Academic Advisor Award; and Darren Incorvaia and Olivia Spagnuolo, Excellence-in-Teaching Citations.

The Giving Profile on page 7 showcases recently retired faculty colleagues Kay Gross—former Kellogg Biological Station (KBS) director—and Gary Mittelbach, both of whom are zoology graduates. The two of them were outstanding faculty members and did much to help define the identity and shape the future of KBS.

You can learn about notable new NIH, NSF and U.S. Fish and Wildlife Service grant funding for projects being led by Sarah Fitzpatrick, Julia Ganz, Elena Litchman and Will Wetzel on page 8.

The newsletter also highlights a sampling of interesting IBIO research that ranges from protecting monarchs, integrating prairie strips with farmland to preserve biodiversity and crop yields, and antibiotic resistance of bacteria in soils to evolutionary and health insights provided by electric fish, Rio pearlfish and squid. Read more about these projects and the researchers leading them on pages 6 and 9-11.

The back cover story provides a brief biosketch of Ph.D. student Kara Dobson, and her award-winning photograph of sunrise at the KBS LTER site.

Our communications manager, Janet Hershberger, does a terrific job of sharing our stories, and yours, on the IBIO website (integrativebiology.natsci.msu.edu/news). Please send Janet your stories to share and help us continue to grow and shape the future for the better. We need your support, both moral and financial.

Now, please turn the page and enjoy learning more about us.

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ALUMNI CLASS NOTES

Barb Frey, biological science, '65, M.S., zoology, '67, taught for 31 years in the Biology Department at Oakland Community College, Auburn Hills, Mich., before retiring in 1999. She remains involved with and connected to MSU, including serving as vice president of the Oakland County MSU Alumni Club.

Mark Uhrich, zoology, '74, worked for the U.S. Geological Survey as a hydrologist for more than 30 years, starting in Lansing, Mich., and then moving to the Pacific Northwest, where he worked on Mount St. Helens and on rivers and streams throughout Oregon. Uhrich, who retired in 2014, specialized in river sediment transport. Continuing to work as a hydrologist Emeritus, he was recently lead author of a report on a 40-year history of river sediment from Mount St. Helens. He currently serves on the Oregon/SW Washington Spartan Alumni Board.

Paul Groll, zoology, '81, has been employed by the state of Michigan's Department of Technology, Management, and Budget for more than 27 years. In 2020, he took a new position as director of emerging technology research. In this role, he monitors and studies web news and vendor sources to keep the CTO and executive team current on emerging technologies and critical security attacks, challenges and defenses.

Kenneth Filchak, zoology, '94, received the University of Notre Dame Joyce Teaching Award for 2019-2020—his second time receiving this award.

Susan Terrell, zoology, '97, M.D., '01, is board certified in internal medicine, but branched off into palliative care in 2011. She provides inpatient palliative care at Mercy Health St. Mary's in Grand Rapids, Mich; teaches MSU College of Human Medicine medical students who rotate through their palliative care department; and provides outpatient care for Lacks Cancer Center at St. Mary's.

Jennifer Haeger, zoology '99, D.V.M. '02, earned her Master Beekeeper Certificate from Cornell University in 2021. She currently serves as a board member and mentorship team coordinator for her local bee club, the Ann Arbor Backyard Beekeepers (A2B2), where she helps educate beekeepers and the public on beekeeping and pollinator health and welfare.

Alvin Makohon-Moore, zoology, '10, began a faculty position as an assistant member at Hackensack Meridian Health Center for Discovery and Innovation, Nutley, N.J. in May 2022. His lab focuses on defining evolutionary mechanisms that drive tumorigenesis, metastasis and treatment resistance with the goal of discovering therapeutic opportunities that improve patient outcomes.

Syrena Whitner, zoology, '18, currently lives on the Island of Oahu, where she is a Ph.D. student in marine biology at the University of Hawai'i at Manoa, studying marine fungal ecology.

Mary Panagos, zoology, '19, is pursuing her D.V.M. in the College of Veterinary Medicine at Michigan State University, with anticipated graduation in 2024.

Robby Palazzolo, zoology, '20, is a biological science technician in Grand Teton National Park in Wyoming. Employed by the U.S. Department of the Interior, his responsibilities include applying herbicide safely, and manually treating invasive plant species; revegetation, restoration and monitoring; and identification of plants in the sagebrush-steppe region.

Shannon Frank, zoology, '21, is a primate keeper at the Lemur Conservation Foundation in Myakka City, Fla.

In Memoriam

Peebles

Charles Robert "Bob" Peebles, an MSU professor who taught general education science courses from 1965 until his retirement in 2001, died on February 28, 2022, at the age of 92. Peebles earned a bachelor's degree in ornithology from Cornell University and his Ph.D. in parasitology from the University of Illinois. In 1957, he took a post-doctoral research position at the Agricultural Experiment Station of the University of Puerto Rico. For many years, Peebles also enjoyed teaching a field course through MSU's Evening College; his students learned to identify birds, animals, animal tracks and the natural communities in which they were found.

New Faculty


Aho

Kelly Aho, assistant professor (joint with Earth and Environmental Sciences), will start January 2023. Her lab will focus on the aquatic biogeochemistry of carbon and nitrogen cycling in inland waters. She is particularly interested in greenhouse gas emissions from streams and rivers. Aho received her Ph.D. from the School of the Environment at Yale University and is currently a postdoctoral fellow at the National Ecological Observatory Network (NEON) and Yale University.


Bronikowski

Anne Bronikowski, professor (joint with the Kellogg Biological Station (KBS), started in May 2022. Her research focuses on life-history evolution: the way life-history strategies affect outcomes in areas like lifespan, reproductive senescence and aging. Her arrival expands the reach of KBS research into critical new areas by integrating physiology and genetics to understand how wild animals evolve in response to environmental stresses. Bronikowski received her Ph.D. in evolutionary biology from the University of Chicago.


Kozakiewicz

Chris Kozakiewicz, assistant professor (joint with KBS), will start January 2023. His lab will focus on the role of environmental variation in influencing ecological and evolutionary interactions between wildlife and their parasites. Kozakiewicz received his Ph.D. at the University of Tasmania in Australia and is currently a postdoctoral research fellow at Colorado State University.


Moran

Jim Moran, associate professor, joined in August 2022. Moran specializes in better understanding rhizosphere nutrient exchange processes and the role that spatial organization plays in driving relevant plant, microbial and geochemical interactions. He received his Ph.D. in geosciences from The Pennsylvania State University. Moran comes to MSU from the Pacific Northwest National Laboratory.


Shah

Alisha Shah, assistant professor, joined in March 2022. Her research interests include ecological physiology, evolutionary ecology, conservation, species response to climate change and ectotherms. Shah received her Ph.D. in zoology from Colorado State University. She comes to KBS from the University of Montana (UM) where she was a postdoctoral research associate with the Woods Lab in UM's Division of Biological Sciences.

Retirements


Hill

Susan Hill, professor, retired from MSU in spring 2022 after a long history as a caring teacher and advisor. Her research focus was on the early development of polychaetes (marine annelid worms) and their regeneration and reproduction. After completing her undergraduate work in biology at Queen's University, Canada, Hill earned her M.S. and Ph.D. degrees in zoology from the University of Michigan. She joined MSU's zoology department in 1972. During several summers between 1981 and 2010, she was a principal investigator at the Marine Biological Laboratory, Woods Hole, Mass., and received their John Arnold Research Fellowship (Whitman Fellow) in 2012.


Ostrom

Nathaniel Ostrom, professor and co-director of MSU's Biogeochemistry and Stable Isotope Laboratory, retired from MSU in spring 2022. He spent more than 25 years studying biogeochemistry in soils, lakes and oceans. Ostrom was also a faculty member with the Ecology, Evolution, and Behavior Program; the Environmental Science and Policy Program; and the Great Lakes Bioenergy Research Center. He did his undergraduate studies in marine science, biology and chemistry at the University of Tampa, Florida. He received his Ph.D. in earth sciences from the Memorial University of Newfoundland, Canada, and served as a research specialist in MSU's Department of Earth and Environmental Sciences from 1991-1992, prior to joining the MSU faculty.

Faculty Honors

Sarah Evans, associate professor, is one of 22 leading sustainability scientists named to the 2022 North American cohort of the Earth Leadership Program (ELP). The ELP provides outstanding academic researchers with the skills, approaches, and theoretical frameworks for catalyzing change to address the world's most pressing sustainability challenges, emphasizing new forms of individual and collective leadership.

Julia Ganz, assistant professor, received a $1.72 million NSF Early CAREER Faculty Award. Ganz studies the genetic role of neuronal development in the enteric nervous system (ENS), the system of neurons that regulates all gut functions. Ganz hopes to contribute to developing therapeutic approaches for ENS diseases.

Elena Litchman, professor, is the recipient of the prestigious 2021 G. Evelyn Hutchinson Award from the Association for the Sciences of Limnology and Oceanography (ASLO). Litchman is perhaps best known for her seminal work developing a trait-based approach for the study of plankton ecology.

Elise Zipkin, associate professor, was awarded a Fulbright Senior Scholar Fellowship to spend four months in Israel in 2022. In addition to presenting workshops on advanced statistical methods, Zipkin expanded on her past research to study how climate change affects ecologically and economically important insect species in the Middle East.

Two IBIO faculty members were among 37 MSU College of Natural Science (NatSci) faculty, staff and students recognized at the 2021 NatSci Annual Meeting and Awards Ceremony for their achievements and contributions. **Heather Eisthen,** professor, received a Junior Faculty Mentoring Award; and **Susan Hill,** professor, received an Undergraduate Academic Advisor Award.

Student Honors


Ayebare

Sam Ayebare, a Ph.D. student from Uganda, received a Russell E. Train Fellowship for Aspiring University Faculty for Conservation from the World Wildlife Fund, which will support his current research in the Albertine Rift in central Africa. The fellowship is awarded to students who will return to their home country to work in conservation after completing their degrees.


Incorvaia

Darren Incorvaia, a graduate student in the department, as well as in MSU's Center for Integrative Studies, and the Ecology, Evolution, and Behavior program, received a 2020-21 MSU Excellence-in-Teaching Citation for demonstrating unparalleled excellence in teaching, research and leadership.


Spagnuolo

Olivia Spagnuolo, graduate student, received a 2021 College of Natural Science Excellence-in-Teaching-Citation for her outstanding classroom contributions and the qualitative difference she is making to the undergraduate program.

Contact Us

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CONNECT WITH NATSCI

Research Feature

Forecasting the future to protect monarchs

Monarch butterfly populations are declining. This summer, The International Union for the Conservation of Nature (IUCN) added North America's monarchs to its list of endangered species. But there is hope for these iconic insects; Spartan researchers are developing new approaches to help protect them.

Michigan State University integrative biologist Elise Zipkin and her colleagues recently published a study in the journal *Global Change Biology* that helps identify where the greatest opportunities to support monarch conservation may be.

Over the course of a year—and four generations—monarchs migrate between central Mexico and parts of the U.S. and southern Canada east of the Rocky Mountains. Working with extensive data sets and established models, the team forecasted which counties in the midwestern U.S. and Ontario, Canada, are most likely to offer the most hospitable breeding grounds for monarchs in the face of climate change.

"These projections let us look at how monarch populations will change across the Midwest and say, 'Here's where they'll likely do a little better, here's where they might do a little worse,'" said Erin Zylstra, first author of the new paper and a former postdoctoral researcher in the Zipkin Quantitative Ecology Lab, who is now with the Tucson Audubon Society.

Although forecasts suggest that the eastern monarch population will decline, Elise Zipkin and her colleagues are conducting research to help identify where the greatest opportunities to support monarch conservation may be.

Between 1996 and 2014, the eastern monarch population decreased by more than 80 percent. Last year, Zylstra, Zipkin and their colleagues published a paper in the journal *Nature Ecology and Evolution* showing that climate conditions were the major driver of recent declines.

Building on this work, they collaborated with Naresh Neupane, a climate scientist at Georgetown University, to study what could happen over the next 80 years under a range of climate change scenarios. The National Science Foundation and U.S. Geological Survey's Midwest Climate Adaptation Science Center supported their work.

"We're answering scientific questions that we think are important, but we are also working with individuals and agencies on the ground that can use our work to implement strategic conservation," said Zipkin, associate professor in the Department of Integrative Biology in the College of Natural Science, and director of the Ecology, Evolution and Behavior Program, or EEB, at MSU. "The newly developed Midwest Climate Adaptation Science Center helps us get our research directly into the hands of those people who are thinking about next steps."

Although the forecasts suggest that the eastern monarch population will continue to decline, it identifies pockets, such as northern Ohio and southern Michigan, where populations are growing or holding constant, and where the decline might be slowed or reversed.

And, if this approach helps save monarchs, it can help with other threatened species, too.

"Monarchs are special. They're beautiful, easy to identify, widely distributed and they get people to care about conservation in general," Zipkin said. "With action, we can absolutely protect our planet, migratory species, pollinators and monarchs."

> **FUTURE**
>
> **"The newly developed Midwest Climate Adaptation Science Center helps us get our research directly into the hands of those people who are thinking about next steps."**

Giving Profile

Conservation & conversation: Two KBS endowments established

Two dynamic MSU alumni—Katherine (Kay) Gross (Ph.D., zoology, '80) and Gary Mittelbach (Ph.D., zoology, '80)—have recently retired from MSU's Kellogg Biological Station (KBS), located in Hickory Corners, Mich., but their influence there will be felt for a long time to come. The married couple are connected to two endowments to ensure that the KBS legacy of conservation and community outreach will continue.

Kay Gross and Gary Mittelbach in the gardens at their home on Little Long Lake in Richland, Mich.

Gross, University Distinguished Professor Emeritus, and Mittelbach, Professor Emeritus, both originally had intentions of going to medical school, but their experiences along the way diverted them.

"One of my professors at the University of Iowa convinced me to go to Iowa Lakeside Labs one summer and work with him at the field station," Mittelbach said. "I experienced what it was like to do research and to be a field biologist." It's also where he met Gross.

Gross had gone to the field station to take a couple of extra classes that were offered, and to try something different. Drawn by the passion for science that she saw in the graduate students, she decided to pursue a Ph.D. in ecology, rather than medicine.

Gross and Mittelbach joined the KBS faculty in 1987, where they enjoyed long and successful careers.

Upon Mittelbach's retirement in 2018, Gross was inspired to set up the KBS Aquatic Ecology Fellowship Endowment to honor his contributions—and that of his mentors, Don Hall and Earl Werner. Mittelbach has a stellar reputation and is highly respected by his students and his colleagues. He is also the author of a textbook—*Community Ecology*—now in its second edition.

The unique facilities at KBS, including the Experimental Pond Laboratory and the diversity of aquatic habitats in the area, combined with a focus on graduate student training, has allowed KBS to become recognized as a center of excellence for research and training in aquatic ecology.

"This endowment will help ensure that this legacy continues," Mittelbach said.

A second endowment—the Dessert with Discussion Endowment (DwD)—was created in honor of Gross when she retired. The DwD endowment will ensure the continuation of a popular program that was launched by Gross when she was interim director of KBS. It was initially funded by the Kellogg Foundation as a lecture series known as Dinner with Discussion.

> **SCHOLARSHIP**
>
> **"Every successful person I've talked with said that somebody somewhere along the line helped them out with a scholarship or fellowship."**

"This is a signature program of KBS outreach to the local community," said Gross, who served as KBS director from 2005-2018, and retired from MSU in 2021. More than 25 lectures have been presented over the years.

The intent was that over time, KBS would establish ways for continuing this lecture series through donor and community support.

"This endowment cements that goal," Gross said.

During their time at KBS, Gross and Mittelbach greatly expanded the number of paid student internships, fellowships and jobs. They also quadrupled the number of scholarship funds.

"Every successful person I've talked with said that somebody somewhere along the line helped them out with a scholarship or fellowship," Gross said.

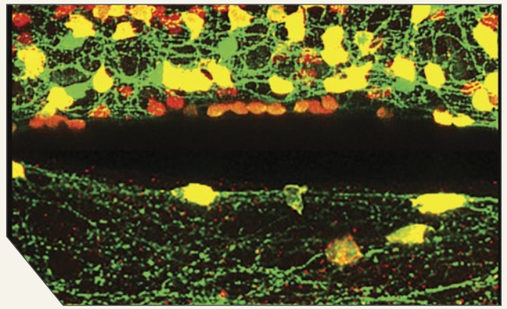
Mittelbach and Gross hope that their passion for science, and these two endowments, will inspire future generations to further the KBS mission.

Key Grants

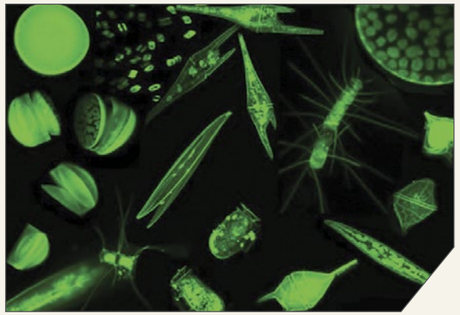
Florida Scrub-jay.

Sarah W. Fitzpatrick, assistant professor, received a two-year, $248,709 U.S. Fish and Wildlife Service Recovery Challenge Grant to determine the genomic and demographic consequences of introducing the Florida Scrub-jay (FSJ) to an FSJ population on Florida's Atlantic coast. The federally threatened FSJ is a rapidly declining species facing genetic risks associated with its small population and reduced connectivity. In 2019 and 2020, researchers translocated eight FSJs to a coastal population. Fitzpatrick will study the consequences of these translocations to test for genetic rescue.

Julia Ganz, assistant professor, received a two-year, $439,408 National Institutes of Health R21 grant to determine the regenerative capacity of the enteric nervous system (ENS) and to identify the cellular and molecular mechanisms controlling ENS regeneration. Because zebrafish ENS can regenerate ENS neuronal injury after focal ablation of a small number of ENS neurons, Ganz's team aims to establish the cellular and molecular mechanisms and the cell lineage decisions that guide ENS regeneration in zebrafish as a critical first step in identifying the genes and gene regulatory networks necessary for successful ENS regeneration.



Five-day-old zebrafish embryos.



A collage of marine phytoplankton cells.

Elena Litchman and **Chris Klausmeier,** MSU Foundation Professors, received a three-year, $675,507 National Science Foundation (NSF) Emerging Frontiers grant. In this project, researchers will combine mathematical models and data analyses to uncover the mechanisms that govern the structure and dynamics of microbial communities and species interactions. The results will improve understanding of how microbial communities function and how they can be modified to improve animal, plant and human health. Shannon Manning, MSU associate professor of microbiology and molecular genetics, is also a co-PI on the grant. The team is collaborating with Mason Porter at UCLA on the research; the total grant award for both institutions is $936,042.

Will Wetzel, assistant professor, received a four-year, $555,281 NSF grant to advance science through the Herbivory Variability Research Coordination Network by expanding thinking beyond a focus on means to include the causes and consequences of variability itself. This project will form a Research Coordination Network (The Herbivory Variability Network) that will bring together scientists from across fields and career stages with the common goal of understanding the causes and consequences of interaction variability.

Beetle on a leaf.

A little prairie goes a long way to help farms, nature

We need to feed the planet's population, but the way we grow our food is helping fuel the loss of the planet's natural biodiversity.

New MSU research demonstrates that bringing a little prairie back to farms in Michigan and other parts of the Midwest could help preserve both biodiversity and crop yields.

"The goal is to do both simultaneously in the vast area planted in row crops," said Lindsey Kemmerling, who earned her doctorate while working on the project in the lab of Nick Haddad, a professor at MSU's W.K. Kellogg Biological Station (KBS).

"Prairie strips have broad-ranging effects—including improved soil health and increased biodiversity," said Haddad, who is also the director of the Long-Term Ecological Research (LTER) site at KBS.

The researchers selected narrow areas in research fields where, instead of crops, they planted prairie vegetation native to southwest Michigan. These areas grew into what are known as prairie strips—slivers of land that increase biodiversity by attracting native pollinators and other organisms that are less prevalent on developed land.

The team showed that a prairie strip's flora and fauna brought an array of beneficial "ecosystem services" to the strips and the surrounding farmland, such as attracting more pollinators and increasing pollinator activity.

They also discovered that prairie strips bolstered a plot's natural pest defenses with a larger abundance of spiders, and they attracted more dung beetles, which can break apart manure and liberate nutrients for plants and soil.

Prairie strips, like the one shown here, can be integrated into farmland to promote soil health, increase biodiversity and diminish carbon footprints without sacrificing crop yields.

> **"We hope this work will help springboard future farm diversification."**

They also saw an uptick in soil carbon that was readily available to microbes. The prairie vegetation also grew larger and deeper root systems than annual crops, further enhancing a plot's carbon-storing capacity.

When combined with the right field management practices, it was found that prairie strips could be implemented without compromising crop yield.

"We were excited to see that the benefits of prairie strips for biodiversity and ecosystems in the strips spilled over into cropland," said Haddad who, along with entomologist Doug Landis, had the idea of integrating prairie strips in the middle of managed farmland when he joined MSU about five years ago and became the lead principal investigator of the LTER site. He and his colleagues wondered what other benefits the prairie strips could bring to farms in Michigan and throughout the Midwest, where roughly a quarter of agricultural land was once prairie. In addition to offering ecological advantages, researchers believed that the prairie strips would make economic sense for farmers.

But the researchers stressed that prairie strips aren't a one-size-fits-all solution. They're designed for farms that were once home to native prairies.

There are opportunities to introduce other native plant communities—savanna and woodland, for example—along the perimeters of farm fields. This could increase habitat, biodiversity and ecosystem services in ways that benefit nature and people.

"We hope this work will help springboard future farm diversification," Haddad said.

Big lessons from little fish

Michigan State University scientists have sequenced the first complete genome of the Rio pearlfish *(Nematolebias whitei)*, a three-inch long annual killifish native to Brazil. This work will help researchers better understand the biology and evolution of the species' survival skills and learn how and when genes turn on during development.

Rio pearlfish hatching.

This new study strengthens the Rio pearlfish's potential as a model organism that can lead to further understanding of human health. This is one of the overarching goals of the Fish Evo Devo Geno Lab—evolutionary developmental and genomic biology—led by Ingo Braasch, associate professor.

"The Rio pearlfish is an ideal research organism to study fundamental questions about the genetic basis of animal development and evolution," Braasch said.

These fish live in puddles that form around Rio de Janeiro during the region's rainy seasons. During dry seasons, the pools dry up and the adult pearlfish populations are wiped out. Their eggs, however, survive in the soil by essentially going dormant, entering what's known as diapause.

The dried-out eggs are exceptionally hardy, making them easy to store and transport. Placing the dormant eggs back into water causes them to hatch.

Examining the genetics of the diapause state could provide clues about what's happening at a molecular level in human developmental disorders. Additionally, better understanding of this natural "hypersleep" could help humans using suspended animation to make surgeries safer and extended space travel possible. Because their lifecycles are short, and they age quickly, pearlfish also provide a path to study aging.

Beyond the gut: Exploring big impacts of nature's tiniest worlds

The human gut microbiome has become a part of the public lexicon over the past 10 to 15 years. And now, researchers at Michigan State University are peering into the world of microbiomes in plants and animals, searching for keys to a healthier world.

Hawaiian bobtail squid, glowing.

Elizabeth Heath-Heckman, assistant professor, is studying a species of luminescent bacteria called *Vibrio fischeri* that lives inside the Hawaiian bobtail squid.

"The bacteria and the squid are both easy to raise in a laboratory, and unlike other animals used to study microbiomes, the squids don't rely on the bacteria for any of their nutritional needs or for their immune response," Heath-Heckman said.

The squids have a light organ that sits just above their ink sac that glows with the help of these bacteria. The light organ aids in a camouflaging behavior called counter-illumination, which helps the squids avoid being spotted by predators swimming below them by disguising their silhouette against the bright surface of the water. This is an ideal set-up to study how bacteria affect the physiology and development of a host because it can be easily manipulated.

Because *V. fischeri* is the only bacteria that lives in the light organ, Heath-Heckman can directly tie the changes she sees in the host to the way it interacts with the bacteria. Understanding this interaction can shed light on more complicated associations with microbes in other plants and animals—and even in humans.

Dead bacteria: An overlooked path to antibiotic resistance

Dead bacteria in the soil can still make their presence felt in the land of the living. New research led by Michigan State University integrative biologists is showing that this could have big implications for antibiotic resistance on farms.

A collection of soil microcosms where live bacteria acquired antibiotic resistance genes from dead bacteria.

According to the World Health Organization, one of the biggest threats to food security is antibiotic resistance. Infectious bacteria that can evade antibiotic treatments are huge concerns for the well-being of livestock, the food industry and the public.

"Outside of medicine, antibiotic resistance isn't talked about maybe as urgently as it should be," said Sarah Evans, associate professor.

Evans and her team wanted to take a closer look at how DNA from dead bacteria could introduce antibiotic resistance to living bacteria in the soil. In better understanding that process, the team also explored ways to help stop it.

The researchers collected soil samples from sites around W. K. Kellogg Biological Station, where Evans is also a faculty member. They sterilized the soil and added living cells of the soil bacteria *Pseudomonas stutzeri* along with DNA from antibiotic resistant forms of *P. stutzeri*.

They found that live bacteria could integrate the DNA even when it was present at low concentrations, and live cells that picked up DNA persisted throughout the 15-day duration of the experiments.

Overall, this work demonstrates that dead bacteria are an overlooked path to antibiotic resistance.

This research has already offered ideas on stemming horizontal transfer of antibiotic resistant genes on farms and could have applications in helping researchers promote the transfer of beneficial genes.

Shocker! How fish evolved electric organs

MSU scientists are part of a research team that has made a shocking discovery—how small genetic changes enable weakly electric fish to evolve their electric organs.

"The really striking thing to me is these esoteric fish allow us to understand something profound about how our own genomes function," said Jason Gallant, associate professor.

Electric fish native to Africa (such as this gray elephant fish) and South America (such as the rust-colored knifefish) evolved along different paths to reach the same destination—having an electric organ.

Weakly electric fish are fish that use weak electric signals in a manner akin to bird songs, to communicate with other electric fish and share important information, including their sex and species. They're related to the better-known strongly electric fish, such as electric eels, that can generate enough power to stun prey or zap predators.

All fish have duplicate versions of the same gene that produces tiny muscle motors, called sodium channels. Electric fish turned off one copy of the sodium channel gene in muscle, turned it on in other cells and voila: a new organ was born. This new research is helping show exactly how it happened.

The team discovered a short section of DNA in the sodium channel gene that controls whether the gene is expressed in any given cell. The researchers found that, in electric fish, this control region is either altered or entirely missing. And the implications go far beyond the evolution of electric fish.

"Electric fish are masters of messing with what's usually a very highly constrained biophysical system," Gallant said. "They've become this evolutionary laboratory that allows us to better characterize and understand ion channels."

These findings could have broader implications for human health and disease.

MICHIGAN STATE UNIVERSITY | DEPARTMENT OF **INTEGRATIVE BIOLOGY**

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IBIO grad student places third in national photo contest

Kara Dobson, a Ph.D. student in integrative biology, took third place in the first-ever LTER photo contest, featured at the National Long-Term Environmental Research (LTER) Network All Scientists Meeting held this September in Asilomar, Calif.

Kara Dobson's winning image of the new KBS LTER's rain exclusion and warming experiment. Inset: Kara Dobson

Dobson's photo captures a sunrise on the KBS LTER and includes both the rain exclusion and warming experiments. She won a Jody Grip Tight Tripod, an 8" x 10" print of her winning photo and an LTER hat for her third-place finish.

"I was really thrilled when I heard I had won [third place]," said Dobson, who works with IBIO faculty Nick Haddad and Phoebe Zarnetske. "It was so unexpected, since all of the photo submissions were fantastic!"

Dobson described her photo as follows: "Early morning fieldwork can sometimes have a bright side (literally). For my research, I sample plant chemical emissions from the KBS LTER's new rain exclusion and warming experiment, shown in the photo. To sample these plant chemicals, I have to continuously sample the headspace of the plants for eight consecutive hours to get an accurate reading of plant emissions during the day. This means getting into the field by 7:00 a.m. to begin setting up my sampling equipment. This photo was taken on one such morning, when the sun was just beginning to peek over the tops of our rainout shelters."

"Kara's photo is the only winner without mountains, a body of water, snow or ice—a testament to Kara's creative composition," said Tom Getty, IBIO department chair.

Contest criteria included highlighting the unique research initiatives at one's LTER site and generating photos for the LTER's new photo-sharing website.

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