Researchers tackle spotted lanternflies and bats’ white-nose syndrome

Assistant Professors Matthew Helmus and Jocelyn Behm, along with Associate Mathematics Professor Benjamin Seibold, are investigating the spread and economic impact of the spotted lanternfly planthopper, an invasive insect from Asia. Since first found in Berks County in 2014, it has spread rapidly throughout Pennsylvania, including the Philadelphia region, and threatens $18 billion worth of state commodities—

including vineyard grapes, fruit trees, hardwood trees such as black walnut and maple, and Christmas trees.

With $117,000 in funding from the Pennsylvania Department of Agriculture, researchers are merging data science, field biology and mathematical modeling to predict how the pest is spreading. Helmus is using data science techniques to identify landscape variables associated with increased spread; Behm is field sampling landscape genetics to estimate connectivity among pest outbreaks; and Seibold is constructing mathematical models that calculate where people and their vehicles might inadvertently spread the pest.

The state and USDA will use this information to help with their control efforts. “I do think that control is possible, but I think there is going to have to be a lot more focus by both the public and the government,” says Helmus.

Chair’s Message

Since last spring’s update, the Department of Biology has welcomed 17 new PhD students into biology and has added a new interdisciplinary PhD program in bioinformatics. Our Professional Science Master’s programs (biotechnology, bioinformatics, bioinnovation) continue to attract new students and place them in jobs upon graduation: 96% of graduates are employed in pharma, industry or academic positions or enrolled in graduate or professional school. The biology and neuroscience undergraduate programs remain robust with an increasing number of students taking part in research projects in the Bio-Life Building and beyond. We plan to introduce a new undergraduate major in genomic medicine in fall 2020.

Biology faculty have been active in research around the world with projects in Central America, Haiti, Antarctica, and the marine waters of the U.S. and Costa Rica. Research funding further reflects the breadth of our faculty, with grants on topics as wide ranging as invasive species, brain/neuron function, super-resolution microscopy, human health, development, locomotion and population dynamics.

I thank our students, faculty and staff who come together to ensure a continuing upward trajectory in our reputation locally, nationally and internationally. I also want to recognize our alumni and friends who have contributed to the growth and success of the department.

Robert Sanders
Professor and Chair

bio.cst.temple.edu

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You can contribute to the continued success of the College of Science and Technology and the Department of Biology by supporting scholarships, undergraduate research, graduate fellowships, faculty endowment and innovative programs. Make your gift at giving.temple.edu/givetocst.
Yale cancer research postdoc

Krishna Mudumbi moved from India to the United States at the age of four when his father, a cardiovascular pharmacologist, accepted a postdoc position at North Carolina State University.

At Emory University, he majored in political science. But undergraduate research in a genetics lab led to a master’s degree in biophysics at St. Joseph’s University and, last year, a PhD in biology from Temple.

At St. Joe’s, Mudumbi had investigated membrane proteins surrounding cells—a research area that Temple Professor Weidong Yang wanted to expand. “It’s a rapidly growing field,” says Mudumbi, “Luckily, our interests aligned and I thought his technique was amazing.”

Mudumbi, who was the lead author on four papers either published or submitted while at Temple, is now completing his first year as a postdoctoral fellow at the Yale Cancer Biology Institute. He has built up a core of microscopes for the Yale institute’s four labs. He also is using the same single-cell microscopy techniques he learned under Yang to study signals produced by cell receptor proteins that lead to either growth or differentiation.

“It’s really amazing to be able to provide a lot of answers in a field that is small and shrouded in mystery,” he says.

Breakthrough engineering of zebrafish conditional mutants

As Leonard A. Burg II first learned as an undergraduate in Associate Professor Darius Balciunas’ NIH-funded laboratory, zebrafish have remarkable regeneration capabilities. “We would cut off a tip of the ventricle and within about a month, up to a quarter of the heart would have grown back completely, with no scar tissue and no effect on function,” says Burg, who—at Balciunas’ urging—returned to Temple to earn his PhD, which he expects to do in less than a year.

“I really like working with regeneration and Dr. Balciunas is a fantastic mentor, so the chance to continue working in his lab was a perfect storm,” says Burg.

His doctoral research, which has included a November 2018 paper in PLOS Genetics, involves developing a new CRISPR/Cas9 technique to engineer zebrafish conditional mutants.

“Because some genes that are required for regeneration are also required for development, we needed to be able to knock out a gene specifically in adult fish. We can also knock out a gene at 10 hours into development and 24 hours and find out when the gene is no longer required for development,” says Burg.

The breakthrough technique should enable other researchers to more easily and reliably answer their own research questions, says Burg, who will next seek a postdoctoral fellowship.

Using bioinformatics to determine when species diverged

When Qiqing “Cathy” Tao first entered Carnell Professor Sudhir Kumar’s lab, she was struck by the fact that there wasn’t a wet lab and no traditional bench work was being conducted—just computers analyzing the evolution of human diseases and genomes. “I didn’t know that was possible,” says the Beijing native.

Yet, this December, Tao expects to earn her PhD in bioinformatics and molecular phylogenetics. “The previous challenge for researchers was how to collect data,” she says. “Today, everyone has lots of data. The challenge is how to develop methods to analyze all the available data.”

“That’s why I’m interested in bioinformatics,” adds Tao, whose husband, Xi Hing Cao, earned a PhD in computer science from Temple University this spring.

To answer questions such as how many millions of years ago did chimpanzees and humans diverge, or when did HIV emerge, Tao has worked with Kumar, the director of Temple’s Institute for Genomics and Evolutionary Medicine. They have improved the RelTime timetree approach and—in a first in the phylogenetics field—combined that with machine learning to discover evolutionary rate patterns. Qiqing has published this work and other research articles in top-rated journals.

“It will help researchers analyze big data quickly, even those who don’t have great computing power,” says Tao, who is pursuing a postdoctoral fellowship.

Researchers continued from page 1

Assistant Professor Brent Sewall is the co-principal investigator of a research project aimed at halting the devastating effects of white-nose syndrome on bats that hibernate over the winter in caves and abandoned mines.

First detected in New York state in 2006, the fungal disease is now present in 33 states and seven Canadian provinces. In Pennsylvania, it has reduced populations of three bat species by 90 to 98 percent.

Sewall is collaborating with Professor Barrie Overton, the PI from Lock Haven University, and Greg Turner and Michael Scafino of the Pennsylvania Game Commission, thanks to a two-year, $92,000 grant from the National Fish and Wildlife Foundation. They are investigating whether applying PEG8000, a nontoxic, water-thirsty polymer, to hibernacula during the summer in the absence of bats can effectively inhibit the growth of the fungus that causes white-nose syndrome, and reduce infection when bats later return to hibernate. (In other formulations, PEG is found in toothpastes, skin creams and laxatives.)

“It doesn’t kill fungi or other microbes,” says Sewall. “Rather, it tricks some of them, including the fungus causing white-nose syndrome, into thinking there’s a drought, so the organisms go into a dormant phase. We hypothesize such summer treatments could delay the onset of fungal infection and give bats a better chance of surviving the winter.”
Cordes leads discovery of massive deep coral reef

Associate Professor Erik Cordes was chief scientist for a research expedition that last August discovered a heretofore unknown coral habitat made up of 85 miles of reefs located 160 miles off the South Carolina coast, as reported by the Washington Post, Huffington Post, Weather Channel and NBC News.

The researchers, which included contractors funded by the Bureau of Ocean Energy Management (BOEM) and partners from NOAA and the U.S. Geological Survey, were part of the multi-million-dollar Deep Sea Exploration to Advance Research on Coral/Canyon/Cold seep Habitats (DEEP SEARCH) program, led by Cordes. Their purpose: to collect critical baseline information about deep-water habitats off the Mid- and South Atlantic coast—an area for which the BOEM is issuing seismic testing permits and is considering leasing for oil exploration and production, and developing related management plans.

“This is probably the biggest find that I’ve been a part of in my career,” Cordes says of the mountainous, nutrient-rich reefs a half-mile under the sea surface where the Gulf Stream flows. “The reefs are thousands, if not tens of thousands of years, old. Our goal is to make sure these areas are protected from human impacts in the future.”

Hedges leads effort to preserve diverse Haitian mountain

Carnell Professor S. Blair Hedges and a Haitian CEO have teamed up to establish private nature reserves to protect Haiti’s disappearing species. With funding from Global Wildlife Conservation and Rainforest Trust, the first such park was purchased in January: Grand Bois, a mountain in the southwest of Haiti with rare and endangered plants and animals.

“The native species of plants and animals in Haiti need greater protection,” says Hedges, whose team recently reported, in the Proceedings of the National Academy of Sciences, that Haiti has less than 1% of its original primary forest and is going through a mass extinction of biodiversity. However, they identified a few remaining biodiversity ‘hot spots’ where original forests still exist, including Grand Bois.

His partner is Haitian businessman Philippe Bayard, CEO of Sunrise Airways and president of Haiti’s leading conservation group, Société Audubon Haiti.

Hey honored as AAAS Fellow

Professor Jody Hey, director of the Center for Computational Genetics and Genomics, and co-director of CST’s bioinformatics program, was named a 2018 Fellow of the American Association for the Advancement of Science for his extraordinary achievements in advancing biological science.
Symposium honors acid rain pioneer Gene Likens

In April, the Biology and EES departments hosted a symposium honoring Gene Likens, recipient of the Franklin Institute’s 2019 Benjamin Franklin Medal in Earth and Environmental Science. Likens, president emeritus of the Cary Institute of Ecosystem Studies in New York and distinguished research professor at the University of Connecticut, received the medal for his pioneering long-term studies of forest, stream and lake ecosystems and the impact of acid rain, which led to one of the seminal Clean Water Act bills.

The symposium, “Science Communication: How we do it. How we can improve,” was moderated by Likens, a National Medal of Science recipient. Panelists included Sujay Kaushal, University of Maryland, on urbanization effects on water quality; Nancy Rabalais, Louisiana State University, on coastal dead zones; and Chris Mooney of the Washington Post, who shared a reporter’s perspective. About 40 faculty and students representing 17 academic institutions, as well as independent researchers and science communicators, attended the symposium. Eleven graduate students gave poster presentations.

BIOLOGY DEPARTMENT LAUNCHES COURSES IN ITALY:

• First offered last year by Sicilian native Gianfranco Bellipanni, an assistant professor of instruction, the five-week summer course involves applying biotechnology techniques to address biodeterioration effects to preserve and restore vulnerable historical artifacts in Sicily.

• A six-week independent research and cultural experience in Siena, students conduct research collaboratively for Temple University’s Sbarro Institute for Cancer Research and Molecular Medicine and the Department of Medicine, Surgery and Neurosciences at the University of Siena. The program is overseen by Sbarro Director and Professor Antonio Giordano and Professor Luigi Pirtoli, director of radiation oncology at the University Hospital of Siena.

• Making study abroad possible for STEM students for the first time, this past spring six CST students spent a semester abroad at the Temple Rome campus. Three biology courses were among the classes offered, as well as two math courses for science majors and general education math and earth and environmental sciences courses offered to all students.