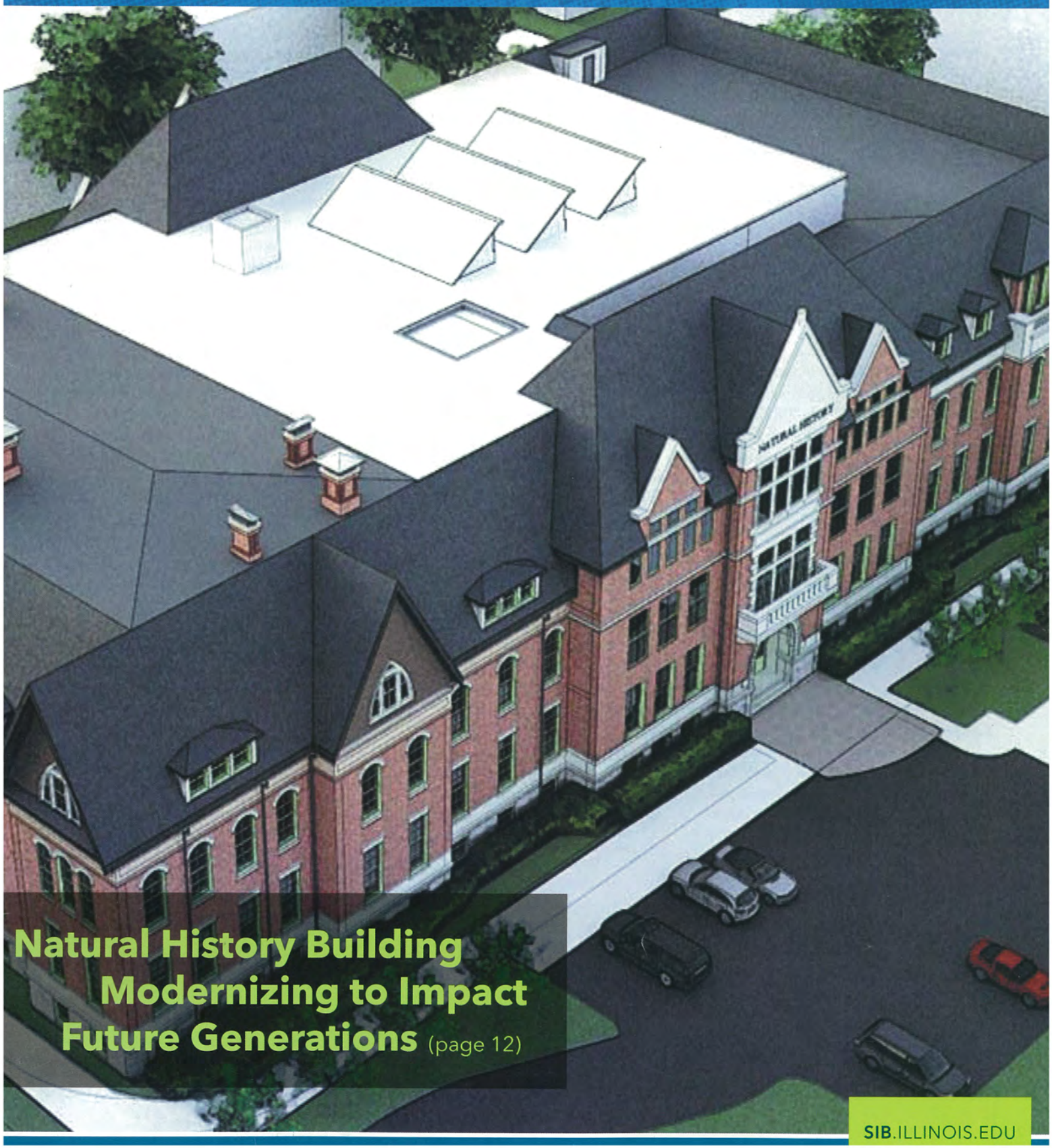
SCHOOL OF
INTEGRATIVE BIOLOGY

UNIVERSITY OF ILLINOIS AT URBANA-CHAMPAIGN • COLLEGE OF LIBERAL ARTS AND SCIENCES

WINTER 2015



Natural History Building Modernizing to Impact Future Generations (page 12)

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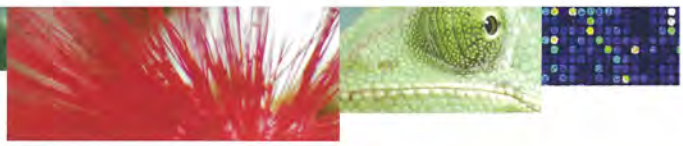

FROM THE **DIRECTOR**

Dear Friends,

I am delighted to welcome you to this most recent SIB newsletter. It has been a while since you last heard from us, and it's my great pleasure to update you on some of the accomplishments and changes that have taken place in the school. I would like to start by acknowledging my predecessor, Evan DeLucia, who served as SIB director from August 2008 to September 2013. His years of excellent leadership had the school running so efficiently that it was easy for me to move into the interim position in 2013 and continue as director beginning in August 2014. Dr. DeLucia is now serving as the director for the campuswide Institute of Sustainability, Energy and Environment and we are excited to continue working with him in his new role. Several other SIB faculty have taken on new administrative roles. Dr. Andrew Suarez is now head of the Department of Animal Biology and Dr. Jim Dalling is the acting head for the Department of Plant Biology, while Dr. Feng Sheng Hu serves as interim associate dean for the biological, chemical, physical, and mathematical sciences in the College of Liberal Arts and Sciences. Of course, we are ever grateful to Dr. May Berenbaum for her continuing service as head of the Department of Entomology.

I am pleased to introduce you in this issue to the six new faculty who have joined us since our last newsletter. In the short time that they have been with us, they have already made outstanding contributions in research, teaching, and service. Our faculty continue to be recognized for their achievements, both in terms of tenure and promotion and by winning numerous campus and national awards. There is never enough room to do justice to everyone's accomplishments, but several of them are highlighted in this issue. For example, the Department of Plant Biology's Feng Sheng Hu was recognized as a new Ralph E. Grim Professor of Geology, and Department of Entomology's head May Berenbaum visited the White House on November 20 to receive the National Medal of Science from President Obama.

The graduate students associated with the three departmental programs, as well as the campuswide programs continue to thrive. This issue also profiles some of that work, including the collaborative efforts of several of our students in popular writing (led by assistant professor Katy Heath). Undergraduates, both in integrative biology and integrative biology honors, are excelling both in and out of the classroom. I am sure that you will enjoy reading about the Fulbright Grant winner Sally Feng and IB honors students Venus Kuo and Finey Ruan.

Many of you will remember your time spent in the Natural History Building. Last May, we temporarily said goodbye to its squeaky floors and maze-like hallways as demolition in the interior began. When it reopens, there will have been a stunning transformation into a 21st-century research and teaching facility. In addition to modern classrooms, teaching laboratories and an honor's suite, we will have, for the first time, a community hub where students, faculty, and academic advisors can come together for individual study, group work, and advising and mentoring.

The newsletter would not be complete without acknowledging the support we have received from our donors. We have both major gifts and smaller gifts that are combined into a larger fund. These gifts support activities such as student and faculty research, teaching initiatives, and student travel for national and international conferences, workshops, and research. Every gift is important, and we are so very grateful to all of the SIB friends and alumni who help support our efforts.

When you are next in Champaign-Urbana, please come and visit us in 286 Morrill Hall.

With my best wishes,

Carla E. Cáceres

Carla Cáceres
Director
School of Integrative Biology

SCHOOL OF INTEGRATIVE BIOLOGY

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"School of Integrative Biology at the University of Illinois"
"Integrative Biology at Illinois"

College of Liberal Arts & Sciences

Major Gift Given by Alexander & Caren Goloff

The SIB Departments of Plant Biology and Entomology are deeply grateful to alumni **Alexander A. and Caren (Collver) Goloff** for their generous gift to be apportioned between a named professorship as well as two graduate student fellowships.

Both Alex and Caren Goloff received their undergraduate and graduate degrees at Illinois. Caren Goloff earned a BA in political science and MA in public administration while Alex Goloff earned his BS, MS, and PhD. From his doctoral work in physiological ecology under Fakhri Bazzaz, Dr. Goloff published a model for seed germination in natural populations in the *Journal of Theoretical Biology* that was cited consistently over the following quarter-century. After graduation he worked for Union Carbide, Cargill, Velsicol Chemical, and Sandoz Crop Protection, capping his career as a highly respected executive recruiter.

The Goloffs' graduate fellowships fittingly honor their parents, Alexander and Ruth (Scherff) Goloff and Frank W. and Roberta (Goodin) Collver. They feel strongly that we are all beneficiaries of both large and small contributions from forebears upon whose shoulders we stand, and that we honor that debt in how we live our lives. The Goloffs "hope that each recipient of the [graduate] fellowship will appreciate that this award is available for them because a chain of people over decades have believed in hard work, strong values, a good education, and a commitment to creating a better world."

Alex Goloff is also an ardent believer in interdisciplinary approaches, as embodied in the mission of the School of Integrative Biology. His worldview was evident in his commencement address to the 2013 graduates of the School of Integrative Biology, where he reflected on parallel, scale-independent patterns in biology: "As with any ecosystem, the human mind or brain has many interacting levels. Some individuals have suggested that populations of neurons move around the landscape of the brain much as any animals, plants, or other types of organisms move about the landscape of their ecosystem. These populations of neurons grow, decay, process, and extract new information and compete with, and are synergistic with, other populations of neurons. The activation of synaptic circuits produces patterns which might be construed to be similar to ecological encounters in any ecosystem."

Again, our heartfelt thanks to the Goloffs for their generous support of biology at Illinois!

DEPARTMENTS AND PROGRAMS

DEPARTMENTS

- Department of Animal Biology
- Department of Entomology
- Department of Plant Biology

UNDERGRADUATE PROGRAMS

- Integrative Biology
- Integrative Biology Honors
- IPS - Entomology

GRADUATE PROGRAMS

- Animal Biology
- Entomology
- Plant Biology
- Program in Ecology, Evolution & Conservation Biology (PEEC)
- Online Master of Science Teaching Biology Program
- Plant Biotechnology Professional Science Master's Degree

SIB BY THE NUMBERS

FACULTY (2014)

Professors	22
Associate Professors	7
Assistant Professors	11

STUDENTS (2014)

Undergraduate Students - 437 total

- Out-of-state - 3%
- International - 2%

Graduate Students

- PhD or combined MS/PhD - 161
- 17 in Department of Animal Biology
- 45 in Department of Entomology
- 39 in Department of Plant Biology
- 34 Program in Ecology, Evolution & Conservation Biology
- 18 in Online Master of Science Teaching Biology Program
- 8 in Plant Biotechnology Professional Science in Master's Degree

DEGREES AWARDED (2013-2014)

Bachelor's	167
Master's	18
Doctorate	22

FUNDED RESEARCH:

Total research support (2014) - $25,841,711

DOE	$1,754,439
NIH	$5,501,431
NSF	$13,418,749
USAID	$1,764,785
USDA	$2,199,476
Misc Federal	$89,000
State	$34,001
Private	$1,079,830

YOUR INNER BAT?

Evo/Devo Approaches Shed Light on Mammalian Evolution in SIB

This year has been "developmental" for **Karen Sears'** lab. In April, Karen and her lab's research on the development of the inner ear in mammals was featured on the PBS documentary *Your Inner Fish* (www.pbs.org/your-inner-fish/home). This TV series explores how we can use the mammalian phylogeny and evo/devo approaches to understand human biology.

Karen and her colleagues also published an article in *Nature* this year that examined the developmental mechanisms that led to digit reduction in mammals (www.nature.com/nature/journal/v511/n7507/full/nature13496.html). They found that convergent loss of digits among groups as different as mice and pigs results from a mix of conserved and novel developmental machinery. This work has provided key insight into how regulatory networks can be used to provide the framework for adaptive evolution across distantly related taxa.

Finally, Karen and her colleagues Liliana M. Dávalos at Stony Brook University, Betsy Dumont at the University of Massachusetts-Amherst, and Stephen Rossiter at Queen Mary University of London received a $1.91 million Dimensions of Biodiversity grant from the National Science Foundation to study the development of sensory structures in bats.

Bat embryo

"The tools necessary to conduct these types of studies are only now becoming standard for organisms that are not typically maintained in laboratories," Karen said. "This new toolkit will allow us to not only track the development of sensory organs, but also to test the action of key genes in the lab. The potential to discover mechanisms relevant to many other species and not just bats is unprecedented."

(Photo by L. Brian Stauffer.)

Advisor Receives Campus Award for Excellence

Tonya Swink, academic advisor in the School of Integrative Biology, received the Campus Award for Excellence in Undergraduate Advising. Swink has offered the "very best and most professional service an adviser can give on a personal level to undergraduates." She is nurturing, yet challenging, with the ultimate goal being to help students take responsibility for their own futures. She considers it crucial to describe every option–even those she may consider to be poor choices–for doing so gives the students a thoughtful method for approaching any decision.

Entomology Professor May Berenbaum Receives National Medal of Science

By Diana Yates, *Inside Illinois*

University of Illinois entomology professor and department head **May Berenbaum** received the National Medal of Science in a White House ceremony November 20. She was one of 10 recipients of the medal, which honors American scientists "for achievement and leadership in advancing the fields of science and technology," the White House press office announced.

As she received her medal in the East Room of the White House, Berenbaum was honored "for pioneering studies on chemical coevolution and the genetic basis of insect/plant interactions, and for enthusiastic commitment to public engagement that inspires others about the wonders of science."

Berenbaum, a Swanlund Chair, joined the U of I faculty in 1980. In addition to her ongoing research on the chemical interactions between plants and insects, she is a nationally recognized authority on insects in general, with a recent focus on threats to insect pollinators and pollinator health. She chaired a committee of the National Academy of Sciences on the status of pollinators in North America, and emerged as a spokesperson for the scientific community on declines in honey bee populations around the world.

Berenbaum has written several books on insect fact and folklore, using wit and her own fascination with insect habits to engage readers. She also founded the Insect Fear Film Festival, an annual event on the Urbana-Champaign campus that addresses insect-related fear and loathing and the film industry's penchant for casting insects as villains.

*Entomology professor **May Berenbaum** received the National Medal of Science award from President Obama at a White House ceremony. (Photo courtesy of National Science and Technology Medals Foundation.)*

Berenbaum has been honored many times for her contributions to science and to the public understanding of science. She is a fellow of the American Association for the Advancement of Science, an elected member of the National Academy of Sciences, a fellow of the American Academy of Arts and Sciences, a fellow of the Entomological Society of America, an honorary fellow of the Royal Entomological Society, and a recipient of the Tyler Prize for Environmental Achievement (2011).

Berenbaum graduated summa cum laude in biology from Yale University in 1975. She earned a doctorate in ecology from Cornell University in 1980 and joined the U of I entomology department that year. She became department head in 1992.

BERENBAUM ELECTED AS FUTURE ESA PRESIDENT

May Berenbaum, professor and head of the Department of Entomology at the University of Illinois at Urbana-Champaign, was elected Vice President-Elect of the Entomological Society of America (ESA). After serving as VP-Elect in 2014, she will be Vice President in 2015 and then ESA President in 2016, the same year that ESA will host the International Congress of Entomology, an event that occurs every four years.

Berenbaum will be the fifth female President in the history of the ESA.

"As ESA VP, I will be honored to help ensure that ESA serves as an effective voice of entomology as a science, and that ESA remains uniquely useful to all insect biologists," Berenbaum said. "Many of the world's most pressing environmental challenges, including climate change, emerging infectious diseases, invasive species, and accelerating biodiversity losses, involve arthropods, and entomological expertise should become increasingly valuable for American science competitiveness. Thus, ESA should continue its efforts to increase its national impact on science policy."

Berenbaum has been an ESA member since 1980, and she has written a column called "Buzzwords" for *American Entomologist* since 1991. She is also the author of many books intended for a general audience, including *Buzzwords: A Scientist Muses on Sex, Bugs, and Rock 'n' Roll; Bugs in the System: Insects and Their Impact on Human Affairs;* and *The Earwig's Tail: A Modern Bestiary of Multi-legged Legends*.

"No one in recent years has written on insects with more learning, passion, and disarming humor than May Berenbaum," wrote E.O. Wilson on one of her book covers. "She is a great friend of the Hexapoda and therefore, ultimately, us."

The ESA is the largest organization in the world serving the professional and scientific needs of entomologists and people in related disciplines. Founded in 1889, ESA today has more than 6,500 members affiliated with educational institutions, health agencies, private industry, and government. Members are researchers, teachers, extension service personnel, administrators, marketing representatives, research technicians, consultants, students, and hobbyists. For more information, visit www.entsoc.org.

Scientists Track Gene Activity When Honey Bees Do and Don't Eat Honey

By Diana Yates, *Inside Illinois*

Many beekeepers feed their honey bees sucrose or high-fructose corn syrup when times are lean inside the hive. This practice has come under scrutiny, however, in response to colony collapse disorder, the massive—and as yet not fully explained—annual die-off of honey bees in the U.S. and Europe.

Some suspect that inadequate nutrition plays a role in honey bee declines.

In a new study, described in *Scientific Reports,* researchers took a broad look at changes in gene activity in response to diet in the Western honey bee *(Apis mellifera),* and found significant differences occur depending on what the bees eat.

The researchers looked specifically at an energy storage tissue in bees called the fat body, which functions like the liver and fat tissues in humans and other vertebrates.

"We figured that the fat body might be a particularly revealing tissue to examine, and it did turn out to be the case," said University of Illinois entomology professor and Institute for Genomic Biology director **Gene Robinson,** who performed the new analysis together with entomology graduate student Marsha Wheeler.

The researchers limited their analysis to foraging bees, which are older, have a higher metabolic rate, and less energy reserves (in the form of lipids stored in the fat body) than their hive-bound nest mates—making the foragers much more dependent on a carbohydrate-rich diet, Robinson said.

"We reasoned that the foragers might be more sensitive to the effects of different carbohydrate sources," he said.

The researchers focused on gene activity in response to feeding with honey, high-fructose corn syrup (HFCS) or sucrose. They found that those bees fed honey had a very different profile of gene activity in the fat body than those relying on HFCS or sucrose.

Hundreds of genes showed differences in activity in honey bees consuming honey compared with those fed HFCS or sucrose. These differences remained even in an experimental hive that the researchers discovered was infected with deformed wing virus, one of the many maladies that afflict honey bees around the world.

"Our results parallel suggestive findings in humans," Robinson said. "It seems that in both bees and humans, sugar is not sugar—different carbohydrate sources can act differently in the body."

Some of the genes that were activated differently in the honey-eating bees have been linked to protein metabolism, brain-signaling and immune defense. The latter finding supports a 2013 study led by U of I entomology professor and department head May Berenbaum, who reported that some substances in honey increase the activity of genes that help the bees break down potentially toxic substances such as pesticides.

"Our results further show honey induces gene expression changes on a more global scale, and it now becomes important to investigate whether these changes can affect bee health," Robinson said.

*University of Illinois Institute for Genomic Biology director **Gene Robinson** led a study of the changes in gene activity that accompany changes in the honey bee diet. (Photo by L. Brian Stauffer.)*

Gene activity changes in response to dietary changes in foraging honey bees, researchers found.

Andy holding a blue-tongued skink in Arnham Land, Northern Territory, Australia.

SABBATICAL DOWN UNDER

By Andy Suarez, professor of entomology and animal biology

One thing all academics look forward to is taking a sabbatical. This past year, I spent six months in Australia where I worked as a visiting scientist with Ben Hoffmann at CSIRO in Darwin. I could not have picked a better place as Ben and his supervisor Alan Andersen are experts in Australian ant ecology, particularly in relation to ecosystem function and biological invasions. The goals of my sabbatical were to start new collaborations between our labs, return to being a field biologist, and get my hands dirty (which happens to be an unavoidable consequence of digging up ant colonies).

Elissa (my wife) and I departed from Illinois on February 10 leaving behind -23° C (-10° F) temperatures and about a meter of snow on the ground. We arrived in Darwin about 30 hours later to find ourselves in 38° C (100° F) temperatures and at the tail end of the monsoon season. We stayed with Ben and his family in Humpty Doo (yes, that is the actual name of a town) for a week until we found an apartment just outside Darwin in Parap. A highlight of living in Parap was the weekend market that was loaded with tropical fruits and food stands representing a wide variety of Asian cuisines.

The trip was remarkably successful from an academic perspective. Our primary research project focused on the invasion genetics of the tropical fire ant *(Solenopsis geminata).* This species originates from Mexico and has spread nearly worldwide including much of Australia. We also performed a series of behavioral experiments to examine why some ant species are more resistant to invasions than others. This work was conducted in Arnhem Land, a 97,000 km² Aboriginal reserve about 500 km east of Darwin that includes Kakadu National Park. As a result of mining activities, the yellow crazy ant *(Anoplolepis gracilipes)* was accidently introduced in natural habitat near the town of Nhulunbuy.

Ben's primary goal is to eradicate this species from the reserve and monitor the recovery of the native community.

The trip also provided opportunities for members of my lab to get involved in collaborative projects in Australia. Bill Wills, Ben, and I have a paper in press on morphological variation among populations of the invasive big-headed ant *(Pheidole megacephala).* Adrian Smith is analyzing the cuticular hydrocarbon profiles of furnace ants *(Melophorus anderseni)* to determine how they can successfully parasitize colonies of meat ants (*Iridomyrmex* spp.). This work is being done in collaboration with an undergraduate student working in Darwin from Terry McGlynn's lab at California State University in Dominguez Hills. Finally, Fred Larabee is sequencing Australian trap jaw ants in the genera *Odontomachus* and *Anochetus* to help resolve species boundaries in Australian *Odontomachus.*

In addition to working in Darwin, I gave talks at Universities and CSIRO labs in Canberra, Adelaide, and Cairns during my visit. We ended our Australian adventure by spending a month in Cairns where we attended the IUSSI conference. After the meeting, I spent two weeks in the Maliau Basin (www.maliaubasin.info) in Borneo to help teach the "Ant Course" (http://research.calacademy.org/ent/courses/ant). A highlight of this course was finding some rare ants including the trap jaw ant genus *Myrmoteras,* the vampire ant *(Mystrium camillae),* and foaming ants in the genus *Pseudoneoponera.*

It is hard to describe how awesome this trip was (with one exception—passing a kidney stone). The Australian wildlife is unlike anywhere else; we saw saltwater crocodiles, wallabies, blue-tongued skinks, and more birds than we could keep track of. However, six months is a long time to be away from friends, family, colleagues, our home, and my lab. We are very happy to back, and are already looking forward to my next sabbatical.

Andy and Elissa on the beach outside of Cairns, Australia.

For more information about CSRIO Ecosystem Services Lab in Darwin, Australia
check out www.youtube.com/watch?v=RHSDGVwIMOo

Want to keep up with recent research and news from the Department of Animal Biology?
Follow us on twitter.com/UIUCAnimalBio and facebook.com/UIUCAnimalBio

Aspiring Scientists Learning to Language Public Understands

Communicating the relevance of one's scientific research to general audiences and developing educational outreach programs are critical to the career success of college professors and researchers, but graduate curricula often fail to help students cultivate these essential skills.

However, a new course at the University of Illinois gives graduate biology students experience in these broader impacts, providing opportunities to learn directly from experts in science communication, curriculum development and grant writing.

The course, called "Amplify the Signal," emerged from plant biology assistant professor Katy Heath's own experience trying to write a grant proposal for the National Science Foundation.

During that process, Heath realized "that I had no training in developing public engagement and educational outreach programs, and I didn't know where to start. I talked to my friends—senior faculty members and assistant professors—and many of us felt really unprepared for that aspect of our jobs."

Upon a suggestion by Carol Augspurger, a professor of plant biology who mentored Heath during her undergraduate work at Illinois, Heath decided to create a course for graduate students to better prepare them for these aspects of their future careers.

The course title refers to the importance of communicating scientific information to broad audiences. And during the course, students learn how to communicate their research with nonscientists and get experience writing grant proposals and developing and evaluating educational outreach programs.

Heath's co-instructor when the course first was offered, in fall 2012, was Elizabeth Bagley, who was then a learning scientist and postdoctoral researcher in the College of Education. Twenty-one graduate students enrolled in the course.

The first segment of the course focused on broader impacts/public engagement and the NSF proposal development and review processes. Guest speakers included NSF program officers and Illinois faculty members who had experience writing and serving on NSF review panels that evaluated grant proposals.

During the second half of the course, the students learned about designing

A new course co-developed by plant biology assistant professor Katy Heath teaches graduate students skills such as communicating about their research with nonscientists and developing educational outreach programs. Part of the "Amplify the Signal" course are graduate students (front row): Cassandra Wesseln, Jennifer Han, and Miranda Haus; and (back row) Rhiannon Peery, Christina Silliman, and Heath. (Photo by L. Brian Stauffer.)

Translate Their Research into

By Sharita Forrest, *Inside Illinois*

outreach projects and submitted proposals for learning activities aimed at young children and which were based upon the students' theses research. Acting as an NSF-style review panel, the class evaluated the proposals, ultimately selecting six to fund and develop as part of a Biodiversity Day that the class hosted at the Orpheum Children's Science Museum in Champaign.

"Learning how to set up and develop a short lesson for children that could be repeated—as well as evaluating its educational effectiveness—was extremely valuable," said Laura Stein, a doctoral student in animal biology whose project proposal on keystone species and the impact of extinction was developed for the biodiversity event. "There were also things to keep in mind that I hadn't considered before, such as looking at schools' curricula to see what they're teaching and what kids of a certain age are expected to know."

"Both Laura and I were heavily involved in outreach before the course [through the Graduates in Ecology and Evolutionary Biology organization on campus]," said classmate Rhiannon Peery, a doctoral student in plant biology. "'Amplify the Signal' really helped us formalize that, learn how to make contacts in the community, and write broader impact statements for NSF."

Magazine editors and science journalists also visited the class, teaching the students the fine art of writing compelling narratives and radio spots about their research for nonscientific audiences.

"I think there's significant interest in scientific content that's presented the right way, and I think that's probably the best way to learn how to do it—to work with experts who already know what they're doing," Heath said.

Stein's essay about her research on the genetics of parenting behavior in fish—and how her data collection in California's Navarro River was disrupted one day by a water-loving dog—was among those published by the local online magazine Smile Politely and featured on its radio show on WEFT-FM (90.1), a Champaign station.

"I had always found it interesting to relate complex ideas in the sciences in an intriguing way," said graduate student Christina Silliman, who worked in the University of Michigan's Museum of Zoology prior to beginning graduate school at Illinois. "I considered going into teaching before, but I just loved science so much. I never really thought that this was something that you could do for a living."

Silliman, who expects to graduate in May with a master's degree in entomology, decided after taking "Amplify the Signal" to do her doctoral work in curriculum and instruction in the College of Education.

Silliman's experiences in the course inspired her to obtain a grant from the Melinda Gray Ardia Environmental Foundation to fund development of entomology curricula for primary and secondary school students and teach it at the schools that she attended while growing up near Grand Rapids, Mich.

Since then, Silliman has designed several other science units and applied for other grants to support her work. Silliman and graduate student Katherine Dana also obtained a grant from the Entomological Society of America to develop a workshop and symposium on the topic of broader impacts, which they presented at the society's national meeting, held last November in Austin, Texas.

"Basically everything that I've been doing I learned in or was inspired by taking 'Amplify the Signal,'" Silliman said. "I really enjoyed that class. It was definitely transformative for me. It was inspiring that I could also use what I learned in the course to get grants to do outreach on my own."

In the post-course evaluations, "100 percent of the students who took 'Amplify the Signal' said they would tell their friends to take it," Heath said, and attributed the course's success to its interdisciplinary content and panel of experts.

Heath expects to offer the course every two or three years, with the next offering likely to be during the fall semester 2015.

A paper about the course, co-written by Heath and the students who took the course, appeared recently in the journal *BioScience.*

FENG SHENG HU NAMED RALPH E. GRIM PROFESSOR IN GEOLOGY

Feng Sheng Hu was named the Ralph E. Grim Professor in Geology this past year. This professorship was established in 1977 through the generosity of Professor Emeritus Ralph Early Grim and his wife, Frances. Professor and Mrs. Grim provided initial funding for this position, which has grown through additional gifts to become an endowed professorship. Dr. Hu's faculty appointment is now split between the Department of Plant Biology (75%) and the Department of Geology (25%).

Professor Grim began his career as a petrographer at the Illinois State Geological Survey from 1931-1950. He became a research professor in the Department of Geology from 1948 until his retirement in 1967. Professor Grim is generally viewed as the founding father of clay mineralogy, and was one of the most distinguished faculty members to have been a member of the geology department. He was among the earliest researchers to apply the technique of X-ray diffraction to the study of clay, and is credited with the discovery of the very important sedimentary mineral, illite, which he named after Illinois. Professor Grim devoted much of his research to solving practical problems involving the use of clay minerals in industry, and was the author of the widely used textbook, *Clay Mineralogy.* Over the years, he supervised 40 PhD students at Illinois, and many have gone on to great acclaim themselves. He also organized and was the first president of the International Clay Committee, which, since 1960, has sponsored important international conferences on clay science. His contributions were recognized by the Roebling Medal of the Mineralogical Society of America, the Legion of Merit from the government of the Ivory Coast, and the Bailey Medal of the Clay Minerals Society. He received an honorary doctorate from the University of Illinois in 1984. Professor Grim passed away in 1989, and Mrs. Grim passed away in 1997.

Dr. Hu received his PhD from the University of Washington in 1994, and joined the faculty of the University of Illinois at Urbana-Champaign in 1998. He served as head of the Department of Plant Biology from 2008-2014, and is currently interim associate dean of the College of Liberal Arts and Sciences where he works with the science departments to promote research, teaching, innovation, and public service. His scholarship integrates biological, geological, and atmospheric sciences, with the overall objective to understand long-term ecosystem dynamics under changing climatic conditions. He and his students have conducted field research from the tropics to the Arctic to address a wide array of global change questions. Research discoveries from the group include abrupt climate shifts, species refugia under extreme climate conditions, and unprecedented recent increases in forest burning. Dr. Hu is the author or co-author of more than 100 scholarly articles in top-tier disciplinary and interdisciplinary journals, including *Science, Nature,* and *PNAS.* He has served as an editor for leading ecological and geological journals *(Ecology; Ecological Monographs; Ecological Applications; Ecosystems; Geology).* He was recognized in 2000 as one of the most creative young faculty in the United States and awarded a Packard Fellowship in Science and Engineering. For outstanding research and teaching, he has been named a University Scholar of the University of Illinois, a Fulbright Scholar in France, and an Invitation Fellow of the Japan Society for the Promotion of Science. Dr. Hu was elected a Fellow of the American Association for Advancement of Science in 2008.

Front row: Thomas Johnson, Feng Sheng Hu, and LAS Dean Barbara Wilson.

Back row: Carla Cáceres, Charles Tucker, James Dalling, Evan DeLucia, and Stephen Marshak.

Alumna Receives Fulbright Grant

Recent IB graduate Sally Feng received a fully funded Fulbright Grant this past year. Sally traveled to the Philippines to conduct research for this academic year. Her project is based in a reef restoration program at the Bolinao Marine Laboratory at the University of Philippines. She will document the growth of a destructive gastropod, as well as develop a formal procedure for its removal. She also plans to engage in environmental education at local schools in Bolinao. After her Fulbright year, Sally will attend graduate school for conservation management and hopes to found a nonprofit organization for marine restoration.

Natural History Building Renovation:

An Investment Setting the Stage for 21st-Century Teaching and Learning

The Natural History Building has been a landmark on the University of Illinois campus for 123 years. The initial building was designed by renowned architect Nathan Ricker—Illinois alumnus and first architectural graduate in the U.S.—and was completed in 1892 to house the Departments of Botany, Geology, and Zoology. Nearly every student who has attended the University has had a class in its lecture halls or walked through its historic hallways, but infrastructure that worked for the 19th and 20th centuries does not meet today's teaching and research demands. In May 2014, the building was closed for a $70 million renovation that will modernize how future generations will learn while maintaining the charm of the architectural details that led to its inclusion on the National Register of Historic Places.

When the building reopens in 2017, it will be home to the School of Integrative Biology's (SIB) undergraduate teaching mission, which incorporates animal biology (formerly zoology), entomology and plant biology, as well as all programs and the Departments of Geology, Geography and Geographic Information Science, and Atmospheric Sciences within the School of Earth, Society, and Environment. SIB will occupy approximately 40% of the building, mostly within the oldest section designed by Nathan Ricker. The modern interior design will provide for a community hub, learning center, advising suite, collections rooms, numerous laboratories for general education and advanced students, staff offices, a dedicated suite (classroom, lab, and communal areas) for the Integrative Biology Honors Program, as well as classrooms which incorporate technology to provide a state-of-the-art learning experience.

"SIB is focused on innovation in undergraduate education by developing and revising our curriculum to cultivate active learning which includes skill-based learning, critical thinking, and analysis meant to prepare students for the workforce," said Carla Cáceres, SIB director and professor of animal biology. "When our students leave the University of Illinois, they are strong, independent thinkers who have spent their undergraduate years in a collaborative environment focused on preparing them for a broad range of career opportunities."

Students will gain skills to examine challenges such as the outbreak of a new infectious disease or the causes and consequences of declining biodiversity. They will combine an understanding of basic natural history with new technologies that will bring breakthroughs in fields such as genomics. The holistic approach of the School of Integrative Biology will prepare students to tackle complex problems ranging from understanding evolutionary processes to developing biofuels.

The Natural History Building will have active learning, flexible classrooms designed to promote innovative teaching and learning. The interior of these classrooms will be completely modular and will have digital screens around the perimeter and on tables to enhance collaborative learning. Another notable classroom will be dedicated to the Merit Program for Emerging Scholars and the College of Liberal Arts and Sciences Access and Achievement Program (AAP). Merit focuses on recruitment and retention of students into the areas of biology, chemistry, and mathematics while AAP provides a supportive learning environment to help students with self-advocacy and academic success who are high achieving but also at high risk. These can be students who graduated top of their class in small rural schools or even in large urban schools but could be at risk of dropping out of the sciences because they may not have had educational opportunities in high school that helped prepare them to succeed at the college level.

1892 — Construction completed and building is dedicated (Architect: N. Ricker); Departments of Botany, Zoology and Geology move in

1897 — Lightning strike causes fire

1908-1910 — South and west portions added to building including a lecture hall and Museum of Natural History (Architect: W.C. Zimmerman)

1923 — Final addition completed (Architect: J.M. White)

1986 — Added to National Register of Historic Places

Leaving a Legacy

SIB is dedicated to ensuring that the school's new space within the Natural History Building will result in a dynamic education and research center to accommodate the latest methods in learning and research while incorporating advanced technology. In order to attain this goal, the school, together with the College of Liberal Arts and Sciences, is offering a unique opportunity for alumni and others to invest in the future of the Natural History Building and also leave a legacy for future generations.

This is a pivotal moment for the future of the Natural History Building and SIB is proud to provide nearly 25 areas within the facility that can be sponsored and named in perpetuity to support the future of the school's teaching mission and provide exposure to the thousands of students—majors and non-majors—who will be impacted by the modernized facilities for years to come. Naming opportunities may be secured via a multi-year pledge with final year's investment made by December 31, 2020.

NAMING OPPORTUNITY HIGHLIGHTS

FLOORS: 1st, 2nd, 3rd, and 4th floors may be named for the entire building.

HONORS SUITE: Incorporates a wet lab for molecular and cellular biology and physiology courses, a dry lab for ecology and evolution courses, and equipment and preparatory rooms. Students will have state-of the-art equipment and continual access to work on independent projects and interact with their honors peers in a community and study room.

LARGE FLEXIBLE CLASSROOM: Designed for active learning, group/collaborative learning, and project-based learning, this modular classroom will incorporate heavy technology use and visualization (2,000+ students per year).

LARGE LECTURE HALL: This hall for 350 students will be used for classes from all colleges across the entire campus as well as for special events such as invited guest lectures and film showings (7,000+ students per year).

SIB HUB: The grand entrance on the 2nd and 3rd floors serves as the community hub and large gathering area for the faculty, staff, and students and will include multiple seating clusters for interactions and study. It will be used for receptions, the annual fall picnic, a showcase for student work, and an information center.

FLEXIBLE SCALE-UP CLASSROOM: 45-seat modular classroom is designed for active learning including group/collaborative learning and project-based learning. It will be used by most advanced integrative biology classes with heavy technology use and visualization (900+ students per year).

MERIT CLASSROOM: Dedicated to the development of "at risk" students with a goal of retaining them in STEM majors (science, technology, engineering, and math) via cooperative learning, problem solving, communication skills, study skills and confidence building (200+ students per year).

FLEXIBLE CLASSROOM: General assignment classroom features a modular design and contains the latest concepts of flexible furnishings. Desks can be arranged in rows for traditional lectures, or in circles or arcs for student collaboration (1,000+ students per year).

ADVISING SUITE: Includes reception area, advising offices, and workrooms, as well as a meeting area for individual conferences with advising staff.

LABORATORIES FOR SIB MAJORS AND NON-MAJORS: Inquiry-based labs to teach concepts and "how to do science" for SIB majors taking core laboratory courses in ecology, evolution, genetics, and anatomy/physiology. Labs for non-majors will be for plant and animal biology courses and introductory biology courses commonly used by students from colleges including Applied Health Sciences and Agricultural, Consumer, and Environmental Sciences (800+ students per lab per year). Smaller laboratories will also be available for advanced students–undergraduate and graduate.

COLLECTIONS ROOMS: Vertebrate collection rooms will be used for courses in vertebrate natural history, mammalogy, ornithology, herpetology, and ichthyology with an entomology collection room to be used in all entomology courses for majors, non-majors, and entomology graduate students.

CONTACT SIB Development Officer Sean Williams at sdwilli2@illinois.edu or (217) 300-4462 for more information on opportunities to invest in the future of the Natural History Building. Gifts can also be made directly to the Natural History Building Renovation Fund (#337834) at www.las.illinois.edu/giving.


SIB HUB

1990 — Construction-related fire

2001 — Museum closed and specimens relocated to other areas of building

2010 — Building partially closed due to structural integrity of floors within 1908 addition

2014 — Entire building closed for renovations

2017 — Reopen as a model for modern higher education

NEW FACULTY PROFILES

JULIAN CATCHEN

As a computational biologist, I am excited to join the dynamic faculty of the Department of Animal Biology in the spring semester of 2015. The University of Illinois represents the end of what has been a long path for me. I grew up in Pennsylvania and received my BS in computer science from Penn State University. After completing my degree, I worked as a software engineer for Intel Corporation in Phoenix, Ariz., writing code for Intel's Pentium fabrication facilities.

I have always had an interest in basic research, and with experience in the private sector under my belt, I decided to return to graduate school, joining the PhD program in computer and information science at the University of Oregon. I am a believer in hybrid skill sets—they can provide fresh perspectives on research problems—but, at that time, there were no established bioinformatics programs in the United States. The University of Oregon's biology program is quite famous for its work in teleost fish, and in particular, zebrafish. Despite my fascination with this research, it was not clear how a computer scientist could join a research program in biology. Fortunately, I found work with John Conery and John Postlethwait studying the teleost whole genome duplication and building tools to identify neighborhoods of conserved gene order left over from this evolutionary event. This work is useful for translating research from aquatic medical models to human disease as well as to answer questions of gene family evolution.

As my dissertation neared completion, the cost of sequencing DNA dropped steeply with the development of new technologies. I became involved in the development of a set of analytical tools (Stacks) associated with a new molecular technique called RAD sequencing, which allows for the generation of thousands of molecular markers cheaply, markedly changing the field of genetics.

I joined Bill Cresko's lab for my postdoctoral research and worked on Alaskan threespine stickleback fish. I was awarded an NIH NRSA fellowship to investigate the role that genome architecture plays in the repeated evolution of stickleback from their ancestral, ocean dwelling form to their derived, freshwater form. I continued to develop the Stacks software system for use with RAD-seq in population genomics and also devised novel techniques to identify key chromosomal changes in stickleback that helped enable their freshwater evolution.

In the Department of Animal Biology I am excited to build a hybrid lab focusing on bioinformatic techniques as well as basic questions in genome evolution. My research will continue to focus on how changes to chromosomal architecture aid or hinder adaptation in the wild and the progression of diseases such as cancer. I plan to extend my work in stickleback to other organisms, such as Antarctic notothenioids which have undergone a number of fascinating adaptations for living in freezing waters.

JESSICA CONROY

Jessica Conroy joined the Departments of Geology and Plant Biology in August 2013 as an assistant professor. Jessica, who holds a 75% appointment in geology and a 25% appointment in plant biology, earned her PhD from the Department of Geosciences at the University of Arizona in 2011. Most recently she was a National Science Foundation postdoctoral fellow in the School of Earth and Atmospheric Sciences at Georgia Institute of Technology. Jessica's research has two main thrusts: using the stable isotopic composition of water to understand variability in the hydrologic cycle, including land-atmosphere and ocean-atmosphere interactions, and reconstructing past climate variability using biological, biogeochemical, and physical proxies in lake sediment records. Jessica's research has a strong geographical focus in the tropical Pacific, with current field sites in the Galápagos and Kiritimati. But, she is eagerly launching new projects closer to home, investigating the paleoecology of fossil gastropods in Pleistocene loess deposits of Illinois and the partitioning of evapotranspiration in the Southern Great Plains, a key region of robust land-atmosphere coupling.

ALEXANDRA HARMON-THREATT

Alexandra Harmon-Threatt is an assistant professor in the Department of Entomology who started in November 2013. Originally from Chicago, she began conducting ecological research as an undergraduate at Washington University in St. Louis while double majoring in environmental science and political science. Although her initial undergraduate work focused on plant biology, she became more interested in the pollinators of her plants and began working on pollinator biology during her graduate work at UC-Berkeley with Claire Kremen. After completing her doctorate in 2011, she began an NSF post-doctoral fellowship at Washington University in St. Louis.

With an estimated 80% of flowering plants benefitting or requiring pollinators, any change in pollinator populations can

have significant effect on natural and agricultural communities. Recent declines in bee populations, in particular, have highlighted how little we know about these important insects in their natural environments. Dr. HT's work focuses on addressing questions that can help improve our knowledge of pollinators in natural environments and also can be applied to conservation. This includes questions such as: What kinds of plants do bees prefer and what role does nutrition play in their decision? Do local or landscape features more strongly structure bee communities? How do bees respond to different restoration methods?

Dr. HT's current work is based in both glade and prairie systems in Missouri. The glades are a highly-fragmented plant community nestled within forests in the Ozark region. These habitats provide excellent natural studies on adaptation to fragmentation and the importance of local and landscape features in maintaining biodiversity.

Fall 2014, Dr. HT taught "Introduction to Environmental Biology" followed by "Conservation Biology" in spring 2015. When she isn't chasing bees or teaching classes, Dr. HT enjoys being outdoors, traveling, cooking, crafts, and spending time with her dog, Sam. She is excited to be here at Illinois and is currently seeking highly motivated undergraduate students to work in the lab. See her webpage at http://life.illinois.edu/harmon.

AMY MARSHALL-COLON

I am thrilled to have joined the plant biology faculty and the School of Integrative Biology.

My interest in biology was first sparked growing up as a beekeeper's daughter in rural West Virginia. Despite numerous bee stings, growing up on a honey farm cultivated my interest in interactions among plants, animals, and the environment. I first pursued a degree in environmental science at Lipscomb University in Nashville, Tenn., then migrated further south to the University of Florida where I used crop and soil management toward the sustainable production of vegetable crops. My inability to drive a tractor in a straight line prompted a swift flight from the field to the lab as I moved to the Midwest to attend Purdue University.

During my PhD I focused my research on using metabolomics to investigate the biochemical pathways involved in the synthesis and emission of floral scent compounds in *Petunia hybrida*. I specifically identified how a genetic perturbation can alter flux within a secondary metabolic pathway.

After graduation I took a short break from the Midwest to pursue post-doctoral training at New York University as an NIH-NRSA trainee.

My most recent research is focused on building dynamic gene regulatory network models and validating regulatory hubs associated with the nitrogen assimilation pathway in *Arabidopsis thaliana*.

These diverse research experiences have influenced my long-term research goals that I continue to pursue at Illinois. My lab focuses on identifying regulatory factors that influence the partitioning of cellular resources between primary and secondary metabolic pathways in response to environmental signals. I aim to apply combined techniques in biochemistry, metabolomics, genomics, and bioinformatics to understand the regulatory interface between primary and secondary metabolism in plants on a genome-wide scale.

Outcomes of this research will inform my teaching program, in which I hope to create the new course "Introduction to Systems Biology." I am excited by all the possibilities for fruitful collaborations and am looking forward to working with the excellent faculty and students within SIB.

JAMES O'DWYER

I came to Illinois from New Mexico in August 2013. This was a major transition: from the Santa Fe Institute to flagship public university, from desert to prairie, from green chile to sweet corn. And while I miss the chiles, I've felt welcome and very much part of a family from day one.

My research also focuses on transitions. I bring a background in theoretical physics, ecology, and complex systems to understand the mechanisms underlying large-scale patterns of biodiversity, aggregated across many species; my goal is to identify the key processes that cause these patterns of diversity to shift from one form to another. How do time-dependent patterns translate into ecological mechanism? Are there transitions in complexity at the level of the community and ecosystem, mirroring evolutionary transitions in complexity of individual organisms, and what governs these transitions? As a faculty member in the School of Integrative Biology I plan to develop general theoretical models to understand and interpret ecological data to address these questions.

My career as an educator at Illinois began in Spring 2014 with IB496JO "Theoretical Biology and Models." The overarching goal of the class is to identify novel biological questions and translate them into a mathematical or computational form. To paraphrase one of my students: The class takes every piece of mathematics they'd ever

(continued on next page)

NEW FACULTY PROFILES

(continued from page 15)

learned, but makes it directly relevant for biology. This was in parallel to developing computational skills in R, a popular environment for statistical computing and modeling. I write this having just seen my first class of students give a symposium of terrific talks on their class projects, and am truly impressed by the results generated in just a short span of time.

My first two semesters have surpassed my expectations, and I'm excited about the potential for collaboration, research, and teaching here in the future.

WENDY YANG

I joined the Departments of Plant Biology and Geology in August 2013. Moving from Berkeley, where I completed my PhD and postdoctoral work, to Champaign-Urbana was quite a change but a welcome one for my family of three (and now four as of July 4, 2014!). Here I have established a Global Change Ecology and Stable Isotope Biogeochemistry lab which includes a new gas chromatograph for analysis of greenhouse gas concentrations and a new isotope ratio mass spectrometer interfaced with an elemental analyzer and a trace gas analyzer. I love my research program because it involves a dynamic combination of wet chemistry, dirty lab work, field work, and method development with the "toys" in our instrument room.

My research focuses on the mechanisms driving patterns in greenhouse gas emissions and rates of chemical transformations in the environment. The structure and function of ecosystems are changing due to pressures from external forcing such as climate change, anthropogenic nitrogen deposition, and species invasion. Through my research I strive to improve our understanding of plant, microbial, and soil dynamics to better predict, adapt to, and mitigate the effects of these global environmental changes. I use a combination of observational and experimental studies in the field and laboratory settings to study both natural and managed ecosystems. One unique aspect of my research has been the development and application of novel analytical and methodological approaches, particularly using stable isotopes, to address some of the most elusive questions in my field. My research program at Illinois includes projects within three major themes: (1) Controls on Soil Greenhouse Gas Emissions, (2) Effects of Anthropogenic Nitrogen Inputs on Ecosystem Carbon and Nitrogen Cycling, and (3) Iron as a Driver of Redox-Sensitive Biogeochemical Cycling.

I taught IB 100, introductory biology for non-majors, for the first time in Spring 2014 and look forward to teaching it each spring semester. Spring 2015 I am also teaching IB 488 "Environmental Stable Isotopes," a new course that I have developed. The goal of this hands-on course is to train students in the theory and practical application of stable isotope techniques so that they are well-prepared to apply these powerful techniques in their own research. This course is cross-listed with NRES, geology, and atmospheric sciences, so we should have an interesting mix of research interests among the students enrolled in the course.

I greatly enjoyed my first year in SIB, and I look forward to getting to know more of you.

FACULTY PROMOTIONS

DR. CARL BERNACCHI

Dr. Carl Bernacchi joined the Department of Plant Biology as an assistant professor in 2008. He was promoted to associate professor in 2014. His research looks into impacts of climate change on crop physiology, energy fluxes between the atmosphere and plant canopies, carbon sequestration, and crop canopy responses to stress.

DR. ANDREW SUAREZ

Dr. Andrew Suarez joined the Departments of Animal Biology and Entomology in 2003. He was promoted to professor and department head of animal biology in 2014. His lab conducts research on ant ecology and behavior, biological invasions, and how polymorphism and specialization contributes to the success of social animals.

IN MEMORIAM: COLIN WRAIGHT

Colin Wraight, a brilliant scientist and a wonderful friend to all of us, passed away on July 10, 2014 at the age of 68, shortly after retiring as professor of biochemistry, biophysics and quantitative biology, and plant biology. Colin will be remembered for his unsurpassed combination of intellect, wit, modesty, and generosity.

Born and educated in England, Colin earned his BSc at the University of Bristol in 1967 and his PhD there in 1971 as one of Tony Crofts' first PhD students. Three seminal papers from his doctorate accelerated acceptance, in the photosynthesis community, of the chemiosmotic hypothesis as a general mechanism for ATP synthesis. Colin went on to postdoctoral work with pioneers of biophysics at that time, at the University of Leiden (L.N.M. Duysens) and at Cornell University (Roderick Clayton), briefly held a position at UC-Santa Barbara and came to Illinois plant biology and physiology and biophysics in 1975.

Throughout his nearly 40-year research career at Illinois, Colin delighted in uncovering secrets of protein-mediated transfer of protons and electrons in energy conversion in chloroplasts, mitochondria, and bacteria using state-of-the-art technologies from genetic engineering to spectroscopy. His research publications demonstrated versatility, thoroughness, and originality. Many of his contributions were teased out of his favorite organism, *Rhodobacter sphaeroides,* a photosynthetic bacterium that was, for Colin and others, a playground for biophysical research. He insightfully recognized how unique properties of *R. sphaeroides* photosynthesis could be exploited in understanding fundamental aspects of proton-coupled electron transfer. Here at Illinois, Colin's work encompassed bioenergetics, photosynthesis, enzymology, membrane biology, and protein structure and dynamics. He was the first to demonstrate that bacterial reaction centers convert light energy to chemical energy with an unexpectedly efficient quantum yield of ~98%. But he was perhaps best known for his work on the electron acceptor side of the bacterial photosynthetic reaction center, establishing the two-electron gate reduction of ubiquinone and how herbicides displace bound quinone from the specific site.

Colin's accomplishments were widely recognized. He was a plenary speaker at the 7th International Congress on Photosynthesis, chaired a Gordon Conference on Photosynthesis, and held a Guggenheim Fellowship. At Illinois, Colin was appointed to the Center of Advanced Study, served as director of the Center for Biophysics and Computational Biology, and head of the Department of Biochemistry. Longtime friend and collaborator Les Dutton gave a moving tribute to Colin and his legacy at the 2014 Gordon Conference on Photosynthesis, citing Colin's full life and insightful research contributions.

Colin was also a passionate teacher and mentor to generations of students and countless colleagues, always sharing his deep understanding unselfishly. He had unmatched breadth, insight and a famously quick wit. He and his wife, Mary, were known for the gracious hospitality they extended to visitors to Illinois. Throughout his long battle with cancer, Colin maintained an active life in research and campus affairs, always enlivened by his quintessentially British self-deprecating, wry sense of humor. He will be remembered by us all as a kind and unerringly sensible colleague in the laboratory, in the classroom, and in routine institutional matters. Characteristically sitting front and center in seminar audiences, Colin would invariably lead off the question period with an acutely incisive query for the speaker, never to call attention to himself, but simply to satisfy his urgent curiosity about biological mechanisms at all levels. Our hearts go out to Colin's family and all who knew and loved him. ●

Read more about Colin at go.illinois.edu/colinwraight.

STUDENT NEWS

FIRST BELL MERIT SCHOLARSHIP AWARDED

We are excited to announce the first merit scholarship for SIB Honors students, funded by a generous gift from Honors alumnus **Oliver Bell.** The Oliver J. Bell Merit Scholarship provides financial support to enrich a student's undergraduate experience, by providing opportunities to engage in activities on campus, in the community, or through study abroad. For 2014, the IB Honors faculty selected sophomore Finey Ruan as the first recipient of the Bell Scholarship. Finey will use her scholarship towards the tuition and living costs associated with study abroad at the University of Newcastle in England. Finey has been accepted at Newcastle as a third-year pre-med student and will complete a year-long program of study and research with an emphasis in neuroscience. We look forward to welcoming Finey back to IB Honors for her senior year in 2015.

Bell made the long trip from France to our campus in May this year and met with Finey and the recipient of the MCB Honors Bell Merit scholarship, Nhan Huynh. Bell was also able to meet with IB Honors faculty, reminisce with Professor Stewart Berlocher about the "Old Honors Program" in the basement of Harker Hall, and take a tour of the spacious future home of Honors in the Natural History Building, currently under renovation. ●

***Oliver Bell** (center) with recipients of the first Oliver J. Bell Merit Scholarship, **Nhan Huynh** (left, MCB) and **Finey Ruan** (right, IB).*

IB HONORS STUDENT TO STUDY SEEDS IN PANAMA

Photo and story by Sean Mattson

(This originally appeared in the newsletter of the Smithsonian Tropical Research Institute.)

***Venus Kuo** is an IB Honors student and recipient of an NSF Research Experience for Undergraduates Grant. She spent the summer on Barro Colorado Island, Panama.*

The hot and humid tropical forest floor voraciously decomposes virtually anything that is biodegradable. So it came as a bit of a surprise when Jim Dalling, a professor at the University of Illinois, demonstrated that seeds from some pioneer tree species can retain their ability to germinate for up to four decades in forest topsoil.

His research, published in *The American Naturalist* in 2009, inspired **Venus Kuo,** an undergrad at Illinois, to find out what keeps seeds viable. She suspects soil fungi. "Do they play some kind of a protective, mutually beneficial role for the seeds?" asked Kuo, as she hiked to the 50-hectare forest plot on Panama's Barro Colorado Island where the seeds for the original study were collected.

Pioneer trees are the first to emerge when a forest regenerates. But they need a lot of light and this is in low supply in the understory. Not until a tree falls and opens a gap will pioneers have a chance to grow into reproductive adults.

Kuo collected seeds from Dalling's sites as well as other spots in the 50-hectare plot where tree census data suggest pioneer species rained seeds on the forest floor decades ago. She tested the seeds for viability and diversity of endophytic fungi, and compared her findings with younger seeds. She expects fungal diversity will be lower in older seeds, pointing to which fungi may promote long-term seed dormancy.

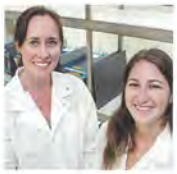
"I think it can probably lead to some interesting questions about how we can predict tree emergence and canopy composition over time," said Kuo. ●

POSTDOC CREATES PODCAST ON ECOLOGISTS AND BIOLOGISTS

Adrian Smith, an SIB postdoc working on chemical communication in insects with Andy Suarez and Larry Hanks, isn't just interested in *science,* he is interested in the *scientist.* What motivates people to become scientists? What keeps them passionate for their work throughout their careers? How to do they communicate science to the public?

To answer these questions, Adrian started the Age of Discovery podcast. His show consists of long-form interviews with eminent ecologists and evolutionary biologists. The interviews focus on stories of personal career paths in science as well as motivations and mentors. The goal of the show is to record personal histories of the guests, getting to know the researchers behind the research. He has interviewed eight scientists so far including Jerry Coyne, Eric Pianka, Joan Strassmann, Marlene Zuk, and SIB's own May Berenbaum. The podcast can be downloaded or streamed for free at the podcast website www.aodpod.com or through iTunes.

SIB Faculty and Graduate Students Featured in *Inside Illinois*



In stickleback fish, dads influence offspring behavior and gene expression

University of Illinois animal biology professor **Alison Bell,** left, and doctoral student **Laura Stein** study how stickleback fish dads influence the behavior of their young. Complete article: go.illinois.edu/Bell_FishDads.

Study: Earth can sustain more terrestrial plant growth than previously thought

University of Illinois plant biology professor **Evan DeLucia** and his colleagues found that land plants have the capacity to produce much more biomass than previously estimated. Complete article: go.illinois.edu/DeLucia_plants.

Scientists say new computer model amounts to a lot more than a hill of beans

Professors **Praveen Kumar,** left, and **Stephen P. Long** have developed a computer modeling system to help plant scientists breed soybean crops that produce more and use less water. Complete article: go.illinois.edu/Long_soybean.

Built-in-billboards: Male bluefin killifish signal different things with different fins

University of Illinois animal biology professor **Rebecca Fuller** led a study of the color-coded signals bluefin killifish display on their fins. Complete article: go.illinois.edu/Fuller_fishfins.

Success of new bug-fighting approach may vary from field to field

Illinois Natural History Survey insect behaviorist **Joseph Spencer,** left, former crop sciences professor **Manfredo Seufferheld,** entomology professor **Barry Pittendrigh** and their colleagues found that different Western corn rootworm populations respond differently to RNAi technology. Complete article: go.illinois.edu/Pittendrigh_bugfighting.

Study: Big-headed ants grow bigger when faced with fierce competitors

University of Illinois entomology professor **Andrew Suarez** (left) and postdoctoral researcher **Bill Wills** discovered that big-headed worker ants grow larger in the presence of other competitive ants. Complete article: go.illinois.edu/Suarez_ants.

(All photos by L. Brian Stauffer.)

School of Integrative Biology Seniors Reflect on Their Major

Graduating seniors answered a survey about their experiences in Integrative Biology. Here, in their own words, they recall the most positive aspects of being an IB major at U of I.

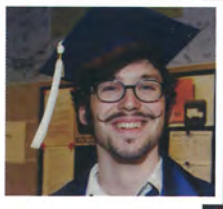
"I loved the courses and faculty, and leave with a very high impression of the IB program."

"The professors were very accessible and awesome at teaching their subject matter. Most of the labs were very hands-on and exciting."

"Gaining a better biological understanding of the natural world as well as the problems facing humanity in the future and a drive to do what I can to improve the future."

"Learning to think critically and develop problem-solving strategies rather than just memorizing facts."

"My analytical skills have increased and my ability to understand how systems work together has increased. I see the world in a different perspective and I have a better understanding where I fit in this world and also how to better the world."



New Master's Degree in PLANT BIOTECHNOLOGY

Plant biotechnology holds great promise for meeting the needs of feeding the world in the face of growing population coupled with global climate change. The sweep of plant biotechnology's influence on sustainable resources and quality of life for all cannot be under estimated. In other words it offers an abundance of opportunities for biologists who desire to engage with some of our most pressing issues in the decades before us.

The Plant Biotechnology MS degree stirs up science with business. To capture students' imagination for plant biotechnology's scope and to prepare them to step into some unique opportunities it offers, the Department of Plant Biology launched a new kind of non-thesis MS degree in Fall 2011—the Plant Biotechnology Professional Science Masters (PSM). While research skills are emphasized in thesis-based graduate degrees, the PSM diffuses the "bench" focus with learning targeted to the interface of science and business. Like the thesis-based MS, the PSM degree values graduate lab- and field-based studies, while also creating experiences to help students transition to jobs "away from the bench" where they will merge their expertise in the fundamental life sciences with the business skills and acumen needed to thrive in the fast-paced global marketplace.

***Grant Hansen,** Marketing Specialist with DuPont and December 2012 PSM graduate, reflects that experiences outside of class, such as his team project with Chromatin Inc., were key to his preparation for his work. "To think our way through a problem that might not have a 'right answer' under a real time constraint is the most effective way to prepare for any work situation."*

Collaborative industry team projects are key to the success of the Plant Biotechnology PSM. Now in its second cohort, the Plant Biotechnology PSM partners with entities across the Illinois campus to provide students with biotechnology fundamentals and a taste for the commercial application of science. This sets the stage for collaborations with industry partners who provide students with crucial "real world" training in the dynamic roles of science and business. One way the PSM accomplishes this is through its team-based case study projects. Through them, the PSM students take on questions of authentic value to their company sponsors.

Both concrete and intangible benefits accrue for PSM students during their team industry projects. They learn to recognize and deal with ambiguity and practice working through a variety of challenges towards their goals. They emerge with knowledge of the dynamics, pace and decision-making in the business environment and often find they have the flexibility to integrate and grow more quickly in a company setting after graduation.

***The Plant Biotechnology PSM December 2014 graduates:** Front row: Andrew Gabalis, Troy Driskell, Xinyi Tu, Julian Alvarado, and Haorui Yang. Back row: program coordinator/advisor Joan Huber and plant biology professor Steve Huber.*

PSM students completed two industry team projects during the 2013-14 academic year. In their first project with **LI-COR Biosciences** (Lincoln, Neb.), the current cohort of Plant Biotechnology PSM students focused on the company's aims of meeting the needs of the plant-based protein research community. The project entailed both hands-on protein-based laboratory research as well as the development of marketing and data analysis of global patterns of protocol preferences among plant protein researchers. In a second project this past year, the team applied business analytics, interviewing skills and research of the primary scientific literature to develop recommendations for a new initiative in the commercial landscape at **Dow AgroSciences** (Indianapolis, Ind.).

The team industry projects are a new direction in the IB curriculum that have the potential to expand to other programs and disciplines. The Plant Biotechnology PSM reaches out to science-based business partners to invite them to collaborate on the development of a case study project. By making valuable contributions to graduate training, the company partners impact the program of study while gaining perspectives on the skills and competencies of potential employees. In turn, the students gain from their business advisors vital feedback of lasting benefit with real experiences in team dynamics, project management and business communications.

Research on Ice

(Left) ***Art DeVries*** *and* ***Chris Cheng*** *in the laboratory on the research vessel Laurence M. Gould. Art is putting on a float coat to go to the back deck while Chris examines an unusual catch.*

Art DeVries and Chis Cheng have been conducting research in Antarctica for over 50 and 30 years respectively. Their research has led to numerous awards and honors over the years and is featured as one of the 10 most important evolutionary discoveries in Sean Carroll's 2008 book *Into the Jungle: Epic Adventures in the Search for Evolution.* This year, DeVries and Cheng continue to receive accolades for their contributions. DeVries received an honorary degree, "Doctor Honoris Causa," on September 19 from Roskilde University in Denmark. DeVries is also the recipient of the 2015 Krogh Distinguished Lectureship Award by the American Physiological Society. Cheng has been been appointed by the NAS/NRC to serve as a member of their Committee for "Developing a Strategic Vision and Implementation Plan for the U.S. Antarctic Program" that will run through Spring 2015, culminating in a NAS/NRC report. The charge for the Committee is to identify and prioritize for NSF the important research the U.S. Antarctic Science Programs for the next decade.

Mateusz Grobelny, a senior in integrative biology, joined DeVries and Cheng in Antarctica this past year where he had a life changing experience:

"By joining Dr. Christina Cheng and Dr. Arthur DeVries in addressing physiological questions surrounding the Antarctic Notothenioids, I was able to embark on a journey to Palmer Station, Antarctica. Starting from the tip of South America, we took a week long voyage across the Drake Passage aboard the Research Vessel Laurence M. Gould. Upon reaching the Antarctic Peninsula we began to trawl the surrounding freezing ocean. Over time, I came in contact with hundreds of extraordinary Antarctic fish, as well as Antarctic benthic fauna-all living in water that is below freezing. Once at Palmer Station, I ran experiments intended to assess thermal preference of Antarctic Notothenioids and stress experiments intended to uncover gene response to changes in water temperature. In between experiments, I was able to explore the neighboring glacier and see stunning icy landscapes. Under Dr. Cheng's and Dr. DeVries' guidance I left Antarctica exhausted but with the knowledge of what it takes to conduct science on one of the harshest continents on planet."

(Left) ***Matt Grobelny*** *with Palmer Station visible in the background.*

(Above background) Palmer Station-64° 46′ 27′ S, 64° 3′ 11′ W. Photo by Matt Grobelny.

(Below) ***Dr. Christina Cheng*** *and* ***Dr. Arthur DeVries*** *bleeding an Icefish,* ***"Chaenodraco wilsoni,"*** *aboard the R/V Laurence M. Gould. Photo by Matt Grobelny.*

As CO_2 Levels Rise, Some Crop Nutrients Will Fall

By Diana Yates, *Inside Illinois*

Researchers have some bad news for future farmers and eaters: As carbon dioxide levels rise this century, some grains and legumes will become significantly less nutritious than they are today.

The new findings are reported in the journal *Nature*. Eight institutions, from Australia, Israel, Japan and the United States, contributed to the analysis.

The researchers looked at multiple varieties of wheat, rice, field peas, soybeans, maize, and sorghum grown in fields with atmospheric carbon dioxide levels like those expected in the middle of this century. (Atmospheric CO_2 concentrations are currently approaching 400 parts per million, and are expected to rise to 550 ppm by 2050.)

The teams simulated high CO_2 levels in open-air fields using a system called Free Air Concentration Enrichment (FACE), which pumps out, monitors, and adjusts ground-level atmospheric CO_2 to simulate future conditions. In this study, all other growing conditions (sunlight, soil, water, temperature) were the same for plants grown at high CO_2 and those used as controls.

The experiments revealed that the nutritional quality of a number of the world's most important crop plants dropped in response to elevated CO_2.

The study contributed "more than tenfold more data regarding both the zinc and iron content of the edible portions of crops grown under FACE conditions" than available from previous studies, the team wrote.

"When we take all of the FACE experiments we've got around the world, we see that an awful lot of our key crops have lower concentrations of zinc and iron in them [at high CO_2]," said University of Illinois plant biology and Institute for Genomic Biology professor **Andrew Leakey,** an author on the study. "And zinc and iron deficiency is a big global health problem already for at least 2 billion people."

Zinc and iron went down significantly in wheat, rice, field peas, and soybeans. Wheat and rice also saw notable declines in protein content at higher CO_2.

"Across a diverse set of environments in a number of countries, we see this decrease in quality," Leakey said.

Nutrients in sorghum and maize remained relatively stable at higher CO_2 levels because these crops use a type of photosynthesis, called C4, which already concentrates carbon dioxide in their leaves, Leakey said.

"C4 is sort of a fuel-injected photosynthesis that maize and sorghum and millet have," he said. "Our previous work here at Illinois has shown that their photosynthesis rates are not stimulated by being at elevated CO_2. They already have high CO_2 inside their leaves."

More research is needed to determine how crops grown in developing regions of the world will respond to higher atmospheric CO_2, Leakey said.

"It's important that we start to do these experiments in tropical climates with tropical soils, because that's just a terrible gap in our knowledge, given that that's where food security is already the biggest issue," he said.

*Plant biology professor **Andrew Leakey** and colleagues report that levels of zinc, iron, and protein drop in some key crop plants when grown at elevated CO_2 levels. (Photo by L. Brian Stauffer.)*

The collaboration included researchers from Harvard University (which led the effort); Ben-Gurion University of the Negev, in Beer Sheva, Israel; the U of I; the University of California, Davis; the U.S. Department of Agriculture's Agricultural Research Service; the National Institute for Agro-Environmental Sciences in Ibaraki, Japan; the University of Melbourne, Australia; the University of Arizona; the University of Pennsylvania; and The Nature Conservancy, Santa Fe, New Mexico.

Free Air Concentration Enrichment (FACE) systems, like this one at the University of Illinois, allow researchers to simulate future atmospheric conditions to determine their effects on plants. (Photo by Don Hamerman.)

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