THE UNIVERSITY OF GEORGIA FRANKLIN COLLEGE OF ARTS AND SCIENCES

PLANTBIO

A DEPARTMENT OF PLANT BIOLOGY NEWSLETTER FALL 2012

Flower Power Masterpieces

Evolution and coevolution from the Burke and Lankau labs

John Burke in the greenhouse with his study plants and Van Gogh's sunflower painting (insert).

Rick Lankau holds the Haines Family Professorship in above-ground ecology.

One of Rick's plots of garlic mustard plants (*Alliaria petiolata*).

The sunflower family (the Compositae) is one of the largest and most ecologically successful families of flowering plants. Species within this family have a flowering head composed of many individual florets. A recent study by professor John Burke showed that the CYCLOIDEA gene family plays a critical role in the development of ray florets, the tiny flowers that ring the sunflower head. Earlier work in Burke's lab involved the cloning and characterization of all members of the CYCLOIDEA gene family from sunflower and showed that there was a huge expansion of this gene family in the lineage leading to sunflower. In a paper that was recently published in PLoS Genetics, Burke's group revealed that the sunflowers in Van Gogh's famous series of 19th-century paintings were carrying a mutation in a specific CYCLOIDEA gene that plays a critical role in the proper development of ray florets, and that the consequence of this mutation was the flower morphology immortalized by Van Gogh. Because of the Van Gogh connection, Dr. Burke´s work received significant attention in the popular press, including articles in *Wired*, History.com, *Scientific American*, Yahoo! News, MSMBC.com, USAToday.com, and *Nature Online News*.

A new study by assistant professor Rick Lankau shows that some native clearweed plants (*Pilea pumila*) have evolved resistance to invasive garlic mustard plants (*Alliaria petiolata*). The study, published in the *Proceedings of the National Academy of Sciences*, is thought to provide the first evidence of coevolution between native and invasive plant species. "It suggests that if you were to take a longer view—a timescale of centuries—that exotic species could become integrated into their communities in a way that is less problematic for the natives," said Rick.

Garlic mustard plant's success is a result of the chemical warfare it wages using sinigrin. This compound, novel to North America, kills fungi that help native plants extract nutrients from the soil.

Through a series of greenhouse and field experiments conducted over three years in five states, Rick has shown that invasive garlic mustard produces more sinigrin in areas where more local plants are present. He found that native clearweed plants, which often grow near garlic mustard, show higher levels of resistance to sinigrin in areas where the two species have a longer history of coexistence. "It looks like the native plants have evolved in response to the traits of the invader," Rick said. Surprisingly, he found that plants resistant to sinigrin actually did worse than their less-resistant-plant counterparts in areas where there was little or no garlic mustard. "It's not all good for those populations that are evolving tolerance because their resistance to the invasive species comes at a cost in uninvaded areas," Rick said.

The findings suggest that the native and invasive species could reach equilibrium over a long period of time. Rick said the study also raises the possibility that humans can help speed this process. He explained that removing invasive species and replanting natives often results in failure, but replacing invasive species with native plants that have had time to adapt to the invader could be more effective. "When people talk about evolution, it's usually in the past tense," Rick said. "But one of the important messages from this study is that it's an ongoing process that can happen fast. And this study suggests that we might be able to jumpstart that process through evolutionarily informed management."

Article by Sam Fahmy, News Director of Franklin College of Arts & Sciences, edited by Rick Lankau.

Here come the (mad) scientists!

Going back to middle school to fight plant blindness by mentoring the next generation of plant biologists

by Lisa Kanizay

Becky Shirk, Jeremy Rentsch, Lisa Kanizay, Stephanie Pearl, Doug Eudy, Jennifer Mandell and Michael McKain are some of our graduate students and postdocs teaching plant biology at Hilsman.

In the spring of 2011, the Plant Biology Graduate Student Association (PBGSA) dedicated a portion of their fundraising efforts to promote science education in Georgia. Stephanie Pearl, Michael McKain, Jeremy Rentsch, Scott Gevaert, Luanna Prevost and I began a rewarding collaboration with Dr. Pamela Stratton, the agriscience teacher at Hilsman Middle School. We also recruited Becky Shirk, Chase Mason, Britnie Foltz and Alan Bowsher to spend one to two days per week working with Dr. Stratton's 7th-grade agriscience classes. Stephanie found that the 7th-grade students were very entertaining and had quite an imagination. She said, "I'll never forget how one of the students approached us before the beginning of our first class, shaking each of our hands and introducing himself as 'Wall Street'. He was very curious about us, asking, "What kind of scientists are you—are you mad scientists? Do mad scientists really like to keep their hands clean? They're always rubbing their hands together."

We worked in pairs, each focusing on activities around plant domestication, systematics, ecology and biogeography. By the end of the semester the 7th graders had been introduced to those facets of plant biology through studying various crop species.

Jeremy had a student exclaim, "What's this green bean looking plant over here?" as she flipped feverishly through her Hilsman Middle School specific plant identification guide. "I found the most plants in my group", she reflected proudly as she tried to identify the mystery plant. Jeremy said, "Many middle school students suffer from 'plant blindness', the inability to thoughtfully observe and identify plants." But not so for the 7th-grade agriscience students at Hilsman Middle School, who recently discovered how to identify many of the flowering plants found commonly on the school grounds.

In turn, these 7th graders taught what they learned to the rest of the class by giving poster presentations on their projects. The class then visited the Plant Biology greenhouses, where Dr. Shu-Mei Chang and manager Mike Boyd led them on a tour of the teaching collections. Dr. Stratton and her students encouraged the continuation of this plant-centered collaboration.

Michael, Stephanie, Jeremy and I decided to expand on the student outreach effort with Dr. Stratton's class for 2012. We focused on new hands-on activities including studying phenotypic inheritance using Wisconsin fast plants (*Brassica rapa*), extracting DNA from strawberries, dissecting flowers and observing vascular transport, plus we incorporated floral morphology, plant genetics and food nutrition into the curriculum.

The raised bed garden at Hilsman Middle School was created by our graduate students.

Sunflowers bloom in the raised bed garden at Hilsman Middle School.

Stephanie Pearl said, "It was a good experience to teach the kids basic skills that we take for granted. For example, when we had each of the students plant their own strawberry seedling, we were surprised to find students enthusiastically burying their plants at the bottom of their pots, not realizing that they needed to be planted just below the surface. This situation became a 'teaching moment' for both parties: the students learned how to properly do transplants, and we learned the need to more clearly articulate basic skills and expectations to students at this grade level."

Also, as a new component of the outreach efforts, the graduate students began constructing permanent gardens under the direction of Horticulture student assistant Chris McDowell on the premises of Hilsman Middle School. They built raised beds that will enhance the lesson plans plus created an outdoor teaching area and a community garden space for the students and their families.

UGA faculty members contributed to the success of the project. Dr. David Berle provided expertise and resources for the raised beds, and Dr. Brigitte Bruns provided Wisconson fast plant seeds, supplies and space to grow them. Drs. John Burke and Jim Leebens-Mack and our department graciously provided funding for the 2011–12 school year. These collaborations and the help of other graduate students and postdocs, including Alex Harkess, Alex Matte-Santos, Britnie Foltz, Uma Nagendra, Ethan Milton, Jennifer Mandel, Bryan Prelgovisk, Karolina Heyduk, Dakotah Campbell, Chelsea Cunard, Emily Peeden, Ed McAssey, Doug Eudy, Drew Pearl and Taylor Ladd have made this outreach effort a huge success.

DEPARTMENT NEWS

Michelle Momany
Professor and Department Head

This fall (2012) PBIO began required research rotations for our first-semester graduate students. These rotations will give our students broader exposure to research and strengthen ties within the department, but they will also add to the heavy work load that first-semester graduate students carry. It takes $8250 to support a first-semester graduate student and we typically have six first-semester students who are supported through teaching assistantships. I recently wrote many of you asking for help. I'm happy to report that because of the generosity of several current and former PBIO faculty members and alumni, we now have enough to cover two new students next fall. We're also working towards endowing a scholarship fund to give more sustained support for our graduate students in the future. If you think that you would like to help in this effort to support first-semester graduate students, follow the "Giving Opportunities" link from our homepage www.plantbio.uga.edu. From either the "Ways of Giving" or the "Give Online" links, designate The Plant Biology Graduate Student Fund for your gift.

We are also starting to plan a special event for PBIO alumni, emeritus faculty and friends of the departement next fall, tentative dates August 18–19, 2013. If you've been looking for an excuse to come back to Athens, you might want to save the date.

Regards,

momany@plantbio.uga.edu;
706-542-1811

Q&A

Chlamydomonas to corals

Catching up with Gregory Schmidt and his former student, Leslie Sieburth

Interviewed by Beth Richardson

Gregory at the piano. His wife Brigitte says, "it is his passion; it anchors the family."

Gregory in the lab circa 1979.

Gregory Schmidt's studies of algal photosynthesis have run the gamat from biochemistry to mRNA stablization. His former student Leslie Sieburth is still investigating mRNA stability but working with *Arabidopsis* in her lab at Utah.

Q You received your Ph.D in cellular and developmental biology in 1975. What did you work on?

A My Ph.D. work was at SUNY Stony Brook with ever ebullient Harvard Lyman, studying photoreceptors for light-dependent chloroplast development in *Euglena gracilis*. My work, revealing synergism of blue light and chlorophyll-dependent components, entailed extensive assays of Calvin cycle enzymes, electron microscopy and measurements of chloroplast DNA levels (by cesium chloride density gradient centrifugation in a Beckman Model E). UV target analyses in wild type and mutants revealed mutants to have distinct defective photoreceptors.

As a postdoc at Rockefeller University, I was responsible for obtaining fresh wheat germ from Kansas millers and making preparations for cell-free protein synthesis because kits were nearly nonexistent in the pioneer studies of import of nuclear-encoded proteins into chloroplasts and microsequencing of the Rubisco small subunit precursor.

Q You came to UGA in the fall of 1979. Tell me about the major breakthroughs that have occurred in your lab. I understand that your graduate students Leslie Sieburth (featured in this article) and Gerry Plumley contributed greatly to those groundbreaking discoveries.

A Initially, my lab continued to pursue chloroplast protein import and showed the necessity of "transit sequences" of the precursors. Then our focus shifted to other aspects of chloroplast biogenesis. My postdoctoral research also included isolation and characterization of photosynthetic mutants of *Chlamydomonas* for identifying the functional roles of chloroplast proteins. Nearly all the mutations were in single nuclear genes but were required for biogenesis of many associated proteins. A major finding early on, with studies of Rubisco, was that failure to complete assembly of small subunits with chloroplast-encoded large subunits is followed by extremely rapid degradation of the unassembled proteins. Posttranslational regulation by proteases is now a paradigm in biology, but at the time reviewers considered it an unbelievably wasteful control mechanism. Later, we found parallels in the biogenesis of the complex Photosystem II reaction center array as well, accounting for the "pleiotropic" effects of a single gene mutation. Probing deeper, my graduate student Leslie Sieburth found that nuclear gene products interact with specific chloroplast mRNAs to enable their stabilization for protein synthesis. Other neat findings were those of nuclear-encoded proteins involved in both cis- and trans-splicing of chloroplast transcripts and those that enable selective translation of chloroplast mRNAs. We also worked on communication from plastids and on the roles of porphyrins. Gerry Plumley, who has been highlighted before in the newsletter, began work on antenna complexes and convinced the world that xanthophylls don't just embed in photosynthetic membranes but are essential structural components of light-harvesting proteins. Gerry also initiated studies of gene expression consequences of chlorosis-inducing nitrogen deficiency.

Leslie Sieburth during her graduate school days at UGA.

Leslie with her daughter Emma on a recent trip to Mexico City.

Q Recently your research mentoring involves interdisciplinary work with students from ecology and other disciplines. Has your research emphasis changed due to these interactions?

A My current research focuses on the symbiotic algae of corals and relatives and their physiological role. The new orientation began with Mark Warner from Ecology. He and his graduate advisor Bill Fitt inquired about help with coral photosynthesis measurements. I soon became Mark's co-advisor and later postdoctoral advisor as we discovered that coral bleaching is initiated at elevated temperatures through failure in the repair of Photosystem II reaction centers. Since then, we've made correlations between the genotypic variants of *Symbiodinium* of different coral hosts worldwide and physiological distinctions in their temperature sensitivities. Some corals, for example, can withstand high temperature/high light because of alternative photosynthetic pathways we've identified. Current grad student, Clint Oakley, has developed novel technologies for studying carbon fixation/oxygen exchange and electron transport simultaneously. Further distinctions of symbionts are being revealed at those levels, and some of the features are utterly mystifying to us (at the moment).

Q If you had one wish for the department, what would it be?

A I wish that faculty and students, particularly those immersed in the uncertainties of truly novel research, will always be provided with exceptional and patient support.

Meet Leslie Sieburth

Dr. Leslie Sieburth is a professor in the Department of Biology at the University of Utah. She completed her dissertation "The Role of Nuclear Gene Products in Photosystem II Biogenesis" in 1990 with Gregory Schmidt. She uses *Arabidopsis* to study leaf development. As with her Ph.D. research at UGA, she used forward genetic approaches to identify pathways critical for normal leaf vein patterning. This led to identification of mRNA decay pathways, which are now being dissected in detail, and identification of a novel root-to-shoot signaling pathway.

Q Tell us about your graduate student days at UGA.

A My graduate experience was simply wonderful. When I arrived in Gregory's lab, I carried out a screen to find photosynthetic mutants. After the screen, I used various tools to figure out how Photosystem II was affected in each mutant. It was a period of discoveries and surprises. It really made me feel as if my possibilities were unlimited.

Gregory was a very supportive advisor, and my experiences in his lab were instrumental in setting me on the path for my current career. I was lucky to have a project at the interface between genetics, cell biology and even a little biophysics. Lee Pratt was one of my committee members, and I think he did the most to help me learn to write. Sue Wessler, Russell Malmberg and Rich Meagher all were generous with their time and taught me much about genetics. The camaraderie among the students and support from other members of the lab also made it a very fun and special time. One final note on my grad school days…there was a time when there were insufficient funds for a departmental Christmas party, and I organized an herb sale, put on by the grad students, largely to pay for the next year's Christmas party. I think that herb sale continues today. (Ed Note: Yes, it does!)

Q Has mentoring students become the favorite part of your job?

A I really love my job—and certainly the students are one of the best parts. I especially like to mentor women and help them figure out whether science is their passion and help them to believe in themselves. The undergraduates can be a lot of fun—they bring a certain energy and naiveté that is truly refreshing.

Q What are you doing when you're not working in the lab or teaching?

A My passion is travel. However, John (Mackey) and I have a 13–yr–old daughter and 16–yr–old son. They keep us busy with their interests. Emma competes with a local gymnastics team, and Wyatt loves math competitions and debate. Other things I enjoy doing include hiking, bird-watching, cross-country skiing, gardening and tending my small flock of chickens. Despite missing the ocean, we enjoy living in Utah because of its amazing outdoor opportunities and the excellent opportunities at the University of Utah.

RECOGNITION AND NEWS BRIEFS

Melanie Smith retired from UGA on April 30, 2012. Thank you Melanie for 24 years of great service at the greenhouse and in the teaching labs.

Susan Watkins was recognized for 25 years of service at the Franklin College Staff Awards event. L-R Associate Dean **Russell Malmberg**, PBIO department head **Michelle Momany, Susan** and Dean **Hugh Ruppersburg**.

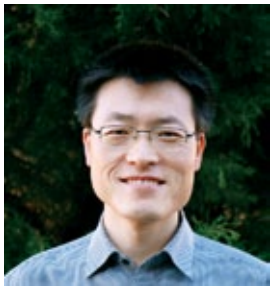
Andy Paterson was awarded a Regents Professorship effective July 1. Congratulations Andy!

Shu-Mei Chang received the Sandy Beaver Excellence in Teaching Award

Kelly Dawe received a Distinguished Research Professorship.

Jonathan Gent (*Dawe Lab*) received a Postdoctoral Research Award.

Michael Hahn received the Creative Research Medal.



Chang Hyun Khang is a new faculty member working on rice blast disease caused by the fungus *Magnaporthe oryzae*.

Megan Connell is a new member of the front office staff.

Greg Cousins is a new staff member working in the greenhouse.

Cecily Hill is our new super accountant.

Beth Richardson is retiring on November 30. She managed the EM lab for 19 years.

HERBARIUM NEWS

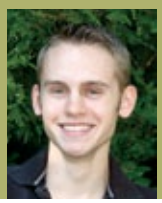
In 2011, we welcomed new collections manager, **Brenda Wichmann**. Brenda grew up in Westminister, Colorado. She made her way to the Southeast where she received a BS degree (1999) from Wofford College in Spartanburg, SC and a MS in Botany (2009) at NC State—Raleigh. While in school, Brenda cofounded the Floristics Alliance, a student-based organization with the mission to engage students in the pursuit of herbarium research and the collection of plants for scientific endeavors. In her last job Brenda worked as an assistant curator of collections for the University of North Carolina—Wilmington from 2009–2011, and she served as vice chair for the Southeastern Chapter of the Ecological Society of America (2009–2011). Her interests include floristics, phytogeography, digitization of herbarium collections and bioinformatics. At UGA, Brenda is involved in a NSF funded project to produce a digital atlas of the vascular flora of Georgia. The atlas will have links to specimen images and label data. Welcome Brenda!


BOWSHER


DONG


CANNON


ISHIBASHI


MASON


OAKLEY


PEARL


RENTSCH


WANG

GRADUATE STUDENT AWARDS

Bowsher, Alan – *Donovan Lab*
PBIO Graduate Student Association Research Assistance Award, 2011; Grad School Presidential Fellowship, 2011; Palfrey Small Grant Award, 2012

Cannon, Jeff – *Peterson Lab*
Jaworski Student Travel Award, 2012

Comer, Jason – *Zomlefer Lab*
Departmental Palfrey Supplement, 2011

Couto-Rodríguez, Mara – *Momany Lab*
Genetics Society of America Travel award, 2011

Dong, Ling – *Leebens-Mack Lab*
Outstanding Teaching Assistant Award, 2012; Palfrey Small Grant Award, 2012

Harkess, Alex – *Leebens-Mack Lab*
Palfrey Small Grant Award, 2012

Ishibashi, Caitlin – *Burke Lab*
Jaworski Student Travel Award 2012

Kerry, John – *Leebens-Mack Lab*
GACRC support to attend NVIDIA sponsored GPU Technology Conference, 2012

Mason, Chase – *Donovan Lab*
Departmental Palfrey Supplement, 2011 PBIO Graduate Association Research Assistance Award, 2011; Graduate School Assistantship, 2011; PBIO Graduate Student Symposium 2nd place poster, 2011; Graduate School Travel Award, 2011; Rosemary Grant Award, 2011

Milton, Ethan – *Donovan Lab*
Palfrey Small Grant Award, 2011

Oakley, Clint – *Schmidt Lab*
3 year EPA STAR Fellowship, 2010 - 2013

Pearl, Stephanie – *Burke Lab*
PBIO Graduate Student Symposium1st place (tie) oral presentation, 2011; PBIO Graduate Association Research Assistance Award, 2011; Palfrey Small Grant Award, 2011, 2012; NSF Doctoral Dissertation Improvement Grant (2011-2013)

Lisa Donovan presented **Michael McKain** (*Leebens-Mack Lab)* with the 2011 Wilbur Duncan Award for Outstanding PBIO Graduate Student. **Michael's** other awards include: Outstanding Teaching Assistant, 2011: Duncan Award for Outstanding Graduate Student, 2011; GRSC 7770 Graduate School Teaching Assistantship, 2011; International Botanical Congress Travel Award, 2011; Future Faculty Program, UGA; Palfrey Small Grant Award, 2012

Prelgovisk, Bryan – *Chang Lab*
Highlands Biological Station Grant, 2011; Palfrey Small Grant Award, 2011; Georgia Native Plant Society Jean Reves Grant, 2011–2012

Rentsch, Jeremy – *Leebens-Mack Lab*
PBIO Graduate Student Symposium 1st place (tie) oral presentation, 2011; Palfrey Small Grant Award, 2011; Outstanding Teaching Assistant Award, 2012

Rodríguez, Yainitza – *Momany Lab*
Graduate School Dissertation Completion Award, 2011

Shirk, Rebecca – *Hamrick Lab*
NSF GRFP Fellowship, 2012; Graduate School Assistantship, 2011; PBIO Graduate Student Symposium 2nd place oral presentation, 2011; Graduate School Travel Award, 2011

Snyder, Luke – *Peterson Lab*
Outstanding Teaching Assistant, 2011; Departmental Palfrey Supplement, 2011

Stephens, Jess – *Malmberg Lab*
Sigma-Xi Grants-in-Aid of Research, 2011

Sugiyama, Anna – *Peterson Lab*
Explorers Club Exploration Fund, 2011; Graduate School Travel Award, 2011, 2012; Foreign Travel Assistance Award from OVPI, 2012

Wang, Li – *Zhang Lab*
Jaworski Student Travel Award, 2011

Wygant, Elise – *Donovan Lab*
Departmental Palfrey Supplement, 2011; G. A. Harris Fellowship from Decagon Devices, 2012

Like us on Facebook.

Search UGA Plant Bio on your Facebook homepage.

THE UNIVERSITY OF GEORGIA FRANKLIN COLLEGE OF ARTS AND SCIENCES

PLANTBIO

DEPARTMENT OF PLANT BIOLOGY
www.plantbio.uga.edu
Miller Plant Sciences Building

FALL 2012 ISSUE

Department Head
Michelle Momany

Editor and Writer
Beth Richardson

Contributing Writers
Sam Fahmy, Lisa Kanizay

Photo credits: Paul Efland (Burke), Peter Frey (Hahn), Stephanie Pearl (Hilsman garden), Brigitte Bruns (Schmidt at piano), Leslie Sieburth, and UGA photo services (mustard plants and Paterson). All other photos by Beth Richardson. Dogwood Drawings: Wendy Zomlefer, *Guide to Flowering Plant Families.* The UNC Press.

ALUMS—Let us know what you're up to these days. Email beth@plantbio.uga.edu

Department of Plant Biology
The University of Georgia
Athens, GA 30602-7271

Nonprofit Org.
U.S. Postage
PAID
30086
1176

Your support makes a difference to the future of our dedicated and talented graduate students!

❑ Yes! I want to make a contribution to the **Plant Biology Graduate Student Fund.**

Make a gift by mail with the form below or securely online at: www.plantbio.uga.edu/giving_opportunities/

Make checks payable to the UGA Foundation and mail to:

The UGA Foundation
Milledge Centre, Suite 100
394 S. Milledge Avenue
Athens, GA 30602-5582

Thanks!

❑ $25 ❑ $50 ❑ $100 ❑ $500 ❑ Other: $_____

Name _____

Address _____

City _____ State _____ Zipcode _____

AFASPBIO212