

biology update

CASE WESTERN RESERVE UNIVERSITY DEPARTMENT OF BIOLOGY

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Andrew Lund and Emily Haines at the Bosque Rio Abajo research site

Undergraduates Gain Summer Research Experience in the Tropics

By Ana B. Locci and Joseph Koonce

During the first week of February 2010, Case Western Reserve juniors Emily Haines and Andrew Lund traveled to Puerto Rico to start their undergraduate research experience in tropical systems at the Universidad de Puerto Rico (UPR) as part of the Summer Program for Undergraduate Research (SPUR). During their trip, the students visited the Humacao Campus for a project planning meeting, toured research laboratories, met UPR students and visited two research sites in the El Yunque and Bosque Rio Abajo forest reserves.

weeks with two UPR professors, Denny Fernandez and Raymond Tremblay, to begin a comparative study of the physiology and distribution of a native and an invasive orchid species. The project team will do field experiments within the Bosque Rio Abajo, located in the northwest part of the island of Puerto Rico. Emily and Andrew will also have the opportunity to stay for three days at the El Verde Biological Field Station in El Yunque National Park and work with international research groups in tropical ecology.

At the end of May, Emily and Andrew will be back in Puerto Rico to work for four

continued on page 4

INSIDE

How Do Species Respond to Changing Environments?	2
Undergraduate Feature: A Broad and Thorough Foundation	4
Gelfand Science and Engineering Fellows	5
Letter from the Chair	6
Faculty Highlights	7
Graduate Student Highlights	7
Two RIBMS Students Win Recognition	8

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How Do Species Respond to Changing E

By Mike Benard

Since life originated, all species have faced changing environments. Today, human activities are altering the environment at a much higher rate than in many other periods of evolutionary history. These changes include the introduction of new predators, competitors and disease, the fragmentation of formerly continuous habitats into “islands,” and climate change.

There are a variety of ways that a species can respond to these rapidly changing environments. First, a species may go extinct, unable to survive in the new environment. Second, a species may survive, but with drastically reduced numbers of individuals. Third, a species may move, changing its geographic range. Fourth, a species may evolve, adapting to the new environment.

The goal of research in my laboratory is to understand the factors that determine why species respond to changing environments in a specific way. Ultimately, this work will lead to the development of general strategies that can be used to assess extinction risk and develop conservation plans for a wide range of animal and plant species.

Much of the current research in my lab focuses on the wood frog (*Rana sylvatica*). The wood frog has a two-stage life cycle, in which it spends its early development as a tadpole in small temporary ponds (i.e., vernal pools) and its later development in forests as a terrestrial adult. Once geographically widespread, wood frogs are becoming increasingly threatened as formerly continuous forests are fragmented by urbanization. Wood frog populations in fragmented habitat become smaller and less genetically diverse than those in continuous habitat. Thus, wood frogs are an ideal model system to test the predictive power of different modeling techniques that use habitat characteristics, population modeling and information on genetic diversity to estimate extinction risk.

Much of my research takes place at the University Farm, where I have set up 100 artificial ponds, each capable of holding up to 1,100 liters of water. These artificial ponds allow my colleagues and me to experimentally manipulate specific characteristics of the natural ponds. The data from these experiments can then be incorporated into population models to predict how changes in environmental conditions, such as reduced genetic diversity or increased predation risk, affect overall extinction risk.

Ultimately, this work will lead to the development of general strategies that can be used to assess extinction risk and develop conservation plans for a wide range of animal and plant species.

I began my first experiments at the farm in 2009, working with research assistant Kathy Krynak, CWRU undergraduate Andrew Zajac, CWRU graduate student Sarah Kyker and Holden Faculty member David Burke. My colleagues and I manipulated tadpole genetic diversity and environmental factors (predators, resources), and then measured tadpole development and survival as well as additional ecological variables. We found that genetic diversity not only affected the tadpoles, but also affected the rest of the aquatic community, including algal growth, zooplankton abundance and bacterial diversity. These results demonstrate that reduced genetic diversity in a single species can have drastic consequences for the other species with which it coexists.

In addition to the experimental work at the University Farm, I have also begun a series of quantitative surveys of amphibians and invertebrates living in wetlands in the Cleveland Metroparks and the Holden Arboretum. From our preliminary surveys on 30 wetlands in 2009, we have identified several environmental variables (i.e., whether the surrounding terrestrial habitat is forested, agricultural or urban) that strongly affected amphibian

Environments?



From left: Mike Benard, Heidi Wintersteen (volunteer), Nick Zaringa (volunteer), Tim Krynak (Cleveland Metroparks naturalist), Kathy Krynak (CWRU research assistant). Photo by Mike Benard

and invertebrate species diversity and abundance. We will expand this survey in 2010 and future years. The data from these surveys will provide an opportunity to test predictions generated from the experiments at the University Farm.

Finally, I have recently begun developing an exciting new method for remotely collecting valuable ecological data on amphibian populations. This builds on long-term ecological studies I have been conducting at the University of California Natural Reserve System's Quail Ridge Reserve since 2001. In December 2009, we encircled a single small pond at Quail Ridge with a drift fence. Around the edge of the fence are openings to allow California Newts to enter the pond during their annual breeding migration, and above each opening is a motion-activated infrared digital camera. As newts pass through the openings, they are digitally photographed. The photographs are transmitted via Quail Ridge's wireless mesh network to the Quail Ridge server, and then downloaded to a computer in my CWRU lab for analysis.

Our preliminary tests have shown that we have the ability to set up and run this type of remote monitoring system, but more work is needed to validate the quality of the data. If our system can produce accurate estimates of amphibian population size, it will be of interest to biologists in academia, government agencies or ecological consulting companies that seek to monitor amphibian populations but cannot maintain the considerable person-hours needed to study the population dynamics with traditional methods. •



A wood frog (*Rana sylvatica*) tadpole.
Photo by Mike Benard

Undergraduate Feature: A Broad and Thorough Foundation

By Caitlin Burkman (Biology 2010)



I came to Case Western Reserve as an undergraduate with the intention of majoring in Geology and Evolutionary Biology. My goal was to become a paleontologist. However, when I took my first introductory biology class, I became hooked on living systems, everything from genetics up to ecology. After attending

a few talks at the Cleveland Museum of Natural History on insects, birds and current environmental issues, I decided the biology department should be my academic home. The insect talk was particularly fascinating and helped lead to my decision to become an entomologist. I wondered if I should transfer to a university with an entomology major, but instead decided to keep my foundation in traditional biology strong.

In the Department of Biology at CWRU, I found a range of classes that covered almost all aspects of the field. I knew I

would be able to satisfy my many interests—there was even an entomology class! Luckily, I began working with Dr. Mark Willis, the entomologist in the department, in my freshman year. Since then, I have conducted summer and SAGES capstone research projects in his lab. I believe the broad and thorough foundation provided by the faculty in the biology department at CWRU has prepared me very well for my future work. In the fall I will begin graduate studies in the entomology department at The Ohio State University, studying urban ecology and pollination.

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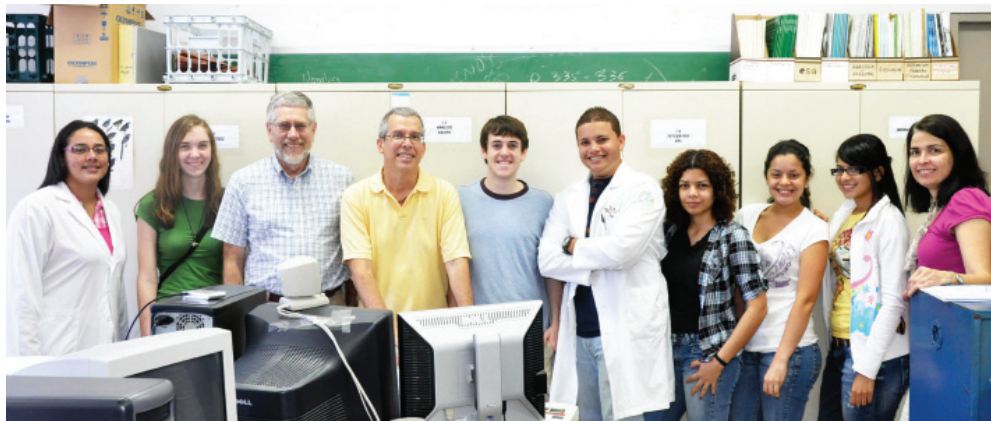
I knew Caitlin was special when she “cold” e-mailed me for advice on what courses to take if she wanted to be an entomologist. We met soon after and I invited her to join my lab. In the past four years she has done everything from caring for our insect colonies to conducting her own research projects. Caitlin was admitted to every graduate program to which she applied and was awarded several fellowships and stipends. She also recently received third prize for her research presentation at the Eastern Branch meeting of the Entomological Society of America, where she was competing with graduate students. Caitlin has been an exceptional student and I have been fortunate to watch her mature into an independent researcher.

—Mark Willis

Tropics continued from page 1

In the last week of June, the students will travel back to Cleveland with a UPR undergraduate student, Daisy Ramirez. Under our direction, they will apply the same research techniques to studying a native and invasive forbs species at the University Farm. Dr. Fernandez will also be working in the primary forests at the farm on several ongoing research projects.

The program is supported by a grant to the Department of Biology by the Howard Hughes Medical Institute for Undergraduate Education in the Biological Sciences. •



Dr. Denny Fernandez (sixth from left), research lab undergraduate students and CWRU faculty and students

The project team will do field experiments within the Bosque Rio Abajo, located in the northwest part of the island of Puerto Rico.

Gelfand Science and Engineering Fellows Enhance the Science Fair Experience for Cleveland Students

By James Bader and Arthur Evenchik

With funding from the Gelfand Family Charitable Trust, James Bader, lecturer in biology, and Nancy Dilulio, former instructor in biology and current assistant dean in the Office of Undergraduate Studies, launched the initial cohort of the Gelfand Science and Engineering Fellows last fall. The program's goal is to improve the quality of the science fair experience for students in the Cleveland Metropolitan School District. The 18 fellows—undergraduates and graduate students in biology, chemistry, biochemistry, nutrition, psychology and engineering—provided intensive mentoring to middle and high school students across the city.

Bader and Dilulio used their experience from the NSF-funded Cleveland Mathematics and Science Partnership to develop a training program for the fellows. Their monthly sessions focused on fundamental science skills as well as tools and strategies the fellows could use when working with younger students. The participants developed a definition of science using the CONPTT methodology (consistent, observable, natural, predictable, testable and tentative), explored the many facets of inquiry by investigating the tracking behavior of termites and used the Experimental Design Analysis instrument (EDA). They also discussed strategies for helping students generate meaningful questions, design valid experiments and analyze the results. In late December 2009, the fellows fanned out to 20 public schools.

Ramya Raman, a senior biochemistry major, worked with students at John F. Kennedy High School. "I started by asking them what their hobbies are, what they like to do for fun, and then tried to see if we could come up with research questions from that," she said. "I challenged the students to create something that was really their own, something they could connect to. That was the most important step."

One of Ramya's students, an inveterate shopper, devoted her project to shoe styles; she wanted to assess the pain that girls incur by wearing heels of different sizes. She designed a survey that captured the amount of walking the subjects did and the number of hours they wore the shoes in question. From a project like this, Ramya says, the young woman could go on to study the anatomy of the foot.

In some cases, the Gelfand Fellows helped students obtain equipment for their projects. Sarah Lukowski, a sophomore psychology major, obtained a box of peak flow meters from her mother, a public health nurse, so that sixth graders at

Forest Hill Parkway Elementary School could measure the amount of air they took in with each breath. For a group of seventh graders, she got the university's athletic department to donate a football helmet so the students could test its effectiveness in blunting the impact of a blow.

The two Gelfand Fellows found it an advantage to be relatively close in age to their students. But they also gained respect as Case Western Reserve undergraduates and as women scientists. "You are a model for them," Sarah says. "When you tell them their project is a good project, they light up ten times more than they do when the teacher tells them. They start believing in themselves."

Forest Hill Parkway held its science fair in mid-February, and with one exception, every student participated. "They all did something, they all had a board and they all were excited to talk," Sarah recalls. "Even though I already knew most of their projects, they wanted to go through their speech with me and tell me all about it." Near the bottom of several boards, she noticed a line reading, *Thank you to Case Western Reserve and to Sarah for helping us.*

"I didn't know I had made that much of an impact," she says. But to anyone familiar with the Gelfand program, it comes as no surprise. •



In addition to training the Gelfand Fellows, James Bader conducts a summer course for Cleveland teachers. Photo by Mike Sands

Letter from the Chair



Dear Alumni and Friends,

In my first letter to you as chair of the Department of Biology, I would like to thank Professor Koonce for his leadership of the department over the past nine years. During that time, the undergraduate class has included a steadily increasing proportion of pre-medical students and biology majors. This has placed the department at the center of undergraduate education in the College of Arts and Sciences.

Inevitably, the rising numbers of undergraduate students taking biology courses have strained the department's resources, and we are now building the faculty so that we can manage this increased interest. During the next five years, we expect to continue recruiting new faculty in our core focus areas: Cell and Molecular Biology, Neurobiology and Ecology. This expansion of the department will require support both from the College of Arts and Sciences and from philanthropic sources to be fully realized.

We are reviewing and revising the undergraduate core curriculum to integrate all three core courses into a more coherent whole. In addition to providing the best education for biology majors, we also need to increase course offerings for non-majors. In this "Century of Biology," we must ensure that all CWRU undergraduates have an understanding of the biological issues that will confront our society in the coming years. The department has a long and continuing history of excellence in teaching and student mentoring, attested to by multiple nominations every year for the three main awards: the

Carl F. Wittke Award for Excellence in Undergraduate Teaching, the J. Bruce Jackson, M.D., Award for Excellence in Undergraduate Mentoring and the John S. Diekhoff Award for Graduate Teaching and Mentoring.

Our graduate program continues to grow, and we expect to reach a steady state of about 100 graduate students enrolled at any one time. Currently we have 32 PhD students, 21 MS students in the regular program and 22 MS students in the Biotechnology Entrepreneurship program. The latter program has been very successful and provides additional expertise to the growing biotechnology industry in Northeast Ohio. The courses offered in this program are also taken by some of our more traditional graduate students. The department strives to provide a graduate education that will enable students to move into either academic or industrial positions.

The competitiveness of the graduate program and its ability to attract the very best students have been enhanced by the receipt of a Graduate Assistance in Areas of National Need (GAANN) program award. Congratulations to Professor Debra Wood for this success.

It is essential to note that the research output from our faculty continues at a high level in spite of the additional demands on their time from the increasing numbers of undergraduate students and the difficult climate for funding. For this reason, I am confident that the department will continue to raise its profile and national ranking.

We have included a small amount in the annual budget for supporting outside speakers for our seminar program, but in order to attract the best speakers and maintain the popularity of this successful program, we will need to increase the amount. We would also like to fund travel grants for graduate students. I hope that you will consider supporting the Department of Biology as it builds upon its achievements.

Sincerely,

Christopher A. Cullis
Chair and Frances Hobart Herrick Professor of Biology

Faculty Highlights, 2009-2010

James Bader is a 2009-2010 Biology Scholars Research Residency participant sponsored by the American Society for Microbiology. He is doing education based-research in his classes and welcomes anyone who is interested.

Roy Ritzmann had two significant journal publications during the past year:

Bender, J. A., A. J. Pollack and R. E. Ritzmann (2010). Neural activity in the central complex of the insect brain is linked to locomotor changes. *Curr. Biol. In press*. For a visual abstract, please visit <http://www.cell.com/current-biology/home>.

Harley, C. M. and R. E. Ritzmann (2010). Electrolytic lesions within central complex neuropils of the cockroach brain affect negotiation of barriers. *J. Exp. Biol. In press*.

Roy Ritzmann, Mark Willis and Roger Quinn are recipients of a four-year grant from the Air Force Office of Scientific Research (AFOSR), "Hierarchical Control of Maneuverability in Walking and Flying Insects: A Neurobiological and Hardware Model Approach." The \$1.07 million grant will provide funding for all three of their labs; Ritzmann is the principal investigator.

Christopher Cullis became the new chair of the Department of Biology, replacing Joseph F. Koonce.

Radhika Atit has had one significant journal publication during the past year:

Mani, P., Jarrell, A., Myers, J., Atit, R. (2010). Visualizing canonical Wnt signaling during mouse embryonic craniofacial development. *Developmental Dynamics* 239: 354-63.

This paper is the first comprehensive atlas of Wnt signaling activity in the developing mouse head. The first author, Preethi Mani '08, is a former undergraduate researcher in Atit's lab.

We want to hear from you!

We are proud of the accomplishments of our faculty, students and alumni. Let us know about job changes, awards, honors and life events. Please email your news and contact information updates to contact-cas@cwru.edu or use the enclosed envelope.

Student Highlights, 2009-2010

Grace Fuller, a Ph.D. student and graduate research associate of conservation and science at the Cleveland Metroparks Zoo, recently had a paper published:

Fuller, G. & Lukas, K. E. (2010). Case studies of infant development in two guenons, the Wolf's guenon *Cercopithecus pogonias wolfi* and Allen's swamp monkey *Allenopithecus nigroviridis*, at Cleveland Metroparks Zoo. *International Zoo Yearbook* 44: 218-231.

Sheryl Petersen, a PhD student, recently published a paper based on her master's research:

Petersen, S. M. and P. B. Drewa (2009). Are vegetation-environment relationships different between herbaceous and woody groundcover plants in barrens with shallow soils? *Écoscience* 12: 197-208.

Elena Less, a PhD student and graduate research associate of conservation and science at the Cleveland Metroparks Zoo, recently had a paper published:

Hoellein Less, E., Lukas, K. E., Kuhar, C. W., and Stoinski, T. S. (2010). Behavioral response of captive western lowland gorillas (*Gorilla gorilla gorilla*) to the death of a silverback in multi-male groups. *Zoo Biology* 29(1): 16-29.

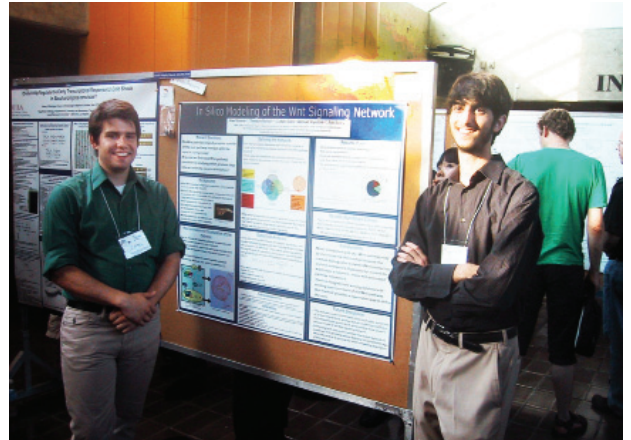
Cara N. Henry-Halldin, a PhD student, conducted field research in Papua New Guinea this past summer.

Two RIBMS Students Win Recognition

By Peter Thomas and Robin Snyder

Research at the Interface of the Biological and Mathematical Sciences (RIBMS) is an interdisciplinary undergraduate research program run collaboratively by the Department of Biology and the Department of Mathematics. Last summer, eight undergraduates from this program, including several Systems Biology majors, presented the results of their research at the Society for Mathematical Biology's annual meeting in Vancouver, Canada.

Two undergraduates, Alex Galante (Systems Biology) and Ted Roman (Computer Science), won an honorable mention for their poster, "In Silico Modeling of the Wnt Signaling Pathway." Ted and Alex were competing with graduate students and postdocs from all over the world, and only three honorable mentions were awarded out of 120 posters.



Ted Roman (left) and Alex Galante with their award-winning poster, "In Silico Modeling of the Wnt Signaling Pathway"

Ted and Alex also competed in the Intersections: SOURCE Symposium & Poster Session and took home the award for Outstanding Interdisciplinary Project. Congratulations to them and to their research mentors, Robert Ewing and Mehmet Koyuturk. •

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You can contribute to our success by making a gift to the department. Your gift will allow us to continue to offer opportunities for our students to excel academically and to conduct cutting-edge research. Please return your gift in the enclosed envelope or give online at giving.case.edu.



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