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Welcome from the Chair:



Dr. Michael F. Antolin

Dear Friends,

As we begin the 2014 and the Spring Semester, we look forward to rebooting the program, resetting our clocks, recharging our optimism, and renewing our friendships.

I, for one, love this time of year, for its cold blustery days, which in Colorado are often drenched in sunshine. I live for my ski days, whether at one of the downhill resorts or just as often up on Cameron Pass schussing along the Meadows Trail or up to Montgomery Pass. And what is

more beautiful than the lighted trees lining the streets in Old Town Fort Collins! Then, of course, we look forward to the lengthening daylight, and the manic days in May when we graduate some 300 Biological Sciences and/or Zoology majors!

I am happy to report that the Biology Department continues to grow in its excellence. In this newsletter we feature the breadth of our students and faculty,

Continued next page

RALPH DIX IN MEMORIAM

Ralph L. Dix, emeritus Professor of Botany, passed away Feb 28, 2013 in Los Angeles, CO from complications of Parkinson's disease.

Ralph worked as a pattern maker in the family foundry until he enlisted in the U.S. Navy and served in the South Pacific during World War II. He graduated from Catholic University in 1951 with a Bachelor's and Master's degree in botany, then earned his Ph. D. in botany from the University of Wisconsin.

He had a 40-year career as a professor of Botany and Landscape Ecology, first at Marquette University, then the University of Saskatchewan. He joined our faculty in 1967 and retired in 1997. He was interested in grasslands, wetlands and native plants, and was a xeriscape pioneer in the early 1970's. His home in Fort Collins was distinctive for inclusion of native plants. Please join us in expressing our gratitude for his service to our department and his impact on plant ecology.



WELCOME FROM THE CHAIR CONTINUED

past and present. We are sorry to note the passing of Dr. Ralph Dix, a botanist who worked and taught here at Colorado State for 30 years! We also welcome our two newest faculty, Assistant Professors Tai Montgomery and Dan Sloan, and note achievements by Dr. Anireddy Reddy. These talented folks reflect why the reputation of the Biology Department continues to rise, as we build a world-class research and educational program. Ms. Becky Chong is just one of the 90 M.S. and Ph.D. students we are currently training in our graduate programs, and one who has risen to a level of excellence we strive for all.

Finally, I was heartened by the number of notes and letters we got back from you in response to our newsletter last Fall, asking about various Professors or giving us some news about your own accomplishments. We want to hear your stories, and if you tell us we can, we will report them in future letters. Please be sure to let us know if you are coming to visit Fort Collins, we love to see our graduates succeeding out there in the real world.

As always, we are proud to be the Biology Department, we are proud to call you our own, and we wish you all the best in the upcoming year.

A LEGACY FOR GRADUATE EDUCATION

We're excited to announce a new scholarship in the Department of Biology. A generous donation from Sharon E. and David E. Kabes has endowed a fund to support graduate students majoring in Biology. In expressing gratitude, Department Chair Mike Antolin says, "The Kabes Scholarship comes at a time when we are actively working to improve the quality of our graduate program, and it will be put to good use."

Originally from Denver, Sharon Kabes graduated with a Master's in Biological Sciences from Colorado State in 1974. She continued her education at the University of North Dakota, earning a Doctorate of Educational Administration. She was a high school biology teacher, a high school principal, and a Professor of Education at Southwest Minnesota State University. While at Southwest Minnesota she also served as chair of the Graduate Council. In 2012, she was honored with that university's Cowan Award for her involvement, both on campus and off, with student organizations, international and multi-cultural programs, and civic organizations.

Dr. Kabes articulates a clear but simple educational philosophy: "I think we're there to serve students and find a way to help all students." Adds Chair Mike Antolin: "In Biology, we focus on training in the sciences as an apprenticeship system, where students become scientists by working in the lab, in the field and in the classroom. The Kabes' philosophy of giving students opportunities to reach their highest potential resonates deeply with the goals of the Biology Department". We're grateful that Dr. Kabes has chosen to give back to the program at CSU that helped her forge a highly successful career in science education.



David E. and Dr. Sharon E. Kabes,

BIOLOGY EDUCATION INFORMS AUTHOR'S PATH



Mary Taylor Young basks in the sunshine in her favorite place, Rocky Mountain National Park

Mary Taylor Young, BS Zoology, 1977, credits childhood summers at her grandparents' cabin adjacent to Rocky Mountain National Park with bringing her to CSU and to her career as a nature writer. "Hummingbirds buzzed around the feeders and mule deer peered in the window. We spent the days chasing chipmunks up Deer Mountain. I was hooked!" said Young.

Those days triggered a love of Colorado and a deep fascination with the natural world and how various species are fine-tuned to mesh with their corner of the world.

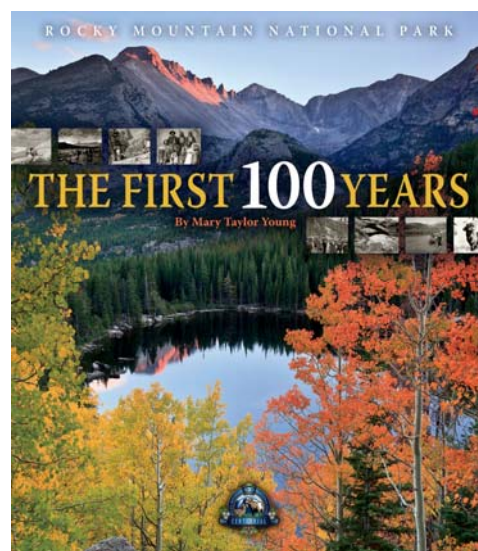
At CSU, she took every animal behavior class offered, including Primate Social Behavior and Insect Social Behavior, which was taught by Dr. Howard Evans, a renowned expert on wasps. She also worked in the Animal Behavior Lab, under the auspices of Dr. Phil Lehner, helping hand-raise 2 litters of coyote pups. She assisted grad student Sharon Conrad in studying how coyotes learn and how that could be applied for non-lethal predator control.

Mammalogy, taught by Dr. Bruce Wunder, was another favorite class. "I can still remember the scientific names of obscure shrews and mice no one ever sees." It must have stuck because in 2013, Mary's book *The Guide to Colorado Mammal*, was a finalist for a Colorado Book Award.

"The way I learned to look at the world and evaluate information as a biologist has been invaluable to me in my career as a nature writer, and in life. I loved CSU and I almost envy young people just starting college for the new worlds and new ways of thinking they're about to discover."

Mary's goal in her writing is to touch both minds and hearts by helping the general public appreciate and understand the natural world so they will support its conservation. She has published hundreds of articles, worked on dozens of nature interpretation projects for the Colorado Division of Wildlife, US Fish and Wildlife Service, the Plains Conservation Center, and others, and published 15 books, including *Land of Grass & Sky: A Naturalist's Prairie Journey*; *The Guide to Colorado Birds* and *On the Trail of Colorado Critters: Wildlife Watching for Kids*.

Now Mary comes full circle with her latest book—*Rocky Mountain National Park: The First 100 Years*. "Researching this book (a coffee table-format history celebrating the Park's centennial), I realized that the entire course of my professional life was in a way determined by those childhood summers in Rocky."



"Try to learn something about everything and everything about something".

Thomas Huxley, 19th Century Naturalist

WELCOME, NEW FACULTY!



Dr. Dan Sloan, Assistant Professor Plant and Evolutionary Biology

What attracted you to CSU? As any alumnus knows, Fort Collins is a pretty nice place to live, so my family and I were excited about moving here. The department is also a great match for my research and teaching interests with its strengths in evolutionary biology and plant molecular biology.

What's the most surprising thing about Fort Collins? The weather. I've been here for four months, and I have already lived through historic floods and a week long stretch of subzero temperatures, and now, as I write this on just about the shortest day of the year, it is 60 degrees and sunny.

How did you get started in your field? I went to a small liberal arts college with lots of opportunities for undergraduate research, which was a key jumping off point for me. Most of my research experience prior to graduate school was based on plant evolution and field ecology. I started my Ph.D. program thinking that I would continue in this vein, and, to some extent, I did. However, research projects almost never end up where you think they are going to, and that was certainly the case for me. My time in grad school coincided with what is arguably one of the most rapid periods of technological advance in the history of the biological sciences. In particular, the advent of high-throughput DNA sequencing technologies made it possible to start asking questions about how evolutionary change occurs at the level of entire genomes, and that became the focus of my research. The cool thing about my dissertation is that most of it was based on technologies that did not exist when I began grad school.

What's the most interesting thing about your research that you wish everyone knew? Essentially all eukaryotic cells (including our own) contain more than one genome. While most of our DNA is housed in the nucleus, our mitochondria also have their own DNA, and basic biological functions require constant interactions between these two genomic compartments. When we look more broadly across the diversity of life, things get even more complicated (and interesting). Plants have a third organelle with its own genome (the chloroplast), and many eukaryotes harbor one or more species of symbiotic bacteria within their cells. A central theme in my research is to understand how the interactions among all of these players that co-occur within cells drive genome evolution.

What do you do for fun and relaxation?

I have two-year old twin sons, so a lot of my downtime is spent with them, which I would characterize as more fun than relaxing. Beyond that, I enjoy hiking, biking, and travel. Now that I am in Colorado, I am hoping to improve upon my meager skills on the ski slopes.



Silene conica – The current record holder for containing the largest known mitochondrial genome.

WELCOME, NEW FACULTY! CONTINUED



Dr. Tai Montgomery, Assistant Professor Informatics and Computational Biology

What attracted you to CSU? Good science and friendly people were the main draws. Living in Fort Collins really appealed to me as well. I've lived my whole life on either coast so I was excited to move to the Rockies and have an entirely new base camp from which to explore.

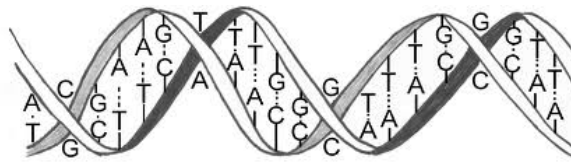
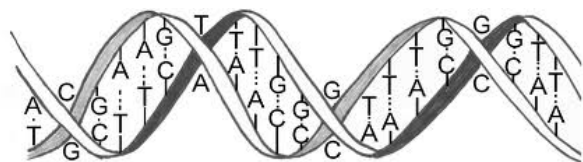
What's the most surprising thing about Fort Collins? The weather was a big surprise. Even when it's only 30 or 40°F out as long as the sun is shining, which it always is, it's quite pleasant. And the snow is so dry here, not like the wet sticky stuff we would get in Boston.

How did you get started in your field? Mostly by accident. I did my undergraduate studies in Botany and spent my summers doing field work - surveying for endangered mushrooms and plants in Oregon, studying the effects of fire on native plants in California. It wasn't until after I graduated and worked as a technician in a molecular biology lab that I became interested in understanding the elaborate mechanisms that cells use to switch genes on and off. Things could have very easily turned out completely differently for me, but I feel fortunate because I happened into something that I really enjoy.

What's the most interesting thing about your research that you wish everyone knew? Tiny but essential molecules called microRNAs help guide development and protect against cancer and other diseases by tuning the expression of thousands of genes to exactly the right levels. Similar regulatory molecules called piRNAs and siRNAs defend the genome from foreign DNA to ensure that genetic information contained in germ cells (i.e. sperm and eggs) is preserved from one generation to the next. And it's all happening right now inside our cells.

What would you like alumni and friends to know about your work? I'm combining genetics and genomics to identify how microRNAs, piRNAs, and siRNAs regulate gene expression. I'm also interested in understanding how genetic information is passed from one generation to another without changes to DNA sequence, a process called epigenetics. piRNAs and siRNAs are emerging as important regulators of epigenetic gene silencing.

What do you do for fun and relaxation? Anything outdoors is fair game - rock climbing, hiking, biking, snowboarding. Since I'm new to the area I'm really enjoying exploring Fort Collins and Northern Colorado.



BIOLOGY RESEARCH ON UPWARD PATH

Colorado State University is listed among the nation's Carnegie Research Universities, which means that research of every kind is a fundamental and integral part of its mission. Research complements our role as one of Colorado's premier institutions for higher learning: many undergraduate students and almost all graduate students engage in research as part of their degree programs.

Overall spending on research at Colorado State is in the range of \$375 million/year, with most of that from federal research grants that are awarded to individuals or groups of faculty. The Biology Department is no exception, and the majority of Biology faculty currently have research grants to fund their laboratories.

Research funding in Biology has steadily increased during the last five years, in 2013 our research expenditures approached \$10M! Add to that the \$ for "overhead" money that comes with each research grant and that pays for supporting facilities and administration. You can see why Biology has become one of the highest profile programs at CSU, and one of the best Biology programs in the country!

To get a better idea of the research being carried out in Biology, visit the web pages of individual faculty to see what we're exploring (<http://www.biology.colostate.edu/faculty/>)!

Recap of 5-year Research Activity Department of Biology

Title	2009	2010	2011	2012	2013
Number of new grants funded	46	47	53	51	61
"Overhead" \$ per year	\$1.1 M	\$1.3M	\$1.5M	\$1.6M	\$1.9M
Research \$ per year	\$5.0M	\$5.9M	\$6.1M	\$7.0M	\$9.6M

Source: Fiscal Year 2013 Annual Research Report, Research Data Center, Sponsored Programs, Colorado State University
<http://web.research.colostate.edu/datacenter/annualreport.aspx>

FOLLOW THE WORMHERDERS IN ANTARCTICA

It's summer at the south end of the world

Prof Diana Wall is back on the ice continuing her on-going research on the ecology of dry valley soils including counting nematodes (i.e. microscopic worms) in the soil. Her team has an interesting blog detailing the research and their experiences in Antarctica. If you ever wondered what it's like there, this is a hands on account. Find the latest post and subscribe to the World of Nematodes blog here:

<http://nemablog.wordpress.com/2014/01/14/p3-a-success/>



DR. REDDY FUNDED FOR BIOFUELS RESEARCH



Dr. A.S.N. Reddy, a highly respected botanist in our department, was recently awarded \$1.39M over the next three years to research gene expression in response to drought stress in Sorghum. The award comes from the Department of Energy's (DOE) Genomic Science Program and is one of only seven awards funded in this program this year.

The DOE is proactively exploring this line of research to expand the options in crop usage for biofuels. Corn is currently the common biosource, but it has the downside of impacting the food chain when yield is diverted from the table to fuel. This affects the cost of food and, in the long term, it is likely not sustainable economically.

Eventually, we need to find more amenable crops that can survive adverse conditions and produce large amounts of biomass for biofuel production to supplement our fossil fuels. Reddy's work helps bring us one step closer.

Reddy's research attempts to understand how plants sense and respond to stresses in their environment -- in this case abiotic or non-living factors (e.g, drought, cold and heat) -- and how they adapt to these stresses. He says, "We're trying to learn more about the impact of stresses on gene expression at multiple levels and use that knowledge to improve crops." Reddy's previous research focused on Arabidopsis, a model plant for more complex crops because of its useful attributes. Arabidopsis, like crop plants, is a flowering plant with a short life cycle (6 weeks) and has the added benefit of a small genome that has already been sequenced. Use of Arabidopsis has greatly contributed to understanding of plant responses to stresses.

The research is now ready to move to a more complex crop plant, Sorghum. Sorghum originated in Africa and is naturally drought tolerant and able to thrive in high temperatures. These are the qualities to enhance in plants so that production of biofuels becomes more widespread and economically viable.

Reddy notes that research now is very different from only a few years ago. As he says, "It used to take years to sequence and analyze one gene, now with the advances in sequencing technology we can sequence all genes in an organism in a few weeks." Sorghum has a larger genome than Arabidopsis; the downside is that it creates more data. Mountains of data. Additionally, scientists have learned that the number of proteins produced in an organism is not tied to the number of genes as originally thought, but rather a single gene can produce more than one protein. "Complexity is not in the gene number, but in how cells use those genes to make proteins," he says. This generates even more data. Terabytes of data.

How do you make biological sense of all that information?

You do it by partnering with a computer scientist, Dr. Asa Ben-Hur, Associate Professor in the Department of Computer Sciences here at Colorado State, who is co-investigator on this project. Metadata is becoming a larger and larger issue in biological research (pun intended).

"Our work now will impact agriculture down the road," says Reddy. "Right now we're attempting to understand the basic biology of how plants cope with stresses."

Please join us in congratulating Dr. Reddy! And for a look at the project abstract, click here:

http://genomicscience.energy.gov/research/DOEUSDA/abstracts/2013Reddy_abstract.shtml

KUDOS FOR OUR GRADUATE STUDENTS

Becky Chong, Ph. D Zoology Candidate



Becky Chong holds a reticulated python in Sulawesi, Indonesia

Inspired by a life-long interest in all things Biology, Ph.D. candidate Becky Chong is ready to graduate this spring and share her love of the natural world. Her work on salamander genomes informs us how differences in nuclear DNA and mitochondrial DNA accumulate over time. Is it a coordinated effort? And how are the differences accumulated across individual organisms, populations and even entire species? The salamander genome has unusual dynamics in that they are larger than almost all other vertebrates; that gives us the ability to ask interesting questions about how these large genomes change over time.

As a young girl, you could generally find Becky outdoors - camping, hiking, playing in the park and being really curious about how things in the natural world work. That natural curiosity has blossomed into using genetic tools to track the evolution of different organisms. She's interested in the natural history of populations and what it all means in evolutionary terms.

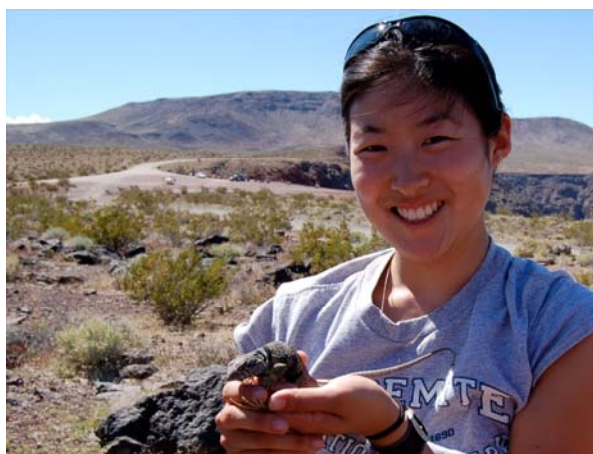
As an undergraduate at UC Berkeley, she was especially inspired in her sophomore and junior years by two classes: Herpetology and The Natural History of Vertebrates. "Those classes made a significant impression on me," she says. So much so that she apprenticed with her professor as a field technician and undergraduate researcher in a disease ecology laboratory. In that partnership, she volunteered the next summer as a summer field technician which involved backpacking for two months through the Sierras surveying endangered frog populations. With another professor, she also worked as an undergraduate researcher in a molecular lab studying herpetology. This research also involved a summer of fieldwork surveying the amphibians and reptiles of Indonesia. Another year as a lab technician in a herpetology lab sealed her interest in "herps," and a biologist is born.

Her long term goal to become a professor is supported by her love of teaching and research. She applied for and received a competitive merit-based grant from the National Science Foundation (NSF) for their Doctoral Dissertation Improvement Grant (DDIG) for \$15,000. She tells other interested students, "It's important to be curious," and stresses that "the best way to learn is to teach others."

For now, she's putting the final touches on her dissertation and scanning the horizon for a post-doctoral position in a research lab to continue asking those important questions.

To learn more about our graduate student's research,

visit: <http://www.biology.colostate.edu/graduates/graduate-students/>



Becky in Death Valley CA, holding an eastern collard lizard