



An early scientific power couple revisited: *Herb and Florence Wagner*



Warren “Herb” Wagner, Jr. and Florence Signaigo were introduced by a fellow botany graduate student in an elevator in the mid-1940s at the Herbarium of the University of California, Berkeley – and the rest, as they say, is history.

Many readers are aware of the multitude of accomplishments by this formidable research team, as Donald Farrar called Herb and Florence in a biographical memoir* written for the National Academy of Sciences. 97-year-young Florence Wagner continues her painstaking research at the U-M Herbarium, identifying ferns from the Hawaiian collection, a labor of love in every sense.

Flashing back to before the fateful elevator encounter, Herb graduated from the University of Pennsylvania in 1942 with his bachelor’s degree. He entered the U.S. Navy Air Corp where he served as a naval air navigator. In the Pacific islands, he spent free time collecting ferns and butterflies, which he poetically called “flying flowers.” This began a lifelong study of the Hawaiian Island ferns.

He attended the University of California, Berkeley for graduate study. Florence’s unassuming nature complimented and contrasted with Herb, who Michael Wynne, professor emeritus of ecology and evolutionary biology, described as a force of nature.



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If I can figure out the world, maybe I can figure out myself

Asking “why?” was integral to young Callie Chappell’s life, who was found abandoned in China as a baby. An American couple adopted Chappell and she grew up an only child, one of the few racial minorities in Traverse City, Mich.

“There’s me and then there’s a black box about who I am,” she said. She was found without a name, a family or a birth certificate. “It really encouraged me to be very curious about the world.”

The classroom felt like home to a young girl who found in science a community of inquisitive people like herself. As a child, she was enamored with bugs, especially monarch caterpillars. During her elementary school



years, she’d traipse through the woods with her Siberian Husky, collecting caterpillars.

“The idea of transformation and metamorphosis was a central theme of my childhood. But now, having been afforded so many opportunities, this idea of metamorphosis manifests itself in my interests and in insects, particularly.”

Chappell was accepted to the Program in Biology’s concurrent undergraduate-graduate studies program. She completed her undergraduate Honors thesis in the Department of Ecology and Evolutionary Biology in winter 2016 and is currently working on her master’s degree in the Department of Molecular, Cellular, and

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Chair's note



Diarmaid Ó Foighil
Chair and Professor of Ecology and
Evolutionary Biology
Curator, Museum of Zoology

Greetings from the University of Michigan's Department of Ecology and Evolutionary Biology! A few weeks ago, I witnessed the cutting down of a large American Elm tree, likely planted by History Professor Andrew Dickson White in the 1850s, on the U-M's historic Diag, directly south of the EEB chair's office in Kraus. It had been fatally weakened by Dutch Elm Disease, an invasive fungal pathogen, and represented a serious safety hazard that could no longer be ignored. Yet the overall canopy shading the Diag pathways remains largely intact, due to the presence of numerous younger shade trees, immune to the pathogen, that were planted over the intervening 160 years and are rapidly achieving maturity.

Change and renewal is very much a current theme in our department and its associated museum units: the University of Michigan Herbarium and Museum of Zoology. Just north of the Ruthven Museums Building, a spectacular new Biological Sciences Building is approaching the halfway point of its construction cycle – one can monitor its progress via live webcams that give north, south and west views: myumi.ch/aKOQy. Representing an investment of a quarter billion dollars by the College of Literature, Science, and the Arts, the BSB will be our purpose-built new home, starting in fall 2018, together with our sister department of Molecular, Cellular, and Developmental Biology, the U-M Museum of Paleontology and the public-access Museum of Natural History. For the first time, all of EEB's tenure-track faculty will be housed in one building. Meantime, our world-class UMMZ collections are moving south to join the Herbarium at Varsity Drive within a newly renovated Research Museums Center that will also include the paleontology and anthropological archaeology collections. Exciting times indeed!

I am pleased to report that significant investment and growth in personnel is also occurring within our academic program. This term, we are conducting searches for three new tenure-track assistant professors in ecology, a strategic priority area within our program, with targeted hires in ecosystem ecology, population and community ecology and theoretical ecology. If we are successful, the resulting three new ecologists will join three newly hired EEB tenure-track colleagues: Alison Davis Rabosky (started September 2016), Melissa Duhaime (starts January 2017) and Ben Winger (starts September 2017). Davis Rabosky and Duhaime are profiled within this issue of *Natural Selections*. Winger, currently a Michigan Fellow, is an ornithologist whose research foci include speciation and community assembly in Andean birds, geographic range evolution in migratory birds, and the relationship between seasonal migration and dispersal and its influence on speciation. Our success in hiring Dr. Winger has instantly renewed our prestigious program in ornithology, long associated with the UMMZ's world-class bird collection.

How many of you envisage coming in to work (with effect) at the age of 97? I'm especially delighted that we can profile the extraordinary life of U-M Herbarium research scientist and fern specialist Florence Wagner, and her deceased but unforgettable husband Warren "Herb" Wagner (1920-2000), in this issue. Their story is one of the great partnerships in botanical research and teaching at the U-M in the latter half of the 20th century.

It is a pleasure to profile two members of our outstanding student body: Nicholas Medina and Callie Chappell. Nicholas is in the first year of his doctoral degree, having graduated last year from our Frontiers Master's Program. As an undergraduate at Brandeis, he became interested in ecosystem ecology and built on that significantly during his master's work at the U-M Biological Station (under the mentorship of EEB faculty member Knute Nadelhoffer, UMBS director.) His excellent work on carbon and nitrogen cycling in forest soils is not only of intense academic interest, it has important implications for our understanding of climate change dynamics going forward. Nicholas plays an active role in the broader life of the department: he currently hosts our informal Tuesday EEB Lunch seminar series, is an influential voice in ongoing diversity, equity and inclusion discussions within our department and is one of our many graduate students who give me great hope for the future of our discipline.

If you are in the need for inspiration, then you must read the profile of Callie Chappell, one of our recent star undergraduates. She graduated with a Biology BSc Honors degree and a GPA of 3.969, garnering multiple prizes for her extraordinary thesis research and superlatives from her advisor EEB faculty member Mark Hunter.

I invite you to stay in touch over the coming year using the many electronic portals to our departmental news and events, including our website (lsa.umich.edu/eeb) and other channels (see this page). If you are visiting Ann Arbor, feel free to drop in to see me at Kraus 2019.

With my best wishes for a peaceful holiday season and a happy and prosperous new year!

Diarmaid Ó Foighil

Editors: Diarmaid Ó Foighil, Nancy Smith
Writer, editor: Gail Kuhnlein
Design & Illustration: John Megahan

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Untangling vital ocean processes that affect our planet

Every day a steady blizzard of marine snow rains about two million tons of carbon to the floor of the deep blue sea. “It’s really beautiful,” said Melissa Duhaime, a new assistant professor of ecology and evolutionary biology, even though the particles are primarily fecal matter and carcasses.

Marine snow is vital for the functioning of Earth, especially in light of climate change. The carbon cycle on our planet is fueled by a conceptual biological pump that removes carbon from the atmosphere into the ocean’s depths.

Microbes, the most abundant life forms on Earth, maintain the planet’s atmosphere, drive essential processes in terrestrial and aquatic ecosystems, and have formed intimate relationships with all plants and animals. “Microbes that live on the surface of the ocean all around the world produce 50 percent of the air we breathe.”

Because atmospheric carbon leads to global warming, anything that increases the potential to draw atmospheric CO₂ into the ocean is beneficial. Human activities send CO₂ into atmosphere at a rate faster than the biological pump can work.

“Microbes that live on the surface of the ocean all around the world produce 50 percent of the air we breathe.”

“Anything that tweaks or influences the process of the carbon sinking can have potentially huge impacts on the efficiency of the biological pump. That’s where we focus our research.”

What brought Duhaime to where she is today? She spent childhood summers shoreside on Cape Cod, Mass., sailing her grandparents’ sunfish for entire days. Once, a hurricane blew in taking her by surprise – her boat even taking on water. Luckily, she and her younger sister were able to sail home. An early and intense bond formed between a girl and the water and so once her interest in microbiology piqued during college, “it was a pretty easy link to make to marine microbiology,” she said.

As an undergrad at Cornell University, she studied political science until she realized that her true passion was for biology. She signed up for a biology class and changed her major “pretty much immediately.”

The following semester, Duhaime took a microbiology class with an “amazing” professor whom she likens to Gandalf, the “Lord of the Rings” sage complete with a long, gray beard. She vividly remembers him in front of the lecture hall with a tall wooden staff that he’d pound on the ground for emphasis. Professor William Ghiorse became her academic advisor. “I was impressed by the content and implications of all of this microscopic life around us and in us.”

Over the next three summers, a series of internships helped Duhaime’s research interests gel. Her first was at the Monterey Bay Aquarium Research Institute in California on

an ecosystem that lies many miles beneath the ocean where hydrothermal vents and their microbes allow vent organisms to persist. It’s one of very few ecosystems on the planet that can persist without energy from the sun. As a budding microbiologist, it was fascinating to see the obligate role of bacteria.

The next summer, Duhaime interned at the Max Planck Institute for Marine Microbiology, Germany, where she worked on microbial symbionts that live a few meters deep in the ocean sediment.

After her next internship at the Woods Hole Oceanographic Institute, the young scientist returned to Max Planck for graduate study. She became fascinated with the idea of “the smaller the organism, the greater the power” and recognized that viruses could influence microbial communities. She used tools of genomics to study ocean viral ecology and evolution for her thesis.

Today, the Duhaime Lab is exploring ocean viruses from several angles. In the lab, they isolate viruses and their microbial hosts. Her model system is in the genus *Pseudoalteromonas*, an ubiquitous ocean bacterium. “You can almost think of it as the *E. coli* of the sea – it seems to be everywhere and has the potential to grow really fast when the conditions are right.”

Her model system is prevalent in marine snow and host to many viruses. The researchers are exploring the relationship between the bacterial host, its viruses, and their environment – namely the microscopic carbon particles and their surrounding gradients.

“These interactions could have huge impacts on the planet’s function and health. I will spend my whole career trying to better understand the controls on those interactions.”

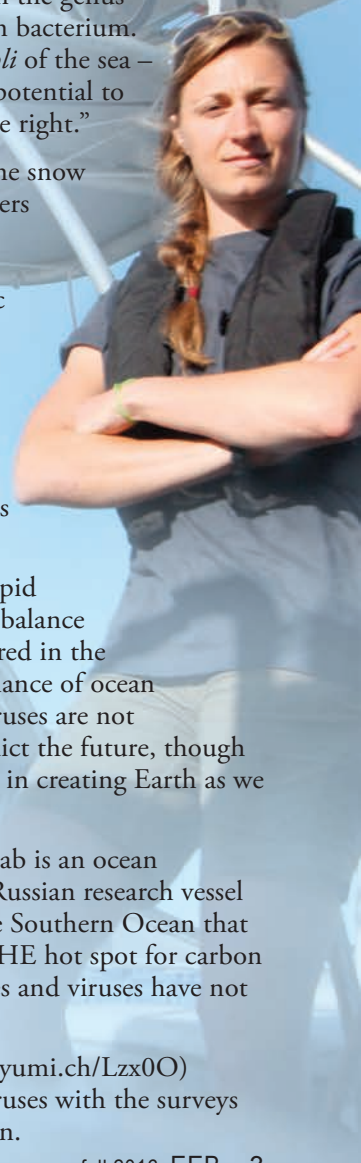
On a global scale, Duhaime said the rapid ongoing human-driven changes to the balance of carbon in the atmosphere versus stored in the Earth has huge implications for the balance of ocean nutrients. “Currently, microbes and viruses are not considered in climate models that predict the future, though in the past their functions were pivotal in creating Earth as we know it.”

The next adventure for the Duhaime Lab is an ocean sampling trip around Antarctica on a Russian research vessel with a team based in Switzerland. “The Southern Ocean that surrounds the Antarctic continent is THE hot spot for carbon that sinks to the sea floor. The microbes and viruses have not been studied to this extent previously.”

The recent Tara Oceans Expedition (myumi.ch/Lzx0O) tripled the number of known ocean viruses with the surveys of all oceans except the Southern Ocean.

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fall 2016 EEB 3



Do you love *your* job enough to clomp through cow patties?

If ever there was an accurate test to ensure someone truly loved their chosen profession, Alison Davis Rabosky passed with flying colors – and much trudging through cow patties. Back to that shortly.

“I was a really strange child,” Davis Rabosky said. “No one in my family has anything to do with science so they always thought I had odd interests. They were a little worried about me for a while,” she said, laughing.

She entered college pre-med at Pomona College, a small liberal arts school in California, and then experiences led her to where she is today – one of the newest faculty members in ecology and evolutionary biology at the University of Michigan. She’s also an assistant curator at the U-M Museum of Zoology. A major influence was a summer Research Experience for Undergraduates program. She loved the summer spent at a research institution where she was treated like a graduate student and learned about scientific research in academia.

An animal behavior course helped seal her fate. During labs on lizard behavior, the class went to a botanical garden with little fishing rods to catch western fence lizards. Most students caught one or two lizards. Davis, an unexpected natural, caught about 30! “I thought, wow, I can be a herpetologist. I can’t imagine anything better than running around the world studying animals in nature.”

The following summer, she found an REU on reptiles at Arizona State University. Her research organism was the tiger salamander (*Ambystoma tigrinum*). In the arid deserts

“I can’t imagine anything better than running around the world studying animals in nature.”

of southern Arizona, salamanders eagerly exploit any of the limited water sources and the regional bodies of water were ponds created for – and also eagerly exploited by – cattle on ranch lands. After the REU, she began to look at Ph.D. programs. “And I haven’t looked back.”

Davis Rabosky’s research program explores the ecological drivers of trait evolution in nature. As an evolutionary biologist and behavioral ecologist, she integrates molecular, field, lab and museum research to explore three main areas: how novel traits evolve; animal behavior and evolution; and the conservation and management of island endemics. She specializes in interdisciplinary research that unites natural history collections with ecological and genetic data to test hypotheses about the origin and stability of traits over time and space. Much of her work has involved reptiles and amphibians, but her research interests include plants, birds and invertebrates.

One of Davis Rabosky’s new projects will utilize the world-class UMMZ collections to investigate the evolution



of toxicity in New World Colubrid snakes and test the hypothesis that an interplay between models and mimics can drive sequential venom evolution and dynamic coloration in both groups. She’ll use novel methods for modeling jaw and tooth shape such as micro-CT scanning and geometric morphometrics of snake fangs. It will be the first broad scale comparative study of tooth evolution in snakes traditionally considered “nonvenomous.”

Davis Rabosky is most well known for her research on how social systems evolve in lizards, research she’s continuing. She examines how social systems first arise in populations of solitary individuals and how and why these nascent social systems may change over time. She’s been working with lizards in the genus *Xantusia* that live in the deserts of southwestern U.S. and Mexico. These questions are important because they help identify common selective factors that promote sociality across taxa, despite vast differences among species in general ecology and evolutionary history. “These lizards are highly, but facultatively, social, allowing for the rare comparison between social and solitary individuals within the same population.”

Davis Rabosky is thrilled to be resurrecting EEB 450, Biology of Amphibians and Reptiles in winter 2018. The class hasn’t been offered since 2012.

“Being a curator has been a personal dream of mine,” she said. “I feel like I won some kind of amazing lottery.

see Cow patties, page 5

Soil science may hold underground secrets to help battle climate change

Many fortunate people can trace their career inspiration back to a few remarkable teachers. For Nicholas Medina, his seventh grade biology teacher was the first inspiration to love science. Motivated by NASA's inclusive science, technology, engineering and math (STEM) education initiatives, she engaged many of her students in after school national engineering competitions and apprenticeships at the City College of New York, where Medina learned about magnetism and popular astrophysicist Brian Greene in a physics lab.

Thanks to similarly remarkable teachers in high school, Medina attended Brandeis University in Boston on a STEM scholarship with the Posse Foundation, which improves college graduation among exceptional students who may be overlooked by typical admissions processes. With support from faculty and graduate student mentors, Medina and his NYC cohort supported each other throughout college, and still do now as they establish their careers.

At Brandeis, Medina began working in a neuroscience lab and wrote his undergrad thesis on the neuronal signals that help mammalian heart tissue develop properly. He also organized an intensive tropical ecology field semester in Panama, where he "gained an appreciation for the diversity of life in tropical forests."

The following summer, Medina organized an internship with a conservation non-profit in Costa Rica where he estimated above ground biomass on an abandoned non-native timber plantation to assess the ecological and reforestation value of similar habitats. "That was pivotal for me in wanting to pursue ecosystem ecology." He added an environmental studies major his senior year and applied to the U-M EEB Frontiers Master's program where "I grew as an ecologist more than I ever imagined." He graduated from Frontiers this year and entered the U-M EEB doctoral program with his advisors Professors Knute Nadelhoffer and Don Zak.

"Forest ecosystems are one of the largest stores of carbon on Earth," Medina wrote in a 2015 GotScience.org article

(myumi.ch/L3ANV). "Consisting of old trees and deep, rich soils, forests are very good at absorbing greenhouse gases. However, our forests may not protect us from climate change as much as previously thought." In the coming decades, some studies argue they will face water and nutrient limitations.

By explaining causes of long-term ecosystem changes, soil research helps us improve our predictions of future Earth surface changes and increases confidence in Earth system models, aiding in more accurate budgeting for clean energy projects and other adaptations, including rethinking socioeconomic values.

Medina's most recent research at U-M Biological Station in Pellston, Mich. analyzes the decadal relationship between leaf litter (leaves dropped from trees) production in forests and soil carbon (C) and nitrogen (N, an essential cellular nutrient) residence times (how long these elements remain in soil). His study site is part of an international network of ongoing experiments called Detritus Input and Removal Treatment (DIRT).

What controls the variation in elemental residence times in soil is one of the most fundamental and unresolved questions in ecosystem ecology. His results suggest that plant litter production controls the residence time of N more than it does for C. "When we add twice as much litter, the carbon that goes in comes out faster," Medina explained. "When we add less litter, the carbon is more resistant to loss."

Modelers have assumed that more litter means more to

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graduate profile

Untangling ocean processes from page 3

Another major research project in the Duhaime lab investigates the impacts of microplastic pollution in lakes and oceans. (myumi.ch/JlgrR).

Duhaime will create a new class on environmental microbiology with a field and lab component for fall 2017.

Duhaime and her husband, Vincent Deneff, EEB assistant professor, have four-year-old twins, Noémie and Aurora, and Hanalei is a year old. "There's such a potential to be an amazing role model. This is a really demanding profession, but if they can see that I really love it and find fulfillment in what I do, then that's the best lesson that I can share with them." 🍂

Cow patties from page 4

Very few people get to be curator at the largest university-affiliated collection in the world."

She and her husband, Dan Rabosky, assistant professor in ecology and evolutionary biology and assistant curator at UMMZ, go birding with their almost three-year-old daughter, Maya, who can identify 60 birds by sight and 30 by sound. At 15 months old, Maya went on a field excursion to interior Australia where they stayed in old sheep ranching stations and tents. "She was a trooper." 🌿

See multi-media story on Davis Rabosky's coral snake mimicry research at myumi.ch/LqADy.

Power couple from page 1



She took a circuitous route to her ultimate botanical career. She earned her bachelor's degree in philosophy, her master's in South American studies, and her doctorate in botany from UC Berkeley. "My thesis was on a family of marine algae, but I married into ferns," said Florence, with a laugh. Wynne noted that her 1954 thesis publication is still highly regarded.

Herb and Florence married in 1948 and had two children, Warren Charles Wagner in 1953 and Margaret Frances Wagner in 1957. Florence has two grandchildren.

"They were right out of *Mad Men*," said daughter Margaret Wagner, referring to the TV show, "the clothes, the martini, the whole bit." When the children were young, Mom was home with the kids.

"Herb had so many interests and things he was enthusiastic about, but Florence kept him grounded and focused," said Anton Reznicek, a research scientist and curator of vascular plants at the U-M Herbarium.

After earning his doctorate degree in 1950, Herb spent a year as a Gray Herbarium fellow at Harvard University, then moved to the University of Michigan in 1951, where they settled.

They worked together for 35 years. Recalling what it was like to work with her husband, Florence said simply, "It was wonderful." They traveled the world together collecting and studying ferns. They went to many far-flung places, such as Mexico, Puerto Rico, Peru, China, Denmark, France and throughout the U.S.

Once their children were in grade school, Florence returned to work in a research position, joining forces with Herb. Their home in Ann Arbor was a busy and warm environment, frequently hosting receptions for visiting botanists and on holidays, wonderful dinners for his graduate students who were in town.

Florence's field of research is pteridophyte (fern) systematics and evolution. Until the work of the Wagners, there had been little scientific systematic study of these plants, although they constitute one-sixth of the total native vascular flora of Hawaii. Florence specializes in the cytology of ferns, specifically counting their chromosomes. She was among the first to get chromosome counts on many fern species.

"Hawaiian ferns are interesting because the spores came from

two directions," explained Florence, "they come from Asia and America and mixed in Hawaii."

Herb was the director of the U-M Matthaei Botanical Garden from 1966 – 1971. He chaired the Department of Botany in the Division of Biological Sciences from 1974 to 1977. He published over 250 articles and was elected to the prestigious National Academy of Sciences in 1985. Florence was chair of the pteridological section of the Botanical Society of America and president of the American Fern Society.

Herb and Florence were interested in the evolutionary mechanisms of ferns and how populations evolve. They spent a great deal of time in the field "bringing home rich collections from tropical and temperate regions," said Wynne.

"Florence provided chromosome analyses and counts to verify the interrelationships between populations of ferns. It was critical in helping Herb prove his theories about fern species crossing and producing hybrids."

Herb's method was soon computerized to produce "Wagner trees," as they became known. Wagner trees continue to appear in systematic literature. Herb is widely considered a founding father of modern plant systematics.

The essential role Florence played in Herb's research is reflected in her co-authorship of roughly a third of his papers, especially those on hybridization, for which he was famous.


Herb and Florence also studied the genus *Botrychium* (Ophioglossaceae), the moonworts. "These little ferns are difficult to find, but they discovered many new species," said Wynne.

Even though he was officially retired, Herb remained an active researcher and teacher until just weeks before his death at age

"They were right out of Mad Men."

79 from heart failure in January 2000. He continued teaching the popular Woody Plants, which he co-created with Burt Barnes and taught for 35 years, and plant systematics. His outrageous performances and exaggerations delighted students who packed his courses. Herb chaired or co-chaired over 45 doctoral committees and was a member on over 235.

He kept up an extensive schedule of invited national and international lectures and meetings. He was a co-author on the legendary book, "Michigan Trees" with Barnes.

Florence and her two black cats, Mississippi and WallaWalla, live in Ann Arbor, close enough to catch rides to the Herbarium a few days a week. She used to have two Labradors, who she would take for long walks at the Nichols Arboretum well into her 80s. The labs were named Deneb and Altair, for stars. Fitting, because Herb and Florence are shining stars in the field of botany and well beyond, as many who know, love and admire them, would agree. 

Chappell from page 1

Developmental Biology. She's interested in applying molecular tools to answer ecological questions. She plans to apply to a doctoral program in ecology and looks forward to a career in academia.

During her sophomore year at the University of Michigan, Chappell decided to get involved in research and was serendipitously connected with EEB Professor Mark Hunter. To Chappell's delight, on top of other shared interests, Hunter's research involves monarchs. She was an undergraduate researcher in his lab for two years.

She participated in a Research Experience for Undergraduates program with Hunter, her advisor, at the U-M Biological Station during summer 2015, on which her Honors thesis is based.

"Callie has discovered a novel phenomenon – that the toxins that insects store in their bodies to protect themselves from bird predators change in concentration and chemical structure when their


in the Program in Biology at U-M and the Goldstein LSA Honors Prize: Marshall Nirenberg Award in Life Sciences, awarded to the nine top graduating Honors seniors at U-M. Recently, Chappell was of eight students nominated by U-M for a Rhodes Scholarship.

Within the EEB department, Chappell credits Hunter, Jo Kurdziel, Beverly Rathcke Collegiate Lecturer, and Paul Webb, professor emeritus, as three of her major role models.

In Kurdziel's class on teaching, one topic discussed that hit home with Chappell was ways to address systematic inequality in the classroom. Of Webb, Chappell said, "You can tell when he wakes up in the morning that he loves what he does every single day."

"Of anyone, Mark has had the largest impact on me," Chappell said of her advisor. It's been his belief in me that made me realize that science is what I really want to do and gave me the courage to believe that I could."

"Callie is a superstar who has enormous drive, commitment and ability," said Hunter. "She is the kind of student for whom hyperbole is insufficient and I look forward to watching her excel."

"Ultimately, in trying to find myself, I found where I belong," she said. 

More Callie awesomeness

Founder of Go, Fight, Win! Creator of free educational debate videos and curriculums, for schools that lack resources to hire debate coaches.

Detroit Research Internship Summer Experience (D-RISE) chaperone – Worked with students from Detroit's Cass Tech High School on research projects in chemistry.

Founder, president of {POSIT} Philosophy of Science in Technology, a student organization that engages in community dialogue on the intersection of philosophy and biochemistry.

For fun: art, kayaking, hiking, cooking, mailing letters, musical theater.

"The concept of service is so important because I cannot forget how much others have influenced where I am today."

host plants are grown under elevated concentrations of atmospheric CO₂," explained Hunter. "Ongoing changes in our atmosphere are influencing the ability of insects to defend themselves against their enemies. This exciting result has profound implications for both natural communities of plants and insects, and for the management of insect pests that feed on our food and fiber crops."

Chappell's extensive list of accomplishments is augmented by three prestigious 2016 awards – she was the first student to win both the Christine Psujek Memorial Undergraduate Award, for the graduating senior who submits the best Honors thesis


Soil science secrets from page 5

decompose and become soil C and N. And less litter to be broken down by decomposers, results in less soil C and N over time. However, "there's some resistance in soil C and N pools," he said. Adding more litter doesn't mean you get more soil C or N and when less is added, C and N pools (amounts) remain constant. He suspects this emerges from both soil microbial adaptations and changes in the spatial arrangement of soil molecules that make C and N more or less accessible for microbial decomposition.

Other forests show variable patterns of soil C and N accumulation in response to variations in plant litter input rates. Medina suspects this is due to joint effects of dominant tree species' physiology, climate and soil texture, all of which individually control the amount of soil nutrients and energy available for future plant growth. Plant growth is vital for absorbing carbon dioxide and sustaining animal populations.

Medina is excited to test his new ideas about what controls long-term soil C and N residence times for his doctoral thesis. He really enjoys teaching and recent discussions at U-M about inclusive teaching. His Frontiers experience introduced him to academic science, "which has taught me about the potential for contributing to society as a professor where you have more freedom to direct yourself and mentor others."

In his "free time," Medina is a musician. He's played bass guitar with EEB folks and percussion in student orchestras, including the Michigan Pops Orchestra.

Like a well-orchestrated symphony, a multitude of relationships invisible to the human eye are playing out constantly on our planet. Scientists like Medina are seeking to bring Earth's underground intricacies closer to our senses. 

The University of Michigan
Department of Ecology and Evolutionary Biology
Kraus Natural Science Building
830 North University
Ann Arbor, MI 48109-1048
USA



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THROUGH THE LENS OF SCIENCE: EEB eighth annual photo contest winners



Jason Dobkowski



Stephen Smith



Joseph Brown

Honorable mentions

EEB Honorary Photographer at Large Contest 2015

First: Jason Dobkowski, "Billy the Kit," Toolik Field Station, North Slope, Alaska.

Second: Stephen Smith, "Hover with a purpose," Cincinnati, Ohio.

Third: Joseph Brown, "Snow shadow," Ford Lake, Ypsilanti.

Honorable mentions:

Pascal Title, "Moon and clouds," Western Australia.

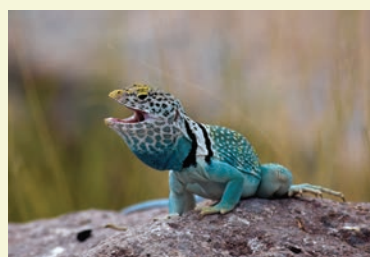
Michael Grundler, "Crotaphytus," Rodeo, New Mexico.

Johanna Nifosi, "Life is beautiful," Bog Cowell, Brighton, Mich.

The photo contest is in memory of David Bay,
"photographer at large" for EEB and its predecessor
departments for 34 years. View all 2015 photos:
myumi.ch/aM0gG (2016 contest is underway).



Pascal Title



Michael Grundler



Johanna Nifosi



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