ECOLOGY AND EVOLUTIONARY BIOLOGY
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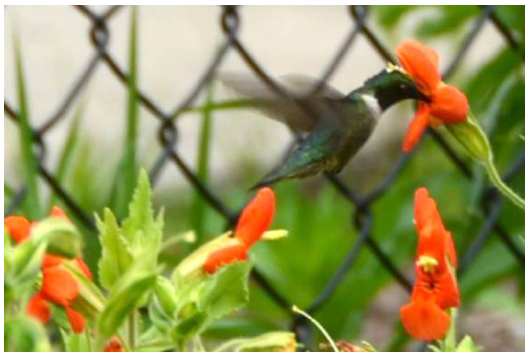
OF BIRDS, BEES AND MONKEYS — MONKEY FLOWERS THAT IS!

Just suppose for a moment that you are a bumblebee and below you is a field of Monkey Flowers of various patterns, colors, and shapes. Chances are nearly 100 per cent that you'd want to sip the nectar of a pink flower with a white central ring (*Mimulus lewisii*), and you would never even glance at the solid red blossom (*Mimulus cardinalis*) growing nearby. Those you would leave to the hummingbirds.



Photos courtesy of Yaowu Yuan

The so-called Monkey Flowers in the genus *Mimulus* got their name because their flowers have a mouth-like shape, and to some they resemble the face of a monkey. They are actually a diverse group of some 150 species worldwide, with about 80 of those species native to California.

While much is already known about the genetics of flower color intensity, little is known about the spatial patterns of pigmentation, such as the ones that help attract bumblebees and other pollinators to certain plants.

But now, in a paper (http://intl.pnas.org/content/early/2016/02/10/1515294113.abstract) published in the *Proceedings of the National Academy of Science (PNAS)*, **Yaowu Yuan** and his colleagues report they have unlocked some of the mysteries of pattern formation and why there are differences in patterns between two closely related species.

Yuan, EEB assistant professor, says the researchers identified a specific gene (called LIGHT AREAS 1 or LAR1) that is responsible for the spatial pattern variation between the bumblebee-pollinated *M. lewisii* and the hummingbird-pollinated *M. cardinalis*. This gene affects the spatial distribution of anthocyanins – the pigments in flowers responsible for colors on the pink, purple, blue spectrum.

LAR1 has a regulatory effect on something called flavonols – chemical compounds that are similar to anthocyanins in structure but are usually colorless.

In answer to the question of how this gene makes the patterns different between species, Yuan explains that there is essentially a competition going on between the anthocyanin pigments and the flavonols.

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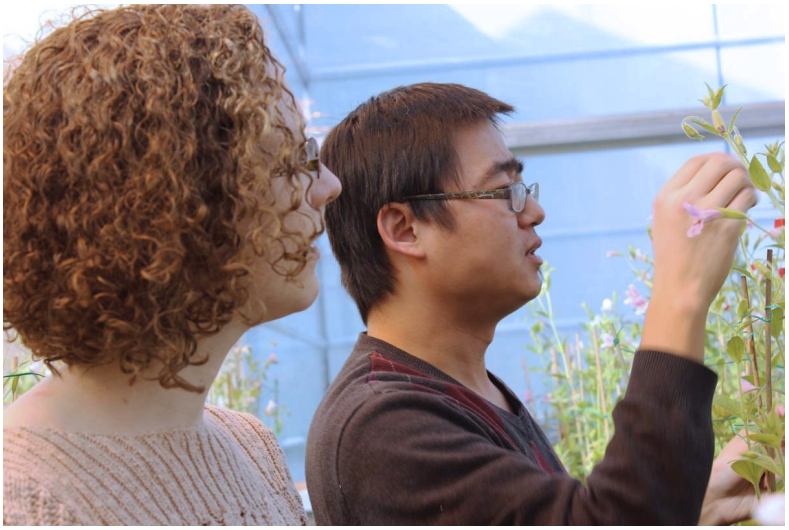
BIRDS, BEES AND MONKEY FLOWERS...

"The production of pigments requires activation of a biochemical pathway – a series of chemical reactions that convert pigment precursors to colorful pigments," he says. "The biosynthesis of anthocyanins and flavonols rely on the same pigment precursors. If there are high activities of flavonol biosynthesis in a cell, the precursors are all 'eaten up' – little anthocyanin [pigment] will be produced – and vice versa."

The interplay between the two sets up a 'prepattern' of pigment distribution in *M. lewisii*, producing the white region surrounding the throat of the otherwise pink petals: the white region has high activities of flavonol biosynthesis caused by the LAR1 gene.

In the 'sister' species *M. cardinalis*, there are low activities of flavonol biosynthesis throughout the flower, because LAR1 is not expressed in that species.



Ecology and evolutionary biology professor Yaowu Yuan, right, and Ph.D. student Lauren Stanley look at monkey flowers in the research greenhouse. (Sheila Foran/UConn Photo)

While colors and patterns may be what attract various pollinators to certain flowers, co-author **Lauren Stanley,** a doctoral student in Dr.Yuan's lab, points out that this is just the beginning of the process. The shape of the flowers also makes a big difference, with the long tongue of a hummingbird able to reach nectar buried deep within a narrow floral tube. At the opposite extreme, the stubby bumblebee prefers wider floral tubes so that it can crawl in to sip the nectar.

"This is a fascinating study," Stanley says, "because it combines both developmental genetics and evolution. The genetics explains the color patternings, and the evolution explains how various species of plants and animals have adapted to suit each other's needs."

She notes that the hummingbird is attracted to the color red, whereas the bumblebee doesn't have the visual receptors for this color but it can recognize the pink and white pattern on the species it favors. The shape of the individual blossom further differentiates the species from one another.

Understanding the mechanism behind colors and patterns in flowers is not only interesting from a basic science perspective, it has potential applications for commercial agricultural crops and for the horticulture industry.

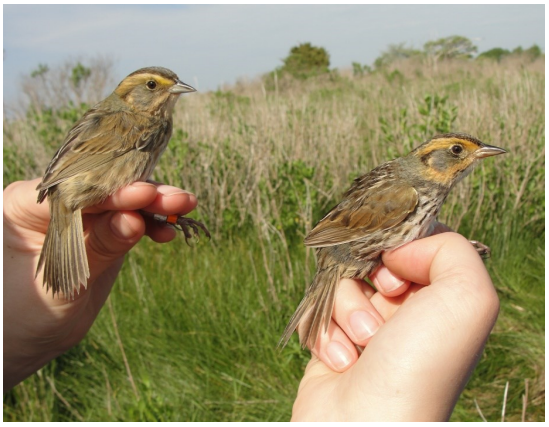
And for Yuan, working with Monkey Flowers in the EEB research greenhouse, there's an additional benefit. "This is such a calming place," he says with a smile. "If my day isn't going as planned, I come up here and spend about 20 minutes, and everything comes into focus. I feel lucky that my research involves finding out what makes flowers so beautiful."

Adapted from *UConn Today* article by Shelia Foran
February 24, 2016

CAN SOFTWARE SAVE SALT MARSHES?

It's a mild and sunny summer day on the tidal salt marshes at Barn Island Wildlife Management Area, which sits across Little Narragansett Bay from Stonington, CT. Walking through a wide, dry stretch of marsh, **Chris Elphick** focuses a spotting scope on a group of little brown birds hidden among the thigh-high grasses.

Elphick identifies the rare saltmarsh sparrow by the yellow shading on its face and the crisp dark streaks on its breast. Saltmarsh sparrows, which represent the most vulnerable of many species that call this habitat home, make their nests in the high marsh among stems of saltmeadow cordgrass, escaping the twice-daily tides that flood the lower marsh. But the Barn Island high marsh and others like it are disappearing as the rising ocean brings salty tides farther inland. Elphick gives the rare sparrow 30 to 40 years before it disappears from the planet.



A Nelson's sparrow and a saltmarsh sparrow at Barn Island (photo by Chris Elphick)

Time may be running out for some coastal cities, too. While sea level rise is squeezing salt marshes against higher, drier land and human infrastructure, it is likewise moving in on some oceanside neighborhoods.

But sea-level modeling tools hold hope for both. By providing concrete pictures of what coastlines will look like under various climate change scenarios, the models are helping planners identify strategies for protecting saltmarsh habitat while managing existing coastal infrastructure and future development.

Coastal salt marshes — communities of plants and animals defined by the coming and going of ocean tides — form on sediment dropped from slowing river waters and incoming tides. They provide a transition between dry land and ocean, protecting the coast from erosion, providing a home to a rich abundance of plant and animal life, filtering nutrients and other pollutants from runoff, and offering that critical band of Goldilocks habitat for the saltmarsh sparrow and other species that call the marshes home.

The maps give communities information they can use to not only plan for future urban infrastructure, but also make room within that infrastructure for saltmarsh habitat. For thousands of years coastal marshes have kept pace with gradually rising oceans, growing vertically or retreating inland. But the world has changed; the rate of sea level rise has doubled on the Northeast U.S. coastline since 1990, dams keep fresh sediment loads from the coast, and human structures such as roads and sea walls block inland migration. As a result, those who seek to protect these unique ecosystems and the services they provide are looking for ways to help them overcome obstacles to migrating inland.

One promising approach involves cooperation between conservationists and city and state planners. Using a coastal mapping tool originally developed for the U.S. Environmental Protection Agency called the Sea Level Affecting Marshes Model, or SLAMM, federal and state agencies and conservation organizations create maps showing where high tide will be as sea level rise increases. The maps give communities information they can use to not only plan for future urban infrastructure, but also make room within that infrastructure for saltmarsh habitat.

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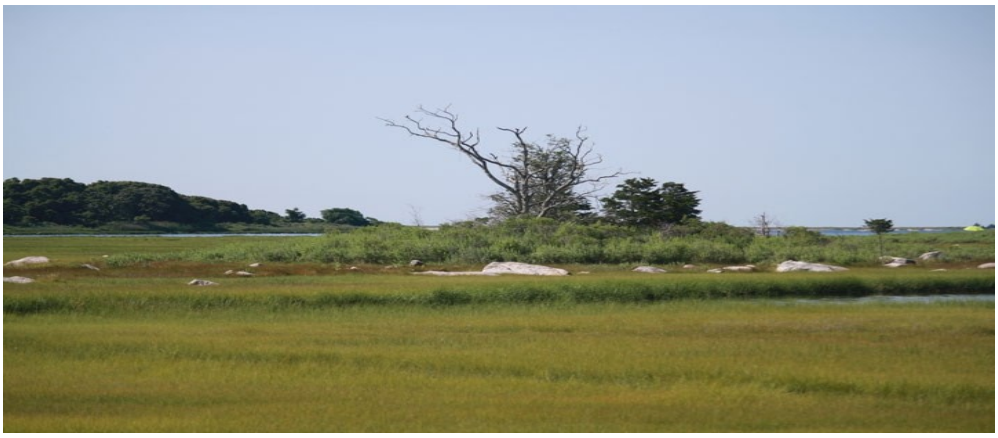
CAN SOFTWARE SAVE SALT MARSHES



Salt marsh at Barn Island Wildlife Management Area.
Credit: U.S. Fish and Wildlife Service/flickr

Rhode Island has used SLAMM to project ocean flooding for all 21 of its coastal communities. "We found it was a place to start the sea-level rise conversation," says Caitlin Chaffee, a policy analyst with the Rhode Island Coastal Resources Management Council. "[It pinpoints] opportunities to remove aging infrastructure and to accommodate the wetlands."

The city of Warwick, for example, worked with CRMC to identify a number of crumbling roads that occasionally flood and will eventually dead-end in the ocean. To close portions of the roads and restore wetland habitat, however, it needed local residents' buy-in, and the SLAMM maps proved convincing.

Marc Carullo, environmental analyst for the Massachusetts Office of Coastal Zone Management, says some communities in his area are excited about the model's potential to help them proactively plan for coastal changes. Currently, salt marshes help protect homes along the coast by decreasing water speed and turbulence and diffusing incoming waves. "If we have large expanses of salt marsh becoming tidal flat, we're going to lose ecosystem services and that could play a big role in how exposed that homeowner is to storm surge," he says. The visualizations SLAMM provides, he says, will help motivate communities to protect salt marshes and the services they provide.

Back in Connecticut, SLAMM modeling shows a 50 percent to 97 percent loss of high marsh by 2100. That's up to 10,000 acres. The model predicts the loss will be mitigated by less than 1,000 acres of potential wetland "gain" at higher elevation — and Elphick says even that is optimistic, since he sees little evidence of marsh migration today except for salt marsh grasses colonizing coastal lawns. He and the little brown saltmarsh sparrow he seeks to protect — indeed, everyone and everything that benefits from the services salt marshes provide — can only hope that the awareness the modeling brings will help coastal communities find a place for salt marshes as they plan for accommodating sea-level rise.

Adapted, with permission from an article in Ensia

PUBLICATIONS

Chazdon, R. L., P. H. Brancalion, D. Lamb, L. Laestadius, M. Calmon, and C. Kumar. 2015 A policy driven knowledge agenda for global forest and landscape restoration. *Conservation Letters*. doi: 10.1111/conl.12220.

L. Poorter, … **R. Chazdon** … D. M. A. Rozendaal. 2016. Biomass resilience of Neotropical secondary forests. *Nature* 530: 211-214. 10.1038/nature16512

Marshall, David C., Kathy B.R. Hill, Max Moulds, **Dan Vanderpool**, **John R. Cooley**, A.B. Mohagen, and **Chris Simon**. 2015. Inflation of Molecular Clock Rates and Dates: Molecular phylogenetics, biogeography, and diversification of a global cicada radiation from Australia (Hemiptera: Cicadidae: Cicadettini). Systematic Biology. Advance Access November 6, 2015. 0(0):1–19, DOI:10.1093/sysbio/syv069.

Menge, D.N.L. and **R.L. Chazdon**. 2015 Higher survival drives the success of nitrogen-fixing trees through succession in Costa Rican rainforests. New Phytologist 10.1111/nph.13734
Authors

Wade, Elizabeth, J., Thomas Hertach, Matija Gogala, Tomi Trilar, and **Chris Simon**. 2015. Molecular species delimitation methods recover most song-delimited cicada species in the European *Cicadetta montana* complex. Journal of Evolutionary Biology 28: 2318–2336. doi: 10.1111/jeb.12756

Rodney B. Siegel, **Morgan W. Tingley**, Robert L. Wilkerson, Christine A. Howell, Matthew Johnson, and Peter Pyle. 2016. Age structure of Black-backed Woodpecker populations in burned forests. *Auk* 133: 69-78. doi: 10.1642/AUK-15-137.1

Morgan W. Tingley, Robert L. Wilkerson, Christine A. Howell, and Rodney B. Siegel. 2016. An integrated occupancy and space-use model to predict abundance of imperfectly detected, territorial vertebrates. *Methods in Ecology and Evolution*. doi: 10.1111/2041-210X.12500

Miranda L. Davis, P. A. Stevens, P. Kjellander. 2016. Beyond Climate Envelope Projections: Roe Deer Survival and Environmental Change. *Journal of Wildlife Management.* doi: 10.1002/jwmg.1029

Rose, Julie M., Bricker, Suzanne B., Deonarine, Sarah, Ferreira, Joao G., Getchis, Tessa, Grant, Jon, **Kim, Jang K.**, Krumholz, Jason S., Kraemer, George P., Stephenson, Kurt, Wikfors, Gary H., **Yarish, Charles**. 2015. Nutrient Bioextraction, pp 1-33 *in* Encyclopedia of Sustainability Science and Technology. 10.1007/978-1-4939-2493-6_944-1

Kim J.K., G.P. Kraemer and **C. Yarish**. 2015. Sugar Kelp Aquaculture in Long Island Sound and the Bronx River Estuary for Nutrient Bioextraction and Ecosystem Services. Marine Ecology Progress Series 531:155-166.

PUBLICATIONS

Massoni, J., T. L. P. Couvreur and H. Sauquet. 2015. Five major shifts of diversification through the long evolutionary history of Magnoliidae (angiosperms) phylogenetics and phylogeography. *BMC Evolutionary Biology* 15: 49. 10.1186/s12862-015-0320-6

Akman, M., **J. E. Carlson, K. E. Holsinger and A. M. Latimer.** 2015. Transcriptome sequencing reveals population differentiation in gene expression linked to functional traits and environmental gradients in the South African shrub *Protea repens*. *New Phytologist*. DOI: 10.1111/nph.13761

Evans, A.E., D. R. Towns and J.R. Beggs. 2015. Relative importance of sugar resources to endemic gecko populations in an isolated island ecosystem. *New Zealand Journal of Ecology* (2015) *39(2): 262-272.* **Annette Evans,** first author on this publication, was awarded a prize by the New Zealand Ecology Society for Outstanding Publication by a New Career Researcher.

Nadeau, C. P., C. J. Conway, and N. Rathbun. 2015. Depth of artificial Burrowing Owl burrows affects thermal suitability and occupancy. *Journal of Field Ornithology*: DOI: 10.1111/jofo.12119. http://onlinelibrary.wiley.com/doi/10.1111/jofo.12119/full

Farkas, T. E. 2015. Fitness trade-offs in pest management and intercropping with colour: an evolutionary framework and potential application. *Evolutionary Applications* 8: 847-853. 10.1111/eva.12283 http://onlinelibrary.wiley.com/doi/10.1111/eva.12283/abstract , http://onlinelibrary.wiley.com/doi/10.1111/eva.12212/epdf

Bush, A. M., and R. K. Bambach. 2015. Sustained Mesozoic-Cenozoic diversification of marine Metazoa: a consistent signal from the fossil record. Geology. 43:979-982.

Bush, A. M., Csonka, J. D., DiRenzo, G. V., Over, D. J., Beard, J. A. 2015. Revised correlation of the Frasnian-Famennian boundary and Kellwasser events (Upper Devonian) in shallow marine paleoenvironments of New York State. Palaeogeography, Palaeoclimatology, Palaeoecology. 433:233-246.

Getty, P.R., Hardy, L., and **Bush, A.M.** 2015. Was the *Eubrontes* track maker gregarious? Testing the herding hypothesis at Powder Hill Dinosaur Park, Middlefield, Connecticut. Bulletin of the Peabody Museum of Natural History. 56:95–106.

Fichman, M.E., **Crespi, J.M.**, Getty, P.R., and **Bush, A. M.** 2015. Retrodeformation of Carboniferous trace fossils from the Narragansett Basin, United States, using raindrop imprints and bedding-cleavage intersection lineation as strain markers. Palaios 30:574-588.

Getty, P. R., **Bush, A. M.**, and Vellone, D. 2015. Early Jurassic trace fossil localities from fluvial and lacustrine facies of the Hartford Basin in Massachusetts. Pp. 49-66 *in* M. S. Gilmore and P. G. Resor, eds. Guidebook for the 107th Annual Meeting of the New England Intercollegiate Geological Conference.

PUBLICATIONS

Ganias, K., **J. N. Divino**, K. E. Gherard, J. P. Davis, F. Mouchlianitis, and **E. T. Schultz**. 2015. A reappraisal of reproduction in Anadromous Alewives: determinate vs indeterminate fecundity, batch size and batch number. *Transactions of the American Fisheries Society* 144. DOI: 10.1080/00028487.2015.1073620

Turchin, Peter 2015 *Ultrasociety: How 10,000 Years of War Made Humans the Greatest Cooperators on Earth.* Published by Beresta Books. ISBN: 978-0-9961395-1-9

Hafting, J.T., J.S. Craigie, D.B. Stengel, R.R. Loureiro, A. Buschmann, **C. Yarish**, M.D. Edwards & A.T. Critchley. Prospects and challenges for industrial production of seaweed bioactives. J. Phycol. 51:821-837 (DOI:10.111/jpy.12326).

Young, A.J., C. Rogerson, S.A. Hammer & **M.R. Opel**. 2015. *Conophytum bachelorum* and its relatives: the introduction of a new conophytum from Namaqualand, *C. confusum*. Bradleya 33: 41-49.

ALUMNI NOTES

Karolina Fucikova (Ph.D. 2012) accepted a tenure-track position in the Biology Department at Assumption College.

Noah Gordon (M.S. 2001); Ph.D. University of Missouri) has been promoted to Associate Professor at the University of Evansville.

Rob Dunn, (Ph.D. 2003) Professor of Applied Ecology, North Carolina State University has three new publication in 2016.:

Urban J, Fergus DJ, Savage AM, Ehlers M, Menninger HL, **Dunn RR,** Horvath JE. (2016) The effect of habitual and experimental antiperspirant and deodorant product use on the armpit microbiome. PeerJ 4:e1605 https://doi.org/10.7717/peerj.1605

Bertone MA, Leong M, Bayless KM, Malow TLF, **Dunn RR**, Trautwein MD. (2016) Arthropods of the great indoors: characterizing diversity inside urban and suburban homes. PeerJ 4:e1582 https://doi.org/10.7717/peerj.1582

Council SE, Savage AM, Urban JM, Ehlers ME, Skene JHP, Platt ML, **Dunn RR**, Horvath JE. (2016) Diversity and evolution of the primate skin microbiome. Proc. R. Soc. B 283: 20152586.

Christopher Martine (Ph.D. 2006), has several publications this spring regarding identification of a new species of an Australian bush tomato, *Solanum watneyi* Please see: http://phytokeys.pensoft.net/articles.php?id=6995; http://time.com/4238060/matt-damon-the-martian-flower/; http://www.livescience.com/53853-tomato-plant-named-for-martian-botanist.html

Sacha Spector (Ph.D. 2001) has been appointed as the Director for the Environment Program of the Doris Duke Charitable Foundation.

AWARDS AND GRANTS

Hans Dam (PI, Marine Sciences), **Michael Finiguerra (Co-PI; EEB)**, Hannes Baumann (Co-PI; Marine Sciences) were awarded a $522,302 NSF-BIological Oceanography grant for their proposal: *Collaborative research: Transgenerational phenotypic and genomic responses of marine copepods to the interactive effects of temperature and CO2*

Cynthia Jones, Pam Diggle, Bernard Goffinet, Don Les and Louise Lewis were awarded a 2016 Provost's Teaching Innovation Mini Grant for their proposal *"Using Digital Image Acquisition to Enhance Plant Biodiversity Education."*

Mark Urban was awarded a $823,650 NSF Grant (2016-2020) for his proposal "*Ecological and evolutionary resilience of aquatic communities to the climate-mediated expansion of an apex predator"*

Margaret Rubega received a Teaching Excellence Career Award from the UConn American Association of University Professors (AAUP).

Mike Willig has been chosen by the University of Connecticut Board of Trustees to be a Board of Trustees Distinguished Professor.

Jill Wegrzyn joined the EEB Department in January, 2016. Dr. Wegrzyn's research focuses on the computational analysis of genomic and transciptomic sequences from non-model plant species. To find out more about her research go to: http://compgenomics.lab.uconn.edu/

Jill Wegrzyn was awarded a $1.2 million NSF Plant Genome Research Program (PGRP) Grant (2016-2019) for the proposal titled *"Standards and Cyberinfrastructure that Enable "Big-Data"Driven Discovery for Tree Crop Researc*h."

Yaowu Yuan was awarded a $510,000 NSF Grant (2016-2019) for his proposal "*Identification and Characterization of Transcription Factors Regulating Carotenoid Pigmentation During Mimulus Flower Development* ."

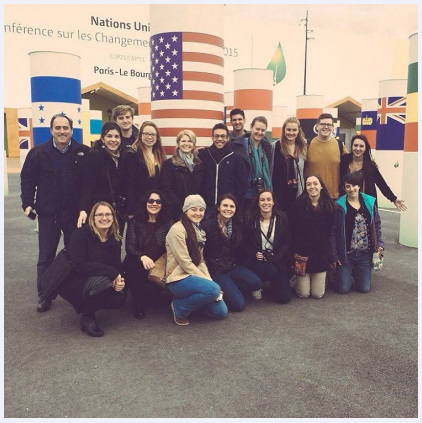
Annette Evans, Master's student working with Elizabeth Jockusch and Mark Urban was recently awarded a prize from the New Zealand Ecological Society for Outstanding Publication by a New Career Researcher. The work from her Master's thesis can be found at: http://newzealandecology.org/nzje/3218. **Annette** also received the 2016 Rosemary Grant from the Society for the Study of Evolution.

Nora Mitchell, Ph.D. candidate in Kent Holsinger's lab received notification from the Evolutionary Genetics Program at NSF that her Doctoral Dissertation Improvement Grant (DDIG) has been approved for funding.

Charles Delavoi, a Ph.D. student in Bernard Goffinet's lab, received an award to support his field work in bryology from the Anderson and Crum Fund of the American Bryological and Lichenological Society.

Fall 2015 IDEA Grants were awarded to undergraduates **Genevieve Nuttall '17** and **Nicholas Russo '18.** Both undergrads are working in Morgan Tingley's lab.

UCONN FACULTY AND STUDENTS ATTEND PARIS CLIMATE CONFERENCE



Last December, we stepped off our bus in Le Bourget, a suburb of Paris. Like everyone else on our bus, we swarmed through a forest of concrete pillars, each painted with a different national flag. Amidst a hum of world languages, someone shouted in English, "Here we are." We quickly assembled in front of the US flag pillar for photos. UConn had arrived at the United Nations climate change talks. This meeting would reach one of the most important global decisions about climate change in decades.

I co-led the UConn contingent of 18 students, faculty, and staff to the United Nations 21st Conference of the Parties, or COP21. We chose the 12 undergraduates from 77 applications based on grades, environmental leadership, and independent project ideas. Students represented majors ranging from economics to human rights. EEB was well-represented by three of our majors: Jessica Griffin, Cristina Macklem, and Rob Turnbull.

Each day in Paris, we gathered in the drawing room of our hotel. Professors took turns leading discussions about atmospheric science, the politics of renewable energy, risks for species extinctions, and the UN climate change talks themselves. Then we streamed aboard the Metro trains and made our way to the UN talks or one of the many other associated events occurring throughout Paris. Students also acted as ambassadors, sending live photos, tweets, and blog posts about developments back to UConn.

We attended lectures, watched protests, and spoke with non-profit groups. At the Generations pavilion at the climate talks, we interacted with negotiators and advocacy groups. At the Grand Palais in downtown Paris, we saw shiny corporate solutions to climate change while police tear-gassed protesters outside. At the Global Landscapes Forum, we learned how forests need to be part of the climate change solution. One night, UConn co-hosted an event for university sustainability that was attended by representatives of universities and colleges across America. We watched Bill McKibben and Naomi Klein deliver a scathing rebuke to Exxon in a dingy warehouse in East Paris.

But most importantly we witnessed history. Amidst laughter and tears, we would watch as the world came together to enact strong limits on greenhouse gases and quite possibly save the world as we know it. And UConn was there. A compilation of blog posts, twitter feeds, and Instagram hashtags: http://www.ecohusky.uconn.edu/engagement/COP21Hub.html

— Article written by Mark Urban

UCONN'S COLLEGE OF LIBERAL ARTS AND SCIENCES SPONSORS CT SCIENCE OLYMPIAD

On Saturday, April 2, 2016 UCONN will host 45 teams of students — 450 students, 250+ teachers, coaches, judges and parents will be on campus for the event.

For the past 32 years, Science Olympiad has led a revolution in science education. What began as a grassroots assembly of science teachers is now one of the premiere science competitions in the nation, providing rigorous, standards-based challenges to nearly 7,400 teams in 50 states. Science Olympiad's ever changing line-up of events in all Sciences, Technology, Engineering and Mathematics (STEM) disciplines exposes students to practicing scientists and career choices, and energizes classroom teachers with a dynamic content experience.

Science Olympiad competitions are like academic track meets, consisting of a series of 23 team events in each division (Division B is middle school; Division C is high school). Each year, a portion of the events are rotated to reflect the ever-changing nature of genetics, earth science, chemistry, anatomy, physics, geology, mechanical engineering and technology. By combining events from all disciplines, Science Olympiad encourages a wide cross-section of students to get involved. Emphasis is placed on active, hands-on group participation. Through Science Olympiad, students, teachers, parents, principals and business leaders bond together and work toward a shared goal.

The culmination of nearly 300 regional and state tournaments is the Science Olympiad National Tournament, held at a different university each year. This rotating system gives students the opportunity to visit new parts of the country and tour colleges they might consider for their undergraduate studies, and provides a memorable experience that lasts a lifetime.

The Nationals are scheduled to be held at University of Wisconsin at Menomonie on May 20-21, 2016. For additional information about Connecticut Science Olympiad, please go to http://www.ctscienceolympiad.org/division-c; for information about Science Olympiad go to https://www.soinc.org/about.

April 2nd events sponsored by EEB and Geosciences include:

Invasive Species
UConn EEB - Cynthia Jones, Event Supervisor
UConn EEB - Benedict Gagliardi
Teams identify and demonstrate understandings of the ecology of invasive species.

Hydrogeology
UConn EEB, Geosciences - Stephanie Phillips, Event Supervisor
Teams manipulate a groundwater computer model to solve problems and evaluate solutions based on hydrogeological evidence.

GeoLogic Mapping
UConn EEB, Geosciences - Robert Thorson, Event Supervisor
Teams use topo maps, cross sections, and geologic maps to solve problems on subsurface structures and geohazards.