

OEBnews

2021-2022



Newsletter of the

Department of Organismic & Evolutionary Biology

HARVARD UNIVERSITY



**Congratulations to
OEB's new PhD's
Class of 2022 !!**

Contents

3	Letter From The Chair	17	Diversity, Inclusion & Belonging Committee
4	2022 PhD Graduates	18	Integrated Biology (IB) Concentrators News IB 2022 Graduates
8	Research Highlights	19	Field Trips
9	In Memoriam	20	Event Highlights Upcoming Events 2022-2023
10	Faculty Promotion	21	Staff News
11	What We're Writing		
16	2022 REUs		

Highlights

8 Faculty Awards

12 Graduate Awards

13 Welcome G1s!

14 Teaching Awards

15 Postdoc Awards

Welcome from the Chair



Elena Kramer

DEPARTMENT CHAIR (JULY 1 2016-JUNE 30, 2022)
BUSSEY PROFESSOR OF ORGANISMIC AND EVOLUTIONARY
BIOLOGY, HARVARD COLLEGE PROFESSOR,
INTERIM DIRECTOR, HARVARD UNIVERSITY HERBARIA

Dear Colleagues, Alumni, and Friends,

I have mixed emotions about writing my last Letter from the Chair. The last six years have held a lot of unexpected challenges (to say the least), but there have also been a few good surprises and some genuine sources of pleasure. These have ranged from giving my colleagues Ben de Bivort and Stephanie Pierce the happy news of their promotions to tenure (Stephanie just this past winter!), to getting to know new cohorts of graduate students, to watching our whole community cope with the pandemic with perseverance and kindness. Of course, we all know that the pandemic isn't really over exactly and navigating the "new normal" still holds challenges, so patience remains the order of the day!

Let's focus on the positive, though. As I already mentioned, we were thrilled to celebrate with Prof. Stephanie Pierce, who was promoted to tenure right before the holidays in December. We graduated an enormous group of 21 OEB PhD students, whose work truly spanned the entire breadth of evolution and ecology. Seeing so many of them, as well as past graduates, at the first in-person graduation in three years was a real joy, as was our first in-person G4 symposium in as many years. We wrapped up the interview phase of the tenured faculty search in Plant and Fungal Biology and very much hope we will be able to make a strong case for an appointment to the President this fall. The new year will also hold the return of several cherished OEB traditions including in-person departmental seminars, and hopefully more events and celebrations. I also look forward to seeing the continued progress made by the Diversity, Inclusion and Belonging (DIB) Committee, which has been developing ideas ranging from high school internships to a symposium and workshop focused on rising stars in evolution and ecology.

As I step down as Chair, I want to especially thank the entire OEB Administrative team for making all this progress possible, particularly the heroic effort required to get us fully back in classrooms and labs last fall. They have worked incredibly hard to keep us safe and our research and academic efforts going, all while managing all the personal challenges of the pandemic. They deserve our sincere appreciation. I also want to thank everyone else – students, postdocs, faculty, and staff – for your support and friendship over the last six years. Of course, my greatest thanks are reserved for my successor, Scott Edwards, who has taken on this critical role and I know will dedicate himself to helping all of us do our best work.

Please take some time to peruse the entire newsletter, there is more to celebrate within. Remember, you can follow all the latest news from OEB on our [website](#), [Instagram](#), and [Twitter](#), and we always welcome updates on your activities and accomplishments.

Best wishes,
Elena Kramer

Congratulations to our Graduates!



ISABEL (IZZY) BAKER

Adaptations to life on an oxidizing planet — insights from the evolutionary ecophysiology of iron-respiring bacteria. (Peter Girguis, Advisor)

DANIEL BUONAIUTO

Phenological sensitivity as a mediator of plant interactions. (N. Michele Holbrook, Advisor)



CATHERINE CHAMBERLAIN

Climate change alters temperate tree and shrub spring phenology and false spring risk. (N. Michele Holbrook, Advisor)

MOLLY B. EDWARDS

Exploring the development and diversification of the unique *Aquilegia nectar spur*. (Elena Kramer, Advisor)



PHILIP FAHN-LAI

Shoulder to shoulder: Musculoskeletal function of the amniote pectoral girdle and the foundations of the mammalian forelimb. (Stephanie Pierce and Andrew Biewener, Co-Advisors)

Congratulations to our Graduates!



BENJAMIN E. GOULET-SCOTT

Evolutionary history, local adaptation, and reproductive isolation in the *Phlox pilosa* complex (Robin Hopkins, Advisor)



ALYSSA MICHELLE HERNANDEZ

Where the rubber meets the road: How do phytophagous beetles hold onto host plants? (Brian Farrell, Advisor)



NICK HERRMANN

Competition, character displacement, and ecological release in *Anolis* lizards. (David Haig, Advisor)



ALEXANDER (ALEX) HEYDE

Evolutionary models of clonal expansion and niche construction. (L. Mahadevan and Martin Nowak, Co-Advisors)



MILO JOHNSON

On epistasis and adaptation in the budding yeast *Saccharomyces cerevisiae*. (Michael Desai, Advisor)

Congratulations to our Graduates!



JULIAN OHIRO KIMURA

Development in the acoel *Hofstenia miamia* and the embryonic origins of stem cells. (Mansi Srivastava, Advisor)

VANESSA L. KNUTSON

An inordinate fondness for slugs: Phylogenomics of the diverse gastropod clade Heterobranchia, a group key to our understanding of the evolution of shell reduction and loss. (Peter Girguis, Advisor)



SOFIA PRADO-IRWIN

Evolutionary patterns in *Anolis* lizards. (Scott Edwards, Advisor)

C. JONATHAN SCHMITT

Phylogeography, color variation, and hybridization in an Andean tanager, Superciliaried Hemispingus (*Aves: Thlypopsis superciliaris*). (Scott Edwards, Advisor)



KRISTEL SCHOONDERWOERD

Interspecific variation in resting bud morphologies and seasonal heteroblastic leaf sequences among temperate, woody plants. (William (Ned) Friedman, Advisor)

Congratulations to our Graduates!



ZHENGYANG WANG
Insect conservation (Naomi Pierce, Advisor)



BROCK WOOLDRIDGE
The genomic basis of repeated adaptation in deer mice. (Hopi Hoekstra, Advisor)



JAMES XUE
High-throughput functional characterization of regulatory variants related to human evolution and disease. (Pardis Sabeti, Advisor)



MIN YA
Floral meristem termination in *Aquilegia*. (Elena Kramer, Advisor)



XUEMEI ZHAI
What makes Stellwagen Bank a productive coastal region? (Paul Moorcroft, Advisor)

Research Highlights

~ **Professor Javier Ortega-Hernández** and colleagues from the University of New England, The Natural History Museum, and Pomona College report a unique case of an exceptionally preserved nervous system in a 310 million-year-old fossil horseshoe crab from the world-famous Carboniferous Mazon Creek in Illinois, US. The study, published in [Geology](#), is the first time a complete fossilized brain has been discovered replicated in clay minerals. The authors provide a detailed accounting of the study in [The Conversation](#).

~ **Postdoctoral researcher Tiago R. Simões** and **Professor Stephanie Pierce** combined data from fossil footprints and body fossils to provide a precise age for the origin of tetrapods at approximately 390 million years ago, 15 million years older than the oldest tetrapod body fossil. The study, published in [Nature Ecology and Evolution](#), found that most of the close relatives to tetrapods had exceptionally slow rates of anatomical evolution, suggesting the fish relatives to tetrapods were quite well adapted to their aquatic lifestyle. They also found that the skull and jaws were evolving faster than the rest of the body, including the limbs, suggesting changes in the skull had a stronger role in the initial stages of the

fish-to-tetrapod transition.

~ In a study published in [iScience](#) **Professor Javier Ortega-Hernández**, **postdoctoral researcher Rudy Lerosey-Aubril**, and an international team of researchers describe two new species of fossil ctenophores (also known as comb jellies) from the mid-Cambrian of Western USA. The first species, *Ctenorhabdodus campanelliformis*, had a preserved nervous system, unlike most modern comb jellies. The second species, *Thalassostaphylos elegans*, had an important feature known as the “polar fields,” which can be seen as two small dots on top of the apical organ. The two new species illuminate the evolution of the nervous system, sensory structures, and diversity of Cambrian ctenophores, leading the researchers to conclude that Cambrian ctenophores had more complex nervous systems compared to those observed today.

~ **Postdoctoral researcher Tiago R. Simões** and an international team of researchers describe a new species that represents the most primitive member of lepidosaurs in a study published in [Nature](#). *Taytalura alcoberi*, found in the Late Triassic deposits of Argentina, is the first 3D preserved early lepidosaur fossil and the most complete fossil representing the early stages of lepidosaur evolution found to date. Simões

Faculty Notable Awards

- **Gonzalo Giribet** appointed Director of the Museum of Comparative Zoology.
- **Scott Edwards** appointed Chair of the Department of Organismic and Evolutionary Biology.
- **L. Mahadevan** named 2021 Simons Investigator.
- **Charles Davis** and team awarded The National Science Foundation's Advancing Digitization of Biodiversity Collections Grant for the Harvard University Herbaria.
- **Cassandra Extavour** selected as Howard Hughes Medical Institute (HHMI) Investigator.
- **Hopi Hoekstra** elected to the American Association for the Advancement of Science (AAAS) 2021 Fellows in Biological Sciences.

- **Ned Friedman** awarded the Medal of Honor by The Garden Club of America.
- **Andrew Knoll** awarded the Crafoord Prize in Geosciences by The Royal Swedish Academy of Sciences for his pioneering contributions to the studies of life's earliest history.
- **Javier Ortega-Hernández** awarded an Early Career Grant from the 2022 Human Frontier Science Program (HFSP) to study the water to land transition in euarthropods. The awarded project is in collaboration with the Institute of Evolutionary Biology, Barcelona, and University of Naples.
- **Scott Edwards** elected as member of the Royal Physiographic Society of Lund, Sweden.

determined the proper placement of the fossil in the reptile dataset, confirming the team's suspicions that *Taytalura* was in fact the most primitive member of the lineage that eventually originated all lizards and snakes.

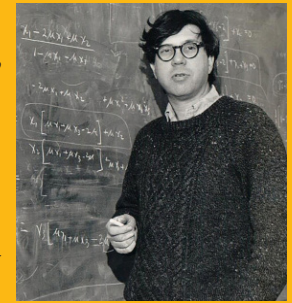
~ **Professor L. Mahadevan** and a team of researchers used observations, lab experiments, theory, and computation to understand the growth and form of the cusp of an apple. The team collected apples at various growth stages from an orchard at Peterhouse College at the University of Cambridge in the U.K. and mapped the growth of the cusp over time. The study, published in *Nature Physics*, showed that different rates of growth between the bulk of the apple and the stalk region resulted in the dimple-like cusp and that the underlying fruit anatomy along with mechanical instability may play joint roles in giving rise to multiple cusps in fruits.

~ In a paper published in *Proceedings of the Royal Society B* **Professor Javier Ortega-Hernández** and a team of researchers, led by **PhD candidate Marc Mapalo**, describe a new modern-looking tardigrade fossil that represents a new genus and species. *Paradoryphoribius* is the first fossil to be found embedded in Miocene Dominican amber and the first fossil representative of the tardigrade superfamily Isohypsibioidea. Mapalo analyzed the 559 micrometer fossil and discovered that it had a unique foregut organization that warranted the researchers to erect a new genus. *Paradoryphoribius* is the only genus that has this specific unique character arrangement in the superfamily Isohypsibioidea and offers the only data on a tardigrade buccal apparatus in their entire fossil record. Tardigrade fossils are rare, with this study the full tally includes only four specimens, three of which are formally described and named, including *Paradoryphoribius*.

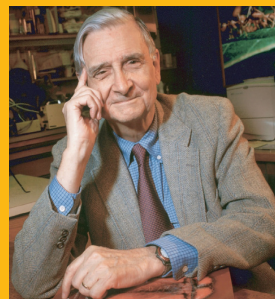
~ An international team of researchers, led by **post-doctoral researcher Javier Luque**, describe the first crab from the Cretaceous dinosaur era preserved in amber in a study published in *Science Advances*. *Cretapsara athanata* is the oldest modern-looking crab (approximately 100 million years old) and the most complete fossil crab ever discovered. Full-body 3D reconstruction showed *Cretapsara* had no lung tissue,

In Memoriam

Richard C. Lewontin:
March 29, 1929 - July 4, 2021



We are deeply saddened to note the passing of our dear friend and colleague Richard (Dick) Lewontin, Emeritus Professor of Biology and Alexander Agassiz Professor of Zoology. Lewontin is considered one of the most brilliant population geneticists. He pioneered the study of genetic variation among humans and other animals from his joint work with John Hubby, University of Chicago, which showed there is much greater genetic diversity among members of the same species than was believed. He joined Harvard in 1973, retiring in 2003, Lewontin was a Fullbright Fellow and received many prestigious awards including the Sewall Wright Award in 1994, the Crafoord prize in 2015, and the Thomas Hunt Morgan Medal in 2017, the highest honor from the Genetics Society of America.



Edward O. Wilson:
June 10, 1929 - December 26, 2021

It is with great sadness that we announce the passing of Edward O. Wilson, Emeritus Pellegrino Professor. Wilson was called

"Darwin's natural heir," and was known as "the ant man" for his pioneering work in entomology. He authored over 30 books, twice receiving a Pulitzer Prize. He received many distinguished awards during his six decades at Harvard including the TED Prize in 2007 and the Hubbard Medal in 2013, the highest award of the National Geographic Society.

only well-developed gills, indicating the animal was aquatic to semi-aquatic. Phylogenetic analysis showed *Cretapsara* bridges the gap in the fossil record and confirms that crabs actually invaded land and fresh water during the dinosaur era, pushing the evolution of nonmarine crabs much further back in time.

~ **Professor L Mahadevan** led a team of researchers from the Harvard John A. Paulson School of Engineering and Applied Sciences (SEAS) to develop a shape-shifting material that can take and hold any possible shape. The study, published in the *Proceedings of the National Academy of Sciences*, paves the way for a new type of multifunctional material that can be used in a range of applications, from robotics and biotechnology to architecture. The study shows how to create structural materials that have an arbitrary range of shape-morphing capabilities, allowing independent control of the geometry and mechanics.

~ In a study published in the *Proceedings of the Royal Society B* researchers, led by **postdoctoral researcher Megan Whitney**, show the first tusks belonged to dicynodonts, which lived between 270–201 million-years-ago before the dinosaurs. The researchers performed paleohistology on paper-thin slices of fossilized teeth from 19 specimens, representing ten different species. They found that dicynodonts evolved to continuously deposit the same canine tooth tissues until the tooth begins to move outside of the mouth to become functional. They also discovered that late in their evolutionary history dicynodonts convergently evolved a true tusk that was ever growing.

~ In a study published in *Developmental Cell* researchers, led by **Professor Mansi Srivastava**, developed a method to make transgenic acoel worms to study how the regeneration process works through transgenesis. Srivastava and co-author **postdoctoral researcher Lorenzo Ricci** injected modified DNA into just fertilized embryos of the marine acoel worm, *Hofstenia miamia*. The DNA glows as the worm matures and is then passed along to its children and their children. When the introduced gene becomes a protein it emits either a green or red fluorescent glow in the dark. This allowed the researchers to visualize with much better detail what the cells look like, where they are in the animal, and how they interact with

Stephanie Pierce Promoted



Stephanie Pierce has been promoted to Professor of Organismic and Evolutionary Biology. Pierce's work investigates ancient evolutionary transitions, focusing on interpreting functional shifts

through the fossil record.

Pierce's meticulous observations, informed by experiments and carefully constructed models, show how ancient vertebrate animals lived – how they moved, how they ate, how they interacted in communities. She has shown how limbs changed in structure and function as vertebrates first colonized the land surface. She demonstrated by detailed study of their tails that some dinosaurs returned to aquatic environments, much as whales and seals did later on. She has illuminated the importance of evolutionary innovations in the spinal column for the diversification of mammals and much more. Pierce's work is painting a compelling new picture of how vertebrate life on land has evolved through time.

each other. In addition to this study, the researchers published a comprehensive characterization of the embryos and nervous system, and uncovered a number of DNA switches that appear to control genes for whole-body regeneration in these worms.

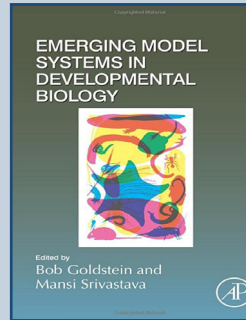
~ In a new study, published in the *Annals of Botany*, **PhD candidate Jacob Suissa** reveals that the unique timing of spore dispersal in the sensitive fern, *Onoclea sensibilis*, is determined by a structural mechanism of humidity-driven movement in spore bearing leaves. Suissa found that the dead mature leaflets opened when dried out and closed again when introduced to water; they moved in direct response to changes in humidity and the process was reversible. The study showed this was due to the orientation of the cells in the leaflets. The upper-side of the leaflet's cells run perpendicular while the lower-side cells run parallel, allowing the leaf to expand like an accordion. This is the first time this mechanism has been documented in a whole fern leaf.

~ In a study, published in [Nature Communications](#), researchers, led by **postdoctoral researcher Barnabas H. Daru**, compiled a dataset of over 200,000 plant species worldwide to demonstrate the extent to which species extinctions and non-native invasive plants reorganize plant communities in the Anthropocene, the current geological age dominated by human activity. Daru and co-author **Professor Charles Davis** examined how landscapes and communities of plants change, especially following the bridging of the eastern and western hemispheres roughly 500 years ago. Their analyses captured a striking loss of species' distinctiveness across landscapes and showed that regardless of extinction scenario, the strongest contributor to biotic homogenization resulted from non-native plants naturalized by humans. It occurred over a short evolutionary span of approximately 500 years and was facilitated – intentionally or unintentionally – by humans moving organisms around the landscape.

~ Many fish species move by undulating their body and caudal fin. Traditionally, these fishes were classified based on key morphological traits and grouped into four expected swimming modes based on four model species: eel, trout, mackerel, and tuna. **Postdoctoral researcher Elsa Goerig** and co-authors **postdoctoral researcher Valentina Di Santo** and **Dylan K. Wainwright** (PhD '19) performed a comparative study of 44 diverse species of these fishes and discovered that despite variability in body shape and native environments, there is convergence in the swimming motion across fish species. The study, published in [Proceedings of the National Academy of Sciences](#), showed that fishes cannot be placed in discrete categories with regards to how they swim, but are rather located on a continuum; highlighting that despite variability in body shape and native environments, there is convergence in the swimming motion across species.

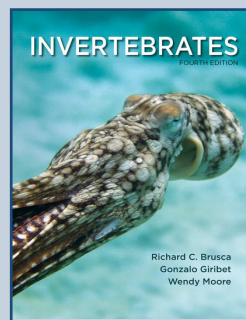
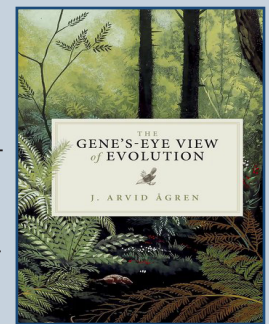
~ In a study in [iScience](#) researchers, led by **postdoctoral researcher Javier Luque**, describe the unusually large optical features of *Callichimaera perplexa*, a 95 million-year-old crab fossil found in a Cretaceous layer of rock in the Andes of Colombia. The study found that, unlike the other crab species, *Callichimaera*

What We're Writing



~ **Emerging Model Systems in Developmental Biology**, Bob Goldstein and Mansi Srivastava, editors. An ever-growing roster of model organisms is a hallmark of 21st century Developmental Biology. Emerging model organisms are well suited to asking some fascinating and important questions that cannot be addressed using established model systems. And new methods are increasingly facilitating the adoption of new research organisms in laboratories. This volume is written by some of the scientists who have played pivotal roles in developing new models or in significantly advancing tools in emerging systems. Elsevier.

~ **The Gene's-Eye View of Evolution**, J. Arvid Agren. The Gene's-Eye View of Evolution is suitable for graduate-level students taking courses in evolutionary biology, behavioural ecology, and evolutionary genetics, as well as professional researchers in these fields. It will also appeal to a broader, interdisciplinary audience from the social sciences and humanities including philosophers and historians of science



~ **Invertebrates**, Richard C. Brusca, Gonzalo Giribet, and Wendy Moore. Invertebrates is a complete, trusted, and engaging textbook whose comprehensive coverage makes it an invaluable resource for both undergraduate and graduate courses and professional researchers. The 3rd edition has been widely praised for its detailed classifications, high-quality illustrations, and coverage of contemporary debates in the field. The 4th edition continues to feature recent scholarship and current perspectives, while streamlining the text to improve accessibility for intro-level students.

maera retained its large eyes throughout development. In fact, its eyes were the fastest growing of all species and could reach up to 16% of their entire body, which is about the size of a quarter; similar to a human with eyes the size of soccer balls. Further analysis showed that *Callichimaera* was an animal with high visual acuity similar to dragonflies – which are among the apex predators of the insect world. *Callichimaera*'s big eyes and overall body form with

unusually large oar-like legs indicate it might have been a fierce, swimming predator, rather than a bottom-crawler as most crabs.

~**Professor Javier Ortega-Hernández** and members of his lab describe the exceptionally preserved nervous system of the soft-bodied euarthropod *Mollisonia symmetrica* from the mid-Cambrian Burgess Shale in British Columbia. Although recent studies suggest that mollisoniids are related to chelicerates,

Graduate Students Notable Awards

-**Katherine Angier** (N Pierce) appointed Ashford Fellow in the Graduate School of Arts and Sciences.

-**Min Ya** (E Kramer) selected to serve on the Strategic Planning Committee: Professional Development for the Botanical Society of America.

-**Anju Manandhar** (NM Holbrook) recipient of the 2020-2021 Simmons Award from Harvard Center for Biological Imaging for her project, "Structural and mechanical characterization of stomatal movement."

-**Min Ya** (E Kramer) recipient of the 2020-2021 Simmons Award from Harvard Center for Biological Imaging for her project, "Live confocal imaging in *Aquilegia* floral meristem."

-**Liming Cai** (C Davis) recipient of the Dorothy M Skinner Award from the Society of Integrative and Comparative Biology for her presentation, "Deeply altered genome architecture in the iconic endoparasitic flowering plant Rafflesiaceae."

-**Nikhil Chari** (B Taylor) recipient of the Harvard Forest Long Term Ecological Research Program Award for his project, "Assessing the impacts of root exudation on soil mineral-associated organic matter dynamics."

-**Molly Edwards** (E Kramer) awarded Vlogbrothers Sponsorship for her YouTube series Science IRL to partner with Team Halo, a UN initiative.

-**Jacob Suissa** (W Friedman) recipient of the 2021 Derek C. Bok award for Excellence in Graduate Student Teaching of Undergraduates.

-**Sophie Everbach** (NM Holbrook) recipient of the Harvard Forest Long-Term Ecological Research (LTER) award for her project, "Eastern hemlock root resource allocation response to hemlock woolly adelgid."

-**Samantha Royle** (J Hanken) awarded the Harvard Medical School Scientific Citizenship Initiative Fellowship.

-**Jacob Suissa** (W Friedman) received Honorable Mention for the Donald R. Kaplan Award in Compar-

ative Morphology for his proposal, "Bumps in the node: The effects of vascular architecture on hydraulic integration in fern rhizomes."

-**Amaneeet Lochab** (C Extavour) awarded the Harvard Graduate School of Arts and Sciences Merit Fellowship for her proposal "Germ cell migration through a developing embryo."

-**Dakota McCoy** (D Haig) recipient of the Linnean Society of London's The Trail-Crips Award in recognition of outstanding contribution to microscopy.

-**Benjamin Goulet-Scott** (R Hopkins) and **Jacob Suissa** (W Friedman) awarded funding through the European Society for Evolutionary Biology's Outreach Initiative Fund for their outreach project, "Let's Botanize," an Instagram-based science communication series using plant life to teach about ecology, evolution, and biodiversity.

-**Zhe He** (NM Holbrook) recipient of the Botanical Society of America (BSA) Bill Dahl Graduate Student Research Award for her project, "Pit membranes and plant resistance to cavitation."

-**Vanessa Knutson** (G Giribet) recipient of the American Malacological Society's Constance Boone Award for Best Student Presentation for her presentation, "Most Cephalaspidea have a shell, but transcriptomes can provide them with a backbone."

-**Wendy Valencia** (N Pierce) recipient of the Xerces Society for Invertebrate Conservation's Joan Mosenthal DeWind Award.

-**Kristel Schoonderwoerd** (W Friedman) awarded Harvard Library's Philip Hofer Prize for her essay, "Winter twig keys: Manuals for tracing time."

- **Misha Gupta** (M Desai) awarded the Fellowship for Students from India for highly accomplished students pursuing studies in the Graduate School of Arts and Sciences in honor of the accomplishments of Harvard Professor Amartya Sen.

- **Richard J Knecht** (J Ortega-Hernández) awarded Harvard Effective Altruism Arete Fellowship.

whose living representatives include horseshoe crabs and arachnids, little was known about their internal anatomy. The study, published in [Nature Communications](#), found that *Mollisonia*'s central nervous system is an ancestral relative to that of living chelicerates, which can help scientists understand the early history of the group. It also suggests a complex pattern of mosaic evolution in which the internal and external anatomy are giving off different signals.

~ In a study in [mBio](#) co-lead author **PhD candidate Isabel Baker** and co-senior author **Professor Peter Girgus** partnered with University of Minnesota researchers to survey the tree of life in search of extracellular electron transfer (EET) microbes. EET microbes are able to “breathe” rocks and other materials that are outside their cell. One set of genes that makes EET possible, *mtrCAB*, have been especially well-studied in the bacterium *Shewanella oneidensis*, one of the first EET-capable organisms ever discovered. By combining their expertise and a global database, the team found that these genes existed in far more organisms than previously assumed and in a wide variety of environments all over the world, including the deep sea, salt flats, oil refinery sites, the human gut, and even wastewater contaminated by the Manhattan project. Further analysis revealed that the set of genes were horizontally transferred extensively throughout the history of life.

~ Researchers in **Professor Benjamin de Bivort's** lab examined genetically similar fruit flies (*Drosophila melanogaster*) raised in an identical environment and found the flies still learned in different ways. The study, published in [Biology Letters](#), found that the flies learned to avoid negative experiences at different rates despite being genetically similar and raised in the same environment; suggesting individuality may not be influenced by nature or nurture only, but possibly by a third factor: randomness. Random factors or differences in experience could contribute to a species' ability to adapt to a changing world by ensuring a healthy variety of individual traits. The researchers believe that small random developmental differences in learning circuits account for different learning styles.

~ A study in [Molecular Biology and Evolution](#), led

Welcome 2022 G1s!

- Kaylin Chong (Brian Farrell, Advisor)
- Daniel Faccini (Ned Friedman, Advisor)
- Jerry Guan (James Mallet, Advisor)
- Ian Hughes (Peter Girguis, Advisor)
- Breanna Jordan (Gonzalo Giribet, Advisor)
- Bronwyn Miller (Cassandra Extavour, Advisor)
- Christina Steinecke (Robin Hopkins, Advisor)
- Julius Tabin (Hopi Hoekstra, Advisor)
- Galen Tiong (Naomi Pierce, Advisor)
- Rhemi Toth (Paul Moorcroft, Advisor)
- Lucy Wilson (Andrew Davies, Advisor)
- Yi Lin Zhou (Benjamin de Bivort, Advisor)

Commencement 2022

The 2022 Commencement ceremonies were held in person for the first time since 2019. We were all very excited to witness our twenty-one amazing graduating PhDs walk and celebrate with their mentors, peers, and the community.

Graduates from prior years joined their 2022 peers to celebrate their accomplishments, as well as family and friends.

Congratulations graduates! We are so very proud of you!

Derek Bok Certificate of Distinction in Teaching

SPRING 2021

-**Certificates of Excellence for Lecturers and Preceptors:** Andrew Berry (LIFESCI 1B, OEB 53), Aaron Hartmann (OEB 60, ESPP 90E).

-**Certificates of Distinction for TFs, TAs and CAs:** Dave Matthews, Connor White, Zane Wolf (OEB 130), RJ Knecht (OEB 141), I-Ting Huang (OEB 177), Mark Wright (OEB 207), Denise Yoon (OEB 223), Nicholas Herrmann (OEB 399), Abigail Burrus, Ya Min (OEB 52), Tianzhu Xiong (OEB 53), Mark Cornwall, Zhengyang Wang (OEB 57), Dan Utter (OEB 60), Ji Seon Min (OEB 242), Samantha Royle, Brianna Weir (GENED 1084), Tanush Jagdish (LIFESCI 50B).

FALL 2021

-**Certificates of Excellence for Lecturers and Preceptors:** Andrew Berry (OEB 53, GENED 1004), Mark Cornwall (OEB 10).

-**Certificates of Distinction for TFs, TAs and CAs:** Jenni Austiff, Nikhil Chari, Landen Gozashti, Brock Wooldridge (OEB 10), RJ Knecht (OEB 155R), Grace Burgin, Maya Woolfolk (OEB 50), Lucrecia Aguilar (OEB 65), Catherine

Ressijac (OEB 65), Calvin Heslop, Denise Yoon (GENED 1004), Alexander Heyde (MATH 242), Tanush Jagdish (OEB 53), Artur Rego-Costa (MCB 112), Connor White (LIFESCI 2).

SPRING 2022

-**Certificates of Excellence for Lecturers and Preceptors:** Andrew Berry (LIFESCI 1B), Aaron Hartmann (OEB 60).

-**Certificates of Distinction for TFs, TAs and CAs:** Artur Rego-Costa (LIFESCI 50B), Mark Cornwall (NEURO 57), Jacob Suissa (OEB 103), Kathleen Pritchett-Corning (OEB 104), Shoyo Sato (OEB 112), Katy Loubet-Senear (OEB 115), Yunha Hwang, Brooke Travis (OEB 119), Zhe He (OEB 173), Sophie MacRae Orzechowski (OEB 190), Mark Wright (OEB 207), Sophie Everbach, Yan Gong, Calvin Heslop, Melissa Mai (OEB 52), Nikhil Chari, Evan Hockridge (OEB 55), Mark Cornwall (OEB 57/NEURO 57), Arianna Lord, Dave Matthews, Shoyo Sato, Connor White (OEB 60), Alexander Heyde (MATH 243), Tanush Jagdish (LIFESCI 50B), Jingting Liang (NEURO 146/MCB 146), Brianna Weir, Alief Moulana (GENED 1084), Denise Yoon (MCB 188).

by **Professor Gonzalo Giribet's** lab, disproves the long-held belief of the monophyly (a group composed of only one ancestor) of Arachnida, suggesting horseshoe crabs colonized the sea from a land ancestor. Chelicerata (Arachnids, horseshoe crabs, and their kindred taxa) are one of the two major branches of arthropods. The researchers assembled a data set of 506 high-quality genomes and transcriptomes sampling all living orders of Chelicerata, and generated a 514-taxon morphological data set of living and fossil Chelicerata. Analyses of the two data sets failed to recover arachnid monophyly, instead placing horseshoe crabs within Arachnida. The findings have far-reaching implications, as it may indicate that horseshoe crabs have colonized the marine environment secondarily, from a terrestrial arachnid ancestor

~ An international team of researchers, led by **post-**

doctoral researchers Stephen Pates and Jo Wolfe, confirm that the specimen *Utaurora comosa*, previously considered a radiodont, is in fact an opabiniid. The study, published in [*Proceedings of the Royal Society B*](#), confirms *Utaurora comosa* as only the second opabiniid ever discovered (*Opabinia* is the first) and the first in over a century. *Utaurora*, found in the 500 million-year-old middle Cambrian Wheeler Formation of Utah, was first described in 2008 as a radiodont. Pates and Wolfe used phylogenetic analysis comparing *Utaurora* with 43 fossils and 11 living taxa of arthropods, radiodonts, and other panarthropods. The initial phylogenetic analysis showed it was most closely related to *Opabinia*. Unlike *Opabinia*, which was discovered in the Cambrian Burgess Shale of British Columbia in Canada, *Utaurora* was found in Utah and, though still Cambrian, is a few million years younger than *Opabinia*. Meaning, *Opabinia* was

not the only opabiniid and not as unique a species as was thought.

~ **Professor George Lauder** and **PhD candidate Dave Matthews** collaborated with colleagues from the John A. Paulson School of Engineering and Applied Sciences (SEAS) and Emory University to develop the first fully autonomous biohybrid fish from human stem-cell derived cardiac muscle cells. The artificial fish swims by recreating the muscle contractions of a pumping heart. The device offers insights into artificial muscular pumps and brings researchers closer to building an artificial heart. The study was published in [Science](#).

~ A new study in [Science Advances](#) by **Professor Yun Zhang's** lab shows that forgetting does not reverse the learning process, rather it generates a new status of the brain. Forgetting is part of normal brain functions due to the limited capacity of the brain. But, understanding forgetting is key to addressing mechanisms underlying many mental health issues. Using the aversive olfactory learning of pathogenic bacteria in *C. elegans* the researchers showed that by examining whole-brain gene expression – both neural activity and behavior output – forgetting does not simply erase the memory or reverse the learning process. Instead it generates a brain state that is different from the naive state and the learned state. The team also found molecules, which function in both invertebrate and vertebrate brains, that can tune the speed of forgetting.

~ A new study in [Development](#) reveals novel interactions between cell division and cell expansion in the key process that establishes floral morphology. The study, led the **PhD candidate Ya Min**, co-author **postdoctoral researcher Stephanie Conway**, and senior author **Professor Elena Kramer**, used a newly developed live-imaging technique to visualize detailed processes that underlie floral primordium initiation and floral meristem termination in the EvoDevo model system *Aquilegia*.

~ **Postdoctoral researcher Tiago Simões** and **Professor Stephanie Pierce** examined a new sphenodontian species from the Early Jurassic of North America and found that the modern tuatara had changed very little from their 190 million year old

Postdoc Notable Awards

- **Nacho Sanguinetti-Scheck** (H Hoekstra) awarded a Human Science Frontiers Postdoctoral Fellowship (HSFP) for his project, "The evolution of neophobia: Comparative neurophysiology of deer mice in the wild."

- **Yangfan Zhang** (G Lauder) awarded Natural Sciences and Engineering Research Council (NSERC) of Canada post-doctoral fellowship for his project, "Fish locomotion: Illuminating the black box of unsteady swimming gates and energetic."

- **Amandine Gillet** (S Pierce) awarded the Marie Skłodowska-Curie Postdoctoral Fellowship for her project, "Back to the sea: Axial evolution in secondarily aquatic mammals."

- **Yangfan Zhang** (G Lauder) awarded The Museum of Comparative Zoology Wetmore Colles Grant for his paper, "Testing the hypoxia tolerance and hypoxic performance of fishes: A two-tier screening approach," published in [Frontiers on Marine Science](#)."

- Postdoctoral Researchers **Megan Whitney** and **Peter Bishop** (S. Pierce) awarded Australian Synchrotron competitively allocated beamtime, sponsored by the Australian Nuclear Science and Technology Organisation (ANSTO) for their project "Unlocking the microanatomy of the early tetrapod *Ossinodus* to reveal how vertebrates colonized the land."

- **Andrea Unzueta martinex** (P Girguis) awarded the National Science Foundation Postdoctoral Research Fellowship in Biology.

- **Rachel Harris** (P Girguis) selected to serve as one of 16 international scientists on the NASA-ESA (European Space Agency) Mars Sample Return Campaign Science Group.

- **Isobel Ronai** (C Extavour) awarded the American Australian Association Postdoctoral Fellowship for her project, "How a highly invasive tick reproduces without mating."

ancestor. They discovered the specimen (found in 1982 in northern Arizona in the Kayenta Formation) in the Museum of Comparative Zoology where it had been sitting in a museum drawer for decades. Pierce and Simões used micro-CT scans to examine the fossil in three dimensions and digitally piece together the flattened skull to reveal a full structure. The study, published in [Communications](#)

[Biology](#), showed the animal *Navajosphenodon sani* (which means "old age" in the Navajo language of the Navajo Tribe who live in the area where the fossil was found) is among the oldest known sphenodontines and provides the first nearly complete skull of any fossil sphenodontine anywhere in the world. The study also shows that the bodies of modern tuatara appeared in the Jurassic era and have changed little in 190 million years, supporting these reptiles as "living fossils."

~ Researchers in **Professor Naomi Pierce's** lab teamed with researchers at the Kunming Institute, China, in a new study that used DNA samples extracted from the blood meals of leeches to map which animals live where in the Ailaoshan Nature Reserve in Yunnan, China. The researchers coordinated with 160 volunteer park rangers to extract DNA from more than 30,000 leeches to survey over 80 species of vertebrates, including amphibians, mammals, birds, and squamates. The study, published in [Nature Communications](#), showed that the DNA samples can be used to find out which wild animals are present across large, protected areas such as national parks. The work helps establish leeches as a surveillance instrument for animal conservation.

~ In a study published in [Soft Matter](#), **Professor L. Mahadevan** and co-authors explore the mathematics of hair combing and explain why the brushing technique used by so many is the most effective method to detangle a bundle of fibers. To simplify the problem, the researchers simulated two helically entwined filaments, rather than a whole head of hair. Using this minimal model the researchers studied the detangling of the double helix via a single stiff tine that moves along it, leaving two untangled filaments in its wake. The researchers also identified the optimal minimum length for each stroke — any smaller and it would take forever to comb out all the tangles and any longer and it would be too painful. The mathematical principles of brushing developed by the researchers were recently used by Professor Daniela Rus and her team at MIT to [design algorithms for brushing hair by a robot](#).

~ In a study, published in [Geology](#), **PhD candidate Sarah Losso** and **Professor Javier Ortega-Hernán-**

REU: Evolution, Ecology, Environment (E3)

OEB completed its fourth successful year of the NSF Research Experiences for Undergraduates (REU). The 2022 session was held in-person for the first time since 2019. The 2022 [E3 REU](#) hosted six undergraduates from around the world.

2022 Participants:

- Michael Cheng, University of Massachusetts, Amherst
- Lena Heinricha, University of Vermont
- Autumn Hildebrand, Rice University
- Karl Hill, North Carolina State University
- Jared Jaroszewski, St. Mary's University, San Antonio, TX
- Abby Ross, Rensselaer Polytechnic Institute

dez reveal the mating behavior of trilobites (a group of 520-250 million-years-old arthropods) from the mid-Cambrian fossil, *Olenoides serratus*. While examining one well-preserved fossil from the Burgess Shale housed in the Royal Ontario Museum, Losso discovered peculiarly modified clasper-like legs in the mid-body similar to those found on adult male horseshoe crabs, suggesting a similar mating strategy. Losso examined 65 specimens with preserved appendages known to date and found that the smaller appendages have a unique morphology known only from *O. serratus*. This tells scientists more about the reproduction in trilobites and how they would have mated, which previously has been hard to understand and has been very speculative based on modern analogies. The study provides strong evidence to suggest that a *Limulus*, or horseshoe crab-like behavior, already existed in the Cambrian completely by convergence

~ **PhD candidate Yunha Hwang** and **Professor Peter Girguis** compared the genetic diversity of one of the most abundant marine archaeal populations between pacific and atlantic ocean basins to address a fundamental question of how a genetically defined microbial population adapts across diverse environ-

OEB Diveristy, Inclusion & Belonging

Committee Members

- Melissa Aja, Administrative Manager, MCZ
- Katherine Angier, PhD Candidate
- Nikhil Chari, PhD Candidate
- Molly Gabler, Postdoctoral Researcher
- Kanchi Nataranjan Gandhi, Senior Nomenclatural Registrar
- Gonzalo Giribet, Professor
- Meadow Hall, IB Concentrator, Undergraduate
- Aaron Hartmann, Research Associate
- Evan Hockridge, PhD Candidate
- Robin Hopkins, Associate Professor
- Jenna Legault, Senior Research Administrator, OEB
- Sophie MacRae Orzechowski, PhD Candidate
- Ryan Maloney, Postdoctoral Researcher
- Andrea Unzueta Martinez, Postdoctoral Researcher
- Dave Matthews, PhD Candidate
- Michelle Kennedy, Collections Information and Database Specialist, Collections Operations
- Julius Tabin, PhD Candidate
- Yangfan Zhang, Postdoctoral Researcher
- Breda Zimkus, Acting Director, Collections Operations

Ex Officio Members

- Scott Edwards, Chair of the Department
- Rebecca Chetham, Executive Director
- Sarine Der Kaloustian, Associate Director

Highlights of the 2021-22 year include:

- Established a monthly DIB teatime, a casual space for the OEB community to listen and speak with others about DIB ideas and issues.
- Prepared and distributed an anonymous survey to the OEB community about department spaces. The main objective is to help the OEB, MCZ, HUH and Arboretum consider improvements to their facilities, including changing/removing unwelcome features, adding constructive elements, and developing new policies in an effort to ensure everyone in the community feels represented and welcomed in their place of work. An overview of the results was shared with unit Directors as well as with the OEB community.
- Created the Emerging Scientists Program, which aspires to make science more inclusive and equitable by fostering the academic development and success of underserved students in STEM. The program, which will start in Fall 2024, aims to forge relationships between Harvard researchers and students from Cambridge Rindge and Latin High School (Cambridge, MA), with a specific focus on recruiting and supporting historically underserved students. The program will provide students the opportunity to engage in guided research with a graduate student, postdoctoral fellow, or faculty mentor associated with an OEB lab.

ments. The study, published in the [American Society for Microbiology Journal](#), revealed that these populations feature distinctly different patterns of genetic diversification depending on the selective pressures of habitats. Hwang and Girguis's study is the first in-depth comparative analysis into the population genetics of a biogeochemically important archaeal species mediating global nitrogen and carbon cycles. Their findings also have broader implications, particularly in understanding the population-level responses of microbes to the changing climate and predicting its impact on biogeochemical cycles.

~ **Professor Hopi Hoekstra** took a detailed look at the NCAA tournament mascots in a post to [Sports Illustrated](#). Guess what? Those mascots are not what they claim to be, especially the Wildcats! Hoekstra had kept notes for 23 years on animal mascots. In 2022 she looked at 68 teams in the NCAA men's basketball tourney and found Wildcats (25 in total) to be among the biggest offenders. The most egregious? The TCU Horned Frogs, which should be called horned lizards!

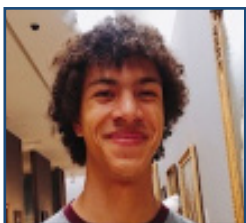
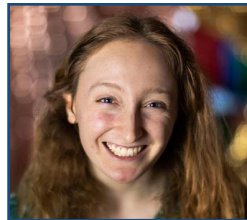
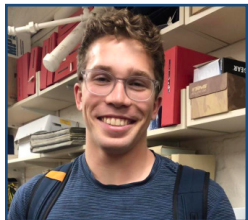
Integrative Biology

IB Awards & Honors



Sorcha Rae Ashe (N Pierce) awarded the [2022 Hoopes Prize](#) in the Faculty of Arts and Sciences for her project, "Flying Colors: The Evolution of Wing Color and Color Vision in the Hyperdiverse Eumaeini Butterfly Tribe (Family: Lycaenidae)."

Graham Friedman (G Giribet), and **Sophie Webster** (R Hopkins) invited to join Phi Beta Kappa.



James Caven (R Hopkins) awarded the [2022 Hoopes Prize](#) in the Faculty of Arts and Sciences for his project, "Many Plants, One Pattern: Environmental Effects on Plasticity in Phlox."

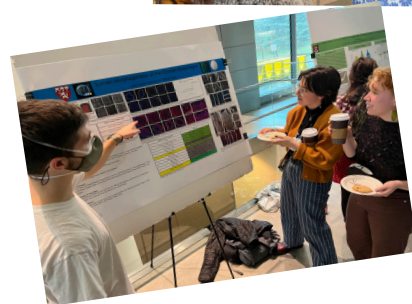
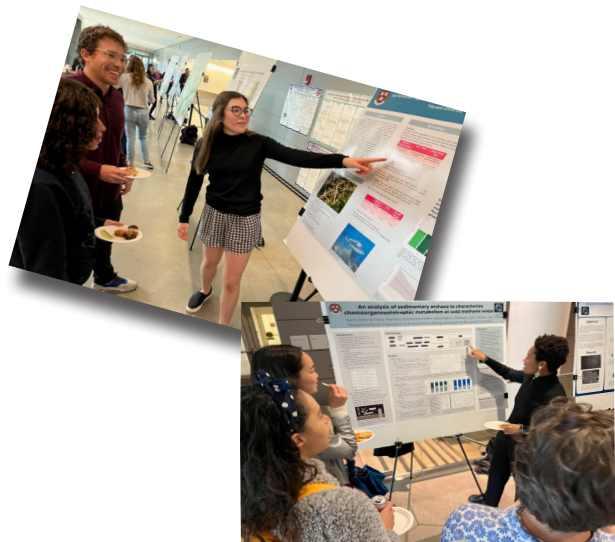
IB POSTER SESSION:

The 2022 Senior Thesis Poster Session took place live on April 6th in the Northwest Building. Attendees enjoyed discussing 17 posters covering a wide range of topics with the graduating students.



Congratulations 2022 IB Graduates!

- Sorcha Rae Ashe (Naomi Pierce)
- Kemi Ashing-Giwa (Peter Girguis)
- James Caven (Robin Hopkins)
- Lauren Church (Benton Taylor)
- Katie DeGroot (Benton Taylor)
- Zoe Flores (Naomi Pierce)
- Graham Friedman (Gonzalo Giribet)
- Natalia Fuentes (Pardis Sabeti)
- Cali Grincavitch (Aaron Hartmann)
- Elly Katz (Elena Kramer)
- Nicole Mejia (Scott Edwards)
- Eris Mihelic (Hopi Hoekstra)
- Ayano Mukai (Andrew Davies)
- Sophie Webster (Robin Hopkins)



OEB Field Trips!

OEB 103: Plant Diversity and Evolution Instructor: Charles Davis



Led by Professor Charles Davis and Teaching Fellow Jacob Suissa, the OEB 103 students spent a week in tropical southern Florida.

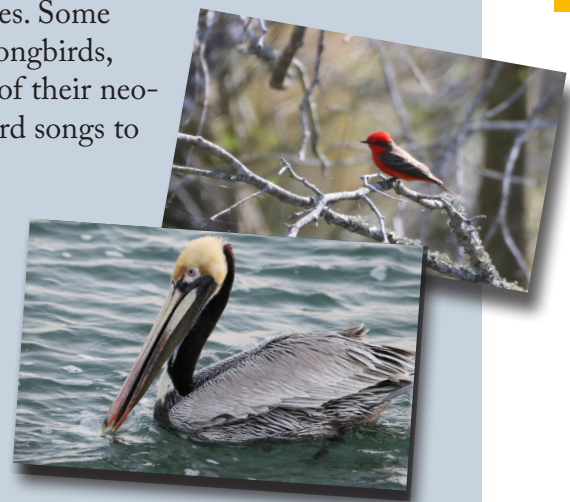
They explored the rich vascular plant diversity of the ecosystems in the region including the iconic coastal Everglades National Park, Big Cypress National Preserve, and The Florida Keys. They also botanized the impressive grounds of the

Fairchild Botanic Garden and the economically and culturally important plants at Fruit and Spice Park. Highlights of the trip included the impressive plant diversity of south Florida, unique ecosystems of the swamps and coastal Everglades, Jimmy Lange (their knowledgeable and friendly guide), and the friendships and bonds built during the week!



OEB 190: Biology and Diversity of Birds Instructor: Scott Edwards

Professor Scott Edwards and Teaching Fellows, Sophie Orzechowski and Alexandria DiGiacomo, led OEB 190 students on an expedition to learn about the rich avifauna found throughout Texas. Students explored the south Texas scrub, the Lower Rio Grande Valley, and coastal marshes. Some highlights included seeing highly endangered Whooping Cranes and songbirds, including Green Jays and Vermillion Flycatchers, at the northern edge of their neotropical ranges. Students submitted their daily sighting and recorded bird songs to eBird, a citizen science tool.



Event Highlights

OEB Seminar Series

The 2021-2022 seminar season had a successful fall and spring with an incredible lineup of speakers from all over the world. Due to COVID, all seminars were held online.

Fall 2021

- **Stephanie E. Pierce**, OEB, Harvard University
- **Andrea L. Sweigart**, University of Georgia
- **Kakani Katija**, Monterey Bay Aquarium Research Institute
- **Sandy Hetherington**, University of Oxford
- **Lúcia Garcez Lohmann**, Universidad São Paulo
- **Graham Coop**, University of California, Davis

Spring 2022

- **Jeanne Cavendar-Bares**, University of Minnesota
- **Veronica Hinman**, Carnegie Mellon University
- **Peter Wilf**, Pennsylvania State University
- **C. Kevin Boyce**, Stanford University
- **Catherine Aime**, Purdue University
- **David S. Hibbett**, Clark University
- **Anjali Goswami**, Natural History Museum, London
- **Lauren Buckley**, University of Washington, Seattle
- **Jessica Ware**, American Museum of Natural History
- **Toby Kiers**, Vrije Universiteit, Amsterdam
- **Anurag Agrawal**, Cornell University.

PBI Symposium

The 16th Annual Plant Biology Initiative Symposium "*Research in the Living Collections of Arborea Botanical Gardens*" took place May 2-3, 2022 at the Weld Hill Research Building. The event was hosted by Professor William (Ned) Friedman. The symposium talks are available for viewing on the [OEB YouTube Channel](#).

Invited Speakers:

- **Michael Donoghue**, Yale University,

- **Lorna J. Gibson**, Massachusetts Institute of Technology
- **M. Patrick Griffith**, Montgomery Botanical Center
- **Andrew Leslie**, Stanford University
- **Richard B. Primack**, Boston University
- **Susanne S. Renner**, Washington University, St. Louis
- **Jessica Savage**, University of Minnesota, Duluth
- **Pamela Templer**, Boston University

2022-2023 OEB Seminar Series

- **September 22:** Brad Seibel, University of San Francisco
- **October 6:** Leslie Babonis, Cornell University
- **October 20:** Richard Phillips, Indiana University, Bloomington
- **November 3:** Christopher Lowe, Stanford University
- **November 17:** Todd Adam Castoe, University of Texas, Arlington
- **December 8:** Christopher Donohue, National Institutes of Health
- **January 26:** Mansi Srivastava, Harvard University
- **February 9:** David Reich, Harvard University
- **February 23:** Yaniv Brandvain, University of Minnesota
- **March 9:** Catherine Linnen, University of Kentucky
- **March 23:** Liana Baums, Pennsylvania State University
- **April 6:** Molly Womack, Utah State University

Visit [OEB Seminars](#) for updates

OEB Staff News

Welcome New Staff!

- **Izzy Acevedo**, Laboratory Technician, Hopkins Lab
- **Tess Avery**, Laboratory Assistant, Lauder Lab
- **Lauren Church**, Research Assistant, Taylor Lab
- **Feven Girmay**, Assistant Director, Graduate Program, OEB Admin
- **Kathy Jean-Louis**, Manager of Financial Operations, OEB Admin
- **Jenna Legault**, Senior Research Administrator, OEB Admin
- **Liliana Teixeira-Davis**, Senior Research Administrator, OEB Admin

Promotions:

- **Tracy Barbaro** promoted to Faculty Coordinator
- **Jennifer Delaney** promoted to Researcher II Natural Science
- **Christian Flynn** promoted to Senior Administrative Coordinator
- **Esther Jules** promoted to Faculty Coordinator
- **Sade McFadden** promoted to Research Assistant I
- **Margaret Richards** promoted to Faculty Associate

Milestones In Service

30 Years of Service:

- **Catherine Musinsky**, Faculty Assistant

25 Years of Service:

- **Erin Ciccone**, Faculty Assistant
- **Kathy Jean-Louis**, Manager of Financial Operations, OEB Admin

15 Years of Service:

- **Megan McHugh**, HR Administrator, OEB Admin

10 Years of Service:

- **Jennifer Delaney**, Research Assistant
- **Kristin Pennarun**, Assistant Director of Research Administration, OEB Admin

5 Years of Service:

- **Cory Hahn**, Animal Technician

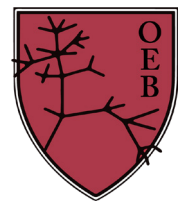


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Wendy Heywood
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OEBnews

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2021-2022