



MUSEUM *of*  
COMPARATIVE  
ZOOLOGY

HARVARD UNIVERSITY

ANNUAL REPORT  
2017 • 2018



## ABOUT THE MCZ

The Museum of Comparative Zoology at Harvard University is a global center for research and education focused on the comparative relationships and evolution of animal life. The MCZ collections comprise approximately 21 million extant and fossil invertebrate and vertebrate specimens, which are a focus of research and teaching for the MCZ, Harvard, and outside students and researchers.

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## DIRECTOR'S MESSAGE

This past year marked the beginning of an important period of transition for the MCZ.

Robert Woollacott retired after 46 years on the faculty and 45 years as curator, and Jonathan Losos departed to assume the William H. Danforth Distinguished University Professorship at Washington University and direct the Living Earth Collaborative.

In January 2019, we will welcome a new faculty-curator, Javier Ortega-Hernández, and a search to fill a faculty-curator position in marine biology is underway. We will also invite our first two E.O. Wilson Biodiversity Fellows, marking the beginning of this endowed postdoctoral fellowship program.

Maggie Lopes assumed a newly created staff position for the MCZ, Manager of Administrative Operations. She came highly recommended from her former position at the Harvard Center for African Studies and has been working tirelessly to review and improve operations here.

Tragically, we were reminded of the precarious existence endured by many natural history collections with the devastating fire that consumed the historic main building of the Museu Nacional in Rio de Janeiro, Brazil. May this tragedy yield a much greater appreciation of the value of museums and their collections, not just in Brazil but in all countries, and of the need to take whatever steps are required to properly conserve and care for them.

The [Harvard Museum of Natural History](#) opened two new exhibits.

*Microbial Life: A Universe at the Edge of Sight* is an innovative exhibit featuring MCZ specimens that highlight notable microbe relationships, alongside live demonstrations and a full-scale kitchen model. (I may never touch a kitchen counter again.)

*Orb-Weavers: Web Masters of the Spider World* showcases research by faculty-curator Gonzalo Giribet and collaborators at The George Washington University. The exhibit features MCZ specimens, photography and multimedia technology.

Lest we be accused of being anything but hip, the MCZ is building a presence on [Facebook](#), [Twitter](#) and [Instagram](#). This of course provides us with a convenient means of sharing photos of dead animals on shelves, but it's also a way to communicate with the public the importance of natural history museums and to highlight both current research projects utilizing the collections and MCZ funding opportunities.

It has been a productive year for the MCZ, with an impressive group of graduate students and postdocs working with faculty-curators on research making headlines worldwide, and curatorial staff hosting visiting scholars and facilitating analysis of the millions of specimens they maintain.

I hope you enjoy reading more about what we accomplished this year.



Stephanie Pierce

**James Hanken**  
Director



*About the Cover:* A nudibranch of the genus *Halgerda* grazes in the waters of North Sulawesi, Indonesia. Photo by Dave Matthews.

*Opposite page:* A micro-CT scan of a shovelnose sturgeon *Scaphirhynchus platyrhynchus*, scanned at the University of Florida as part of the openVertebrate ([oVert](#)) Thematic Collections Network project. Scan by Zach Randall. Read more about oVert on page 18.



# THE MCZ'S FACULTY-CURATORS

The Museum of Comparative Zoology takes pride in our faculty-curators, past, present and future. They touch many facets of the MCZ, from the collections in their care to the students they inspire to the advancement of understanding through research.

Faculty-curators perform a demanding triad of roles as curators, professors and researchers. They make rich contributions to the collections they curate and augment, to the students they instruct and mentor, and via the research they conduct. This academic year we said goodbye to valued colleagues, look forward to welcoming new ones, and share the recognition of our faculty-curators by their peers.



Jonathan Losos

## Farewells

**Jonathan Losos**, Curator of Herpetology, departed Harvard in January 2018 to become the William H. Danforth Distinguished University Professor at Washington University and the founding director of the [Living Earth Collaborative](#), a partnership between Washington University, the Saint Louis Zoo and the Missouri Botanical Garden.



Jean-Francois Bertrand

Robert Woollacott

**Robert Woollacott** retired from Harvard in June 2018 after 46 years on the faculty and 45 years as Curator of Marine Invertebrates in the MCZ.

## New Faculty-Curator

**Javier Ortega-Hernández** will begin a new appointment in January 2019 as an assistant professor in the Department of Organismic and Evolutionary Biology and Curator of Invertebrate



Javier Ortega-Hernández

Paleontology in the MCZ. He completed a bachelor's degree in biology from the Universidad Nacional Autónoma de México, a Masters in Science in Paleobiology from the University of Bristol, and a PhD in Earth Sciences from Cambridge University, where he will soon finish a prestigious Herchel Smith Fellowship in Biological Sciences.

Javier's research focuses on the origin and evolution of invertebrates. He combines traditional methods of paleontological fieldwork and fossil preparation to obtain study specimens, developmental biology of extant organisms, and modern imaging and analytical techniques.

## Honored by Named Species

It is a matter of high regard by one's peers to have a new species named in their honor.

Six ornithologists and birders named a new species of antbird from north-central Peru after renowned biologist and "father of biodiversity" **Edward O. Wilson**, University Research Professor Emeritus and Honorary Curator in Entomology. The Cordillera Azul antbird (*Myrmoderus eowilsoni*) was



named after Prof. Wilson “to recognize his tremendous devotion to conservation and his patronage of the Rainforest Trust, which strives to protect the most imperiled species and habitats in the Neotropics and across the globe.”

A new species of tetrapodomorph sarcopterygian, *Eusthenopteron jenkinsi*, was named in honor of the late **Farish A. Jenkins, Jr.**, faculty member and Curator of Vertebrate Paleontology, for his central role in the Nunavut Paleontological Expeditions from 1999 to 2008, where “he was a key contributor to the anatomical research, fieldwork and quality of life in camp.” *Eusthenopteron jenkinsi* was found along with *Tiktaalik roseae* and several other new species on southern Ellesmere Island, Nunavut Territory, Canada.



Kris Sribbe

Naomi Pierce

*Ophiocordyceps* species that infect ants—so-called zombie-ant fungi—are widespread within tropical forests worldwide and comprise one of the most intriguing and fascinating relationships between microbes and animals. A new species of the fungus was christened *Ophiocordyceps naomipierceae* in recognition of **Naomi Pierce**, Sidney A. and John H. Hessel Professor of Biology and Curator of Lepidoptera, who mentored many biologists to consider ant–symbiont interactions in the deep-time framework provided by phylogenetic studies.



Edward B. Daeschler

Farish Jenkins in the field in Nunavut Territory in 2008

## The MCZ's *Kronosaurus*

A fossil is never just a fossil. It is a window into an organism that lived millions of years ago, a unique individual that continually reveals its secrets as scientific methods advance. But sometimes, that fossil becomes even more. It becomes a beloved mascot.

In 1931–32, William E. Schevill, a member of an expedition sent to Australia by the MCZ, explored the Queensland Lower Cretaceous deposits in the Army Downs region. There he found the specimen—known as MCZ no. 1285—of a *Kronosaurus*, a short-necked carnivorous marine reptile that was one of the largest pliosaurs.

The specimen had been preserved upright, in an articulated state, in a limestone matrix, but it had some damage from erosion. The specimen was removed in blocks weighing nearly four tons and shipped to the MCZ.

Dr. T. E. White prepared the skull and published its description in 1935. However, the rest of the skeleton lay untouched in storage until the mid-1950s,



when Godfrey Cabot provided funding to prepare and mount it. Since erosion had destroyed a large percentage of the once-complete specimen, a third of the finally exhibited skeleton is a plaster restoration.

The MCZ's *Kronosaurus* is a monumental 42 feet long and has been on display continuously since 1958. It can still be seen in its original exhibit in the Harvard Museum of Natural History and serves as a symbol of the Museum of Comparative Zoology.



# FACULTY-CURATOR PROFILES



## Andrew A. Biewener

*Charles P. Lyman Professor of Biology  
Director, Concord Field Station*

Prof. Biewener's research focuses on understanding the biomechanics, neuromuscular control and energetics of animal movement on land and in the air. His goal is to understand general principles that govern the biomechanical and physiological design of vertebrate animals related to their movement in natural environments.



Stephanie Mitchell

## Brian D. Farrell

*Professor of Biology  
Curator of Entomology  
Director, David Rockefeller Center for Latin American Studies*

Prof. Farrell's research is broadly concerned with the evolution of ecological interactions between host plants and animals and their parasites, such as insects and other tiny consumers.

His current projects include applying next-generation sequencing to speciation and phylogenetic studies of associated species, documenting biodiversity in the Dominican Republic, and repatriating digital information from scientific specimens of insects and fossils in museums to their countries of origin.



Tony Rinaldo

## Scott V. Edwards

*Professor of Biology  
Alexander Agassiz  
Professor of Zoology  
Curator of Ornithology*

Prof. Edwards' research focuses on the evolutionary biology of birds and related species, combining field, museum and genomics approaches to understand the basis of avian diversity, evolution

and behavior. Current projects use the genomics technologies to study comparative genomics and the evolution of flightlessness and other traits in birds; phylogeography and speciation in Neotropical and Australasian birds; and the genomics of host-parasite coevolution between house finches and a recently acquired bacterial pathogen, *Mycoplasma*.

## Gonzalo Giribet

*Alexander Agassiz  
Professor of Zoology  
Professor of Organismic & Evolutionary Biology  
Curator of Invertebrate Zoology  
Harvard College Professor*

Prof. Giribet's primary research focuses on the evolution, systematics and biogeography of invertebrate animals, including the use of morphology and next-generation sequencing techniques. Current projects in the Giribet lab include a comprehensive study of the harvestmen of New Zealand, their systematics and biogeography, and a textbook on invertebrates. The lab also works on other projects on systematics and biogeography of arthropods, mollusks and onychophorans, among other groups. He is also interested in homology-related issues and the use of genomic-level data for inferring phylogenies.



© Casey Dunn





Catherine Weisel

**James Hanken**  
*Professor of Biology*  
*Alexander Agassiz*  
*Professor of Zoology*  
*Curator of Herpetology*  
*MCZ Director*

Prof. Hanken utilizes laboratory-based analyses and field surveys to examine morphological evolution, developmental biology and systematics. Current areas of research include the evolution of craniofacial

patterning, the developmental basis of morphological novelty and life-history evolution, biodiversity informatics, and systematics and evolution of neotropical salamanders.



Kris Sribbe

**Hopi E. Hoekstra**  
*Professor of Organismic & Evolutionary Biology*  
*Professor of Molecular & Cellular Biology*  
*Alexander Agassiz Professor of Zoology*  
*Curator of Mammalogy*  
*Howard Hughes Medical Institute Investigator*  
*Harvard College Professor*

Prof. Hoekstra combines field and laboratory work to understand the evolution of mammalian diversity from morphology to behavior. Her research focuses on the genetic basis of adaptive variation—identifying both the ultimate causes and the proximate mechanisms responsible for traits that help organisms survive and reproduce in the wild. Research in the Hoekstra lab integrates ecological, behavioral, genetic and molecular approaches.



Stephanie Mitchell

**George V. Lauder**  
*Professor of Biology*  
*Henry Bryant Bigelow Professor of Ichthyology*  
*Curator of Ichthyology*

Prof. Lauder's research focuses on the biomechanics of fishes and the development of robotic models for studying aquatic locomotion.

His current studies focus on the function of shark skin and other surface structures, the role of flexibility in improving the efficiency of aquatic propulsion, and how fishes control body and fin position as they maneuver through obstacles. Additional broad interests include biological fluid mechanics and theoretical approaches to the analysis of form and function in organisms.



Rose Lincoln

**Jonathan B. Losos**  
*Monique & Philip Lehner Professor for the Study of Latin America*  
*Professor of Organismic & Evolutionary Biology*  
*Curator of Herpetology*

Prof. Losos' research focuses on the behavioral and evolutionary ecology of lizards, specifically how lizards interact with their environment and how lizard clades have diversified evolutionarily. His laboratory

integrates approaches from systematics, ecology, behavior, genetics and functional morphology, taking both observational and experimental approaches in the field and in the laboratory. He departed Harvard in January 2018 to become the William H. Danforth Distinguished University Professor at Washington University and the founding director of the Living Earth Collaborative, a partnership between Washington University, the Saint Louis Zoo and the Missouri Botanical Garden.



## FACULTY-CURATOR PROFILES



Jon Chase

### James J. McCarthy

*Professor of Biological Oceanography  
Alexander Agassiz Professor of Biological Oceanography  
Acting Curator of Malacology*

Prof. McCarthy's research focuses on factors that regulate the processes of primary production and nutrient supply in the ocean. Using field studies and modeling, Prof. McCarthy and his group examine the effects of

seasonal or interannual climate change on marine life from plankton to whales.



Isabella Kirkland

### Naomi E. Pierce

*Sidney A. & John Hessel Professor of Biology  
Curator of Lepidoptera*

Prof. Pierce's research focuses on the behavioral ecology of species interactions,

particularly the coevolution between plants, pathogens and herbivores, and symbioses between ants and other organisms. Her laboratory integrates approaches from phylogenetics, ecology, behavior, genomics and comparative methods to investigate patterns of reciprocal adaptation and diversification exhibited by organisms that live in close association with each other.



Paul Whatmough

### Stephanie E. Pierce

*Assistant Professor of Organismic & Evolutionary Biology  
Curator of Vertebrate Paleontology*

Prof. Pierce's research is focused on major morphological and ecological transitions in vertebrate evolution through an examination of the fossil record.

Her work tends toward 3D modeling and experimentation of the musculoskeletal system, with particular attention to the link between form and function. Current projects include the fin-to-limb transition, the "reptile"-to-mammal transition and evolution of the horse.

### Robert M. Woollacott

*Professor of Biology  
Curator of Marine Invertebrates*

Prof. Woollacott's research focuses on aspects of marine invertebrate life history, such as synchronization of reproductive events and ecology and physiology of larvae. Topics

of particular interest include larval dispersal and population connectivity, as well as human impacts on life in the sea. Prof. Woollacott retired in June 2018.



Isaac Orderberg

### Mansi Srivastava

*Assistant Professor of Organismic & Evolutionary Biology  
Curator of Invertebrate Zoology*

Prof. Srivastava's research focuses on understanding the evolution of animal development and regeneration. Her group utilizes the three-banded panther worm, *Hofstenia miamia*, which she has developed as a new acoel model system. Acoels represent the sister-group to all animals with bilateral symmetry, which allows the study of genetic mechanisms that span 550 million years of animal evolution. Current projects in the lab range from identifying gene regulatory networks for regeneration to determining the embryonic origins of pluripotent stem cells to understanding the origins of bilateral nervous systems.





# EMERITUS PROFILES

Justin Ide



## A. W. "Fuzz" Crompton

*Faculty-Curator, Emeritus*

*Fisher Professor of Natural History, Emeritus*

Prof. Crompton, former Curator of Mammalogy, was the Director of the MCZ from 1970 to 1982, having served as Director of both the Peabody Museum of Natural History at Yale University and the South African Museum in Cape Town. His primary research interests include the origin and evolution of mammals, functional anatomy, and neural control and evolution of feeding in recent and fossil vertebrates. Prof. Crompton received two Guggenheim fellowships for his research on vertebrate paleontology and functional morphology, and in 2011 received the Romer-Simpson Medal from the Society of Vertebrate Paleontology.



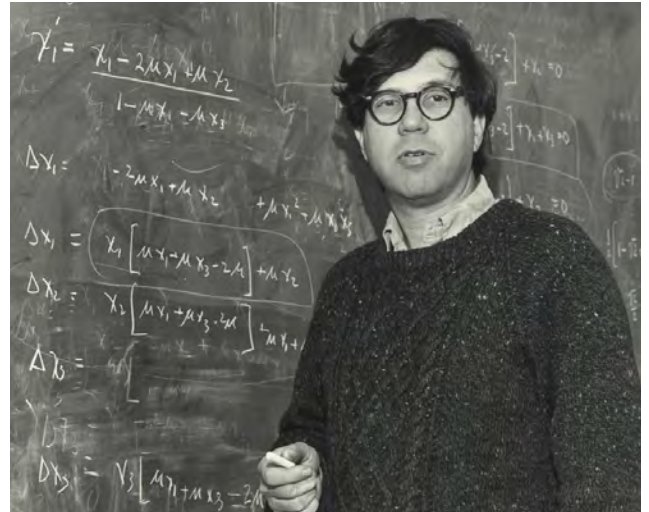
## Richard C. Lewontin

*Professor of Biology, Emeritus*

*Alexander Agassiz Professor of Zoology, Emeritus*

An evolutionary geneticist, Prof. Lewontin pioneered the field of molecular population genetics by merging molecular biology and evolutionary theory, as well as the philosophical and social implications of genetics and evolutionary theory.

Among his many books are *The Genetic Basis of Evolutionary Change*; *Biology as Ideology: The Doctrine of DNA*; *Human Diversity*; and *The Triple Helix: Gene Organism and Environment*.



Beth Maynor Finch



## Edward O. Wilson

*Honorary Curator in Entomology*

*Pellegrino University Professor, Emeritus*

Prof. Wilson is considered the founder of sociobiology and evolutionary psychology and has developed the basis of modern biodiversity conservation. He has received many of the world's leading prizes in recognition of his research, creative literature and environmental activism.

Prof. Wilson was awarded two Pulitzer Prizes for his books *The Ants* (1990, with Bert Hölldobler) and *On Human Nature* (1978). He received the TED Prize in 2007, where he articulated the concept of the Encyclopedia of Life, and the Hubbard Medal in 2013, the rarely given highest award of the National Geographic Society.



# COURSES LED BY FACULTY-CURATORS

Academic Year 2017–2018



Jonathan Losos

OEB 101: Biology of Mammals

## Organismic and Evolutionary Biology

### OEB 10: Foundations of Biological Diversity

*Brian D. Farrell (and Elena Kramer and Peter Girguis)*

An integrated approach to the diversity of life, emphasizing how chemical, physical, genetic, ecological and geologic processes contribute to the origin and maintenance of biological diversity.

### OEB 51: Biology and Evolution of Invertebrate Animals

*Gonzalo Giribet*

Introduction to invertebrate diversity, covering the development, adult anatomy, biology and evolutionary relationships of the main animal phyla, including sponges, mollusks, annelids and arthropods, among others.

### OEB 57: Animal Behavior

*Naomi E. Pierce (and Bence P. Olveczky)*

A review of the behavior of animals under natural conditions, with emphasis on both mechanistic and evolutionary approaches.

### OEB 58: How to Build an Animal

*Stephanie E. Pierce and Mansi Srivastava*

Provides a basic understanding of animal evolution and development and how these processes combine to shape the diversity of life on Earth by exploring anatomical features, how they vary in form and function and how they are made during embryonic development.

### OEB 101: Biology of Mammals

*Jonathan B. Losos*

An introduction to the biology of mammals. Lectures and laboratories examine the morphology, systematics, natural history, behavior, ecology, evolutionary relationships and biogeography of all major taxa.

### OEB 130: Biology of Fishes

*George V. Lauder*

Explores the unparalleled diversity of fish across different aquatic environments, including deep seas, intertidal zones, coral reefs, polar waters, the vast Amazonian basin and great East African lakes.

OEB 217R: What Makes a Rodent?



Melissa Aja





George Lauder

OEB 130: Biology of Fishes

**OEB 157: Global Change Biology***James J. McCarthy (and Paul Moorcroft)*

This course examines how natural and anthropogenic changes in the Earth system are affecting the composition and the functioning of the world's land and ocean ecosystems. Topics include: the ecological impacts of natural and anthropogenic changes in the Earth's physical environment, and the effects of introduced species, species extinctions, land-use change, agriculture and fishing.

**OEB 167: Herpetology***James Hanken*

An introduction to the biology of amphibians and reptiles. Lectures and laboratories examine the morphology, systematics, natural history, behavior, ecology, evolutionary relationships and biogeography of all major taxa.

**OEB 173: Comparative Biomechanics***Andrew A. Biewener*

An exploration of how animals and plants contend with their physical environment, considering their biomaterial properties, structural form and mechanical interaction with the environment.

**OEB 181: Systematics***Gonzalo Giribet*

Introduces theory and practice of systematics, emphasizing issues associated with homology statements and alignments, methods of tree reconstruction and hypothesis evaluation.

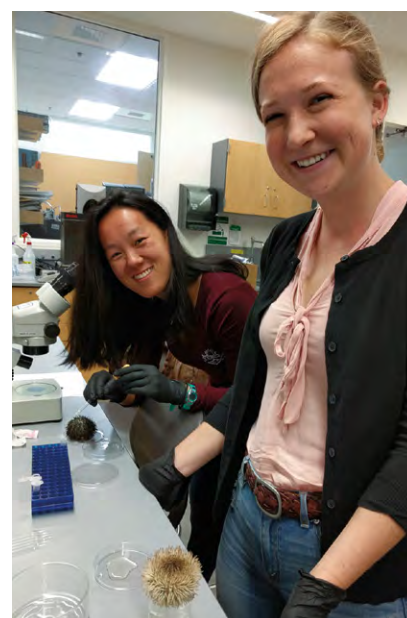
**OEB 190: Biology and Diversity of Birds***Scott V. Edwards*

An introduction to the biology of birds. Covers the fossil record and theories for avian origins, physiology and anatomy, systematics, speciation processes, behavior, vocalizations, demography and conservation.

**OEB 200: The Evolution of Stem Cells and Regeneration***Mansi Srivastava*

An exploration of stem cell biology and the cellular, molecular and genetic principles of regeneration. Covers the main concepts and methods concerning the study of stem cells and familiarity with comparative approaches as applied to stem cell biology and regeneration.

OEB 58: How to Build an Animal



Stephanie Pierce





OEB 10: Foundations of Biological Diversity

**Graduate Courses  
Reading and Research**

**OEB 217R: What Makes a Rodent?**  
*Stephanie E. Pierce*

**OEB 275R: Phylogenetics and  
Phylogeography in the Era of Genomics**  
*Scott V. Edwards*

**OEB 307: Biomechanics, Physiology and  
Musculoskeletal Biology**  
*Andrew A. Biewener*

**OEB 320: Biomechanics and Evolution of  
Vertebrates**  
*George V. Lauder*

**OEB 321: Evolution of Regeneration and  
Development**  
*Mansi Srivastava*

**OEB 323: Advanced Vertebrate Anatomy**  
*Stephanie E. Pierce*

**OEB 325: Marine Biology**  
*Robert M. Woollacott*

**OEB 334: Behavioral Ecology**  
*Naomi E. Pierce*

**OEB 335/E-PSCI 337: Biological  
Oceanography**  
*James J. McCarthy*

**OEB 341: Coevolution**  
*Brian D. Farrell*

**OEB 355: Evolutionary Developmental  
Biology**  
*James Hanken*

**OEB 362: Research in Molecular Evolution**  
*Scott V. Edwards*

**OEB 367: Evolutionary and Ecological  
Diversity**  
*Jonathan B. Losos*

**OEB 370: Mammalian Evolutionary  
Genetics**  
*Hopi E. Hoekstra*

OEB 167: Herpetology



Breda Zimkus



## Freshman Seminar

### FRSEMR 22T: Why We Animals Sing

Brian D. Farrell

Investigates the sounds and structures of different kinds of acoustic animals—including birds, mammals, frogs and insects—and the different kinds of habitats in which they produce their songs and calls.

## Life Sciences

### BIOS S-158: Study Abroad: Biodiversity of the Dominican Republic

Brian D. Farrell

Explores the interplay of ecological niches and evolutionary diversification in the organisms and habitats of a tropical island as a microcosm of the evolution of biodiversity on Earth.

### LIFESCI 1B: An Integrated Introduction to the Life Sciences: Genetics, Genomics and Evolution

Hopi E. Hoekstra (and Kevin Eggan, Pardis Sabeti and Michael Burke)

An integrated approach showing how genetics and evolution are intimately related, together explaining the patterns of genetic variation we see in nature and how genomics can be used to analyze variation.

### LIFESCI 2: Evolutionary Human Physiology and Anatomy

Andrew A. Biewener and George V. Lauder (and Daniel E. Lieberman)

Explores human anatomy and physiology from an integrated framework, combining functional, comparative and evolutionary perspectives on how organisms work.



Gonzalo Giribet

OEB 51: Biology and Evolution of Invertebrate Animals

## Historical Vignette

Without any prior scientific training, in 1873 eighteen-year-old Elizabeth Hodges Clark accepted a job at the MCZ sorting marine specimens. Clark's great-niece Elizabeth Hodges Clark Beeuwkes would later recall her great aunt's descriptions of the "long counters on which the slimy specimens lay" in the museum.

In 1880, Clark accepted a promotion as Director Alexander Agassiz's personal secretary, and over time Agassiz would delegate to her more and more of his professional responsibilities. She managed his correspondence, made administrative decisions during his long absences and proofread his scientific publications. Clark also adapted her life to his geography. In an unusual arrangement, Clark spent her summers installed in the tower room of Agassiz's summer home in Newport, Rhode Island. By the time Agassiz died in 1910, Clark had become so indispensable to his work that he left her in his will \$25,000 and an additional annuity of \$10,000, more than five times the amount he left to his daughter-in-law.

Clark's history offers a window into patterns of women's employment in museums during this period. Although female assistants worked in low-skilled, low-paying positions that conformed to gender-appropriate narratives, Clark, like many women, was good at her job and leveraged her expertise into a circumscribed position of power at the MCZ.

—Jenna Tonn, Boston College



Elizabeth Hodges Clark, from the Archives of the Museum of Comparative Zoology, Ernst Mayr Library, Harvard University



# RESEARCH MAKING HEADLINES



Illustration by  
Diying Huang

## Tail of a New Species

The transparent structure of amber excellently preserves and reveals soft tissues and other delicate features of ancient creatures. In 100-million-year-old amber from Burma, scientists have found a creature that fills a gap in arachnid evolutionary history. And, surprisingly, it has a tail.

Analyses of the physical aspects of the specimens by

**Gonzalo Giribet** and an international team of researchers reveal a new group of arachnids, eight-legged invertebrates that include spiders, scorpions, ticks and mites. The specimens bridge the gap between modern spiders and more primitive ancestors. The newly discovered species has been named *Chimerarachne yingi* after the Chimera, a mythological creature made up of different animals.

*Chimerarachne yingi* has a whip-like tail that is longer than its body—similar to

vinegaroons (whip scorpions), close living relatives of spiders—but also has silk-producing spinnerets and other features more like modern spiders. (Scorpions also have a tail, but it is quite different from that of vinegaroons and *C. yingi*.)

Due to its combination of earlier and later characteristics, this species marks the transition period when silk-producing spinnerets and reproductive organs called pedipalps had evolved, but before tails of earlier lineages were lost.

The researchers postulate that the tail could have been used as an environmental sensing mechanism. This would have been helpful for ground-dwelling predators, but less useful as spiders transitioned to sit-and-wait predators with different sensing mechanisms, when the tail would have disappeared. The research was published in *Nature Ecology & Evolution*.

Huang D, Hormiga G, Cai C, Su Y, Yin Z, Xia F, Giribet G (2018) Origin of spiders and their spinning organs illuminated by mid-Cretaceous amber fossils. *Nat Ecol Evol* 2:623-627

## Serendipitous Symbiosis

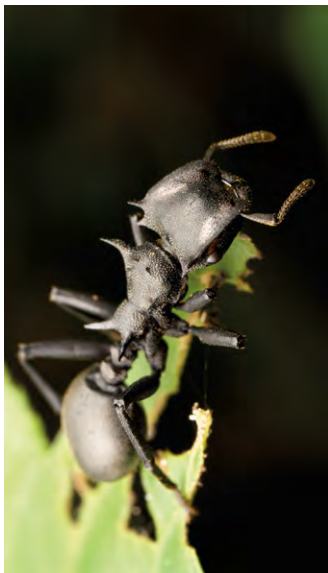
Turtle ants (*Cephalotes*) dine differently. They don't compete aggressively with other ants for optimal food resources, and they have evolved reduced jaws and lost the ability to sting, making it impossible to prey on living animals or scavenge their carcasses. Instead these herbivores forage for nectar, pollen, fungi and other resources from plant canopies and also consume mammal urine and bird feces—lower quality foods that others don't want. So how do they survive? **Jon Sanders, Naomi E. Pierce** and an international group of researchers decided to find out.

In a partnership begun 46 million years ago, turtle ants keep bacteria in their guts that recycle waste nitrogen into essential amino acids to supplement their diets. In an effort to understand the importance of these symbionts, the researchers used antibiotics to suppress the bacteria in lab ants. Then they exclusively fed the ants a diet containing only

nitrogen compounds found in waste, and then used molecular analysis to quantify the ants' decreased ability to process the nitrogen. In addition, turtle ants' protective armor requires a good deal of nitrogen, highlighting their reliance on these cohabiting organisms.

To sustain the bacterial lineage, older ants pass bacteria to the younger ones through anal secretions. The bacteria are so important to their existence that turtle ants develop a fine mesh filter at the start of their digestive systems soon after the symbiont transfer, likely as a measure to prevent further passage by small particles and protect the symbiotic bacteria in the gut. The research findings were published in *Nature Communications*.

Hu Y, Sanders JG, Łukasik P, D'Amelio K, Millar JS, Vann DR, Lan Y, Newton JA, Schotanus M, Kronauer DJC, Pierce NE, Moreau CS, Wertz JT, Engel P, Russell JA (2018) Herbivorous turtle ants obtain essential nutrients from a conserved nitrogen-recycling gut microbiome. *Nat Commun* 9:964



Jon Sanders



## Uplifting Developments

An aerofoil is a curved structure, such as a plane's wing, that moves through air or water. Design enhancements that improve lift and decrease drag on the aerofoil's surface, such as blade-like passive vortex generators, can improve the performance of airplane wings, wind turbine blades, helicopter blades, drones and autonomous underwater vehicles. Inspired by the scales of a shark, a research team led by **George V. Lauder** has developed a new type of passive vortex generator that significantly improves the effectiveness of aerofoils.

The world's fastest shark is the shortfin mako, *Isurus oxyrinchus*. Prof. Lauder has studied its denticles—thousands of toothlike scale structures that cover its extremely aerodynamic body—and found that these denticles help reduce drag in the water. But what if they can also improve lift?

To test this theory, Prof. Lauder and his team 3D-printed shark denticle-inspired structures on the upper surface of aerofoils to study their impact on lift and drag. They found that

the denticles, in addition to reducing drag, altered the pressure distribution to enhance suction and improve lift. After determining the most effective placement and modifying the structure of the denticles based on their experiments, they tested the resulting continuous shark-inspired vortex generator to find that it improved lift-to-drag ratios by up to 323%. In addition, the structure can be easily incorporated into conventional manufacturing processes, bringing this technology one step closer to large-scale adoption for aquatic and aerospace applications. The research was published in *Journal of the Royal Society Interface*.

Domel AG, Saadat M, Weaver JC, Haj-Hariri H, Bertoldi K, Lauder GV (2018) Shark skin-inspired designs that improve aerodynamic performance. *J R Soc Interface* 15:20170828

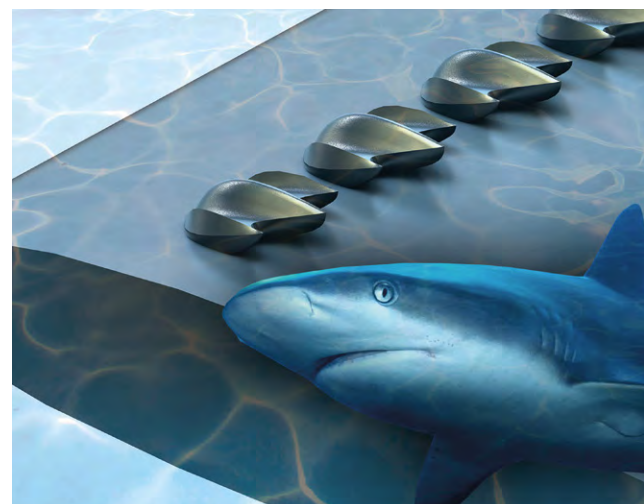


Illustration by James Weaver

## On Their Toes

Reduction in the number of toes is a major trend in the evolution of many four-legged animals, including some dinosaurs, lizards, marsupials, rodents and ungulates like cattle, deer, hippos and camels. However, the most extreme example of digit reduction is in the single toe of the modern horse.

The classic explanation of this evolutionary sequence is that, as the ancestral horses' habitat changed from forest to grassland, it became important to select for long, slender legs for increased speed to better evade predators and fewer toes to more effectively and safely support increased body mass.

To test the body mass hypothesis, **Brianna McHorse**, **Andrew A. Biewener** and **Stephanie E. Pierce** explored the mechanical stresses that movement placed on limbs as body mass increased and toes decreased over the horse lineage.

They used modern 3D imaging to capture internal bone geometry of 13 fossil horse

genera—from the dog-sized, four-toed *Hyracotherium* of about 50 million years ago to the modern horse (*Equus*)—and developed a novel, continuous measure of digit reduction that accounted for the changing size of the side toes for the first time.

They found that while load-bearing side toes were necessary to avoid unsafe stresses in smaller ancestral horses, as body mass increased, the central toe became larger and its internal geometry evolved to become more resistant to bending as the side toes began to shrink. The research was published in *Proceedings of the Royal Society B*.

McHorse BK, Biewener AA, Pierce SE (2017) Mechanics of evolutionary digit reduction in fossil horses (Equidae). *Proc R Soc B* 284:20171174



Brianna McHorse



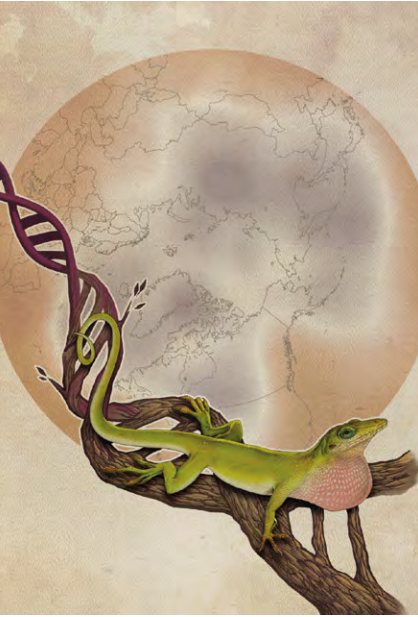


Illustration by Julia Yu and Alex David Jerez Roman

## Out in the Cold

There are times when planning and serendipity can collide fortuitously, as they did for **Shane Campbell-Staton** while he was investigating the genetics of cold tolerance in the green anole. Anoles are subtropical lizards that live throughout the Caribbean and Central and South America, but the hardiest of these, the green anole, *Anolis carolinensis*, has a range that extends into North Carolina, Mississippi and Tennessee.

In August 2013, Campbell-Staton was close to completing his doctoral research. He had just returned from a six-week collecting trip gathering green anoles at five locations in the 750 miles from Hodgen, Oklahoma, south to Brownsville, Texas, on the Mexican border, an area covering much of the species' variation in cold tolerance. He collected DNA from several dozen green anoles and also gathered data

relating to their gene expression profiles and their ability to physically function in the cold.

However, a subsequent freakishly cold winter in the area caused by an extreme polar vortex afforded an exciting opportunity to further examine the green anole's biological response to the extreme weather. Armed with his earlier data, Campbell-Staton returned to the same sites after the record cold spell to examine the surviving populations. He found that the lizards in the southernmost sites had strong shifts in cold tolerance and gene expression profiles that more closely mirrored that of northern populations. The research of Campbell-Staton, **Scott V. Edwards, Jonathan B. Losos** and colleagues was published in *Science*.

Campbell-Staton SC, Cheviron ZA, Rochette N, Catchen J, Losos JB, Edwards SV (2017) Winter storms drive rapid phenotypic, regulatory, and genomic shifts in the green anole lizard. *Science* 357:495-498

## Avoiding the Straight and Narrow

If you're a rodent in the open desert, evading predators is a life-or-death skill. Often, we think the most successful prey is the one with greater speed or endurance. But when eluding predators with simple ballistic attack strategies, like owls or snakes, bipedal locomotion may be the key to success.

Bipedal rodents may have an advantage over their quadrupedal cousins due to the randomness of their movements. To test this hypothesis, **Talia Moore, Andrew A. Biewener** and fellow researchers developed a new way to measure the unpredictability of motion in three-dimensional space. They used a metric of randomness—entropy—to quantify the

erratic movements of bipedal jerboas (family Dipodidae) versus those of quadrupedal, gerbil-like jirds (genus *Meriones*). Jerboas, who ricochet around by changing their gait at each step, can vary their stride length, direction and speed while hopping, skipping, running and jumping.

In quantifying the spatial motion of jerboas and jirds, the researchers found that the jerboa movements have higher randomness during simulated predator attacks. They then used behavioral methods to demonstrate the relative comfort of the jerboas over that of jirds in moving beyond shelter to forage for food, an indication of the jerboas' superior success in evading predators.

The research offers an innovative approach to understanding interspecies interactions in a natural setting and may also have applications in the field of robotics. The findings were published in *Nature Communications*.

Moore TY, Cooper KL, Biewener AA, Vasudevan R (2017) Unpredictability of escape trajectory explains predator evasion ability and microhabitat preference of desert rodents. *Nat Commun* 8:1-9



Talia Moore





# HIGHLIGHTS FROM THE COLLECTIONS

## Rediscovering a Harvard Dig Site

At some time during the 1930s, the MCZ acquired an 80-acre site in Goshen County, Wyoming. During that decade, paleontologists excavated approximately 4,000 pounds of material, shipping some of it back to Cambridge by train.

These fossils from the Oligocene, estimated to be around 34 million years old, include ancestors of camels, horses, hippopotamuses, rhinoceroses, turtles and birds. However, it has been more than 80 years since Harvard scientists have worked there, and the site was mostly forgotten.

Stephanie Pierce



Chris Capobianco



Stephanie Pierce

At left: Stephanie Pierce  
From top: James Hanken; Chris Capobianco; collected fossil specimen

In June 2018, **James Hanken**, **Stephanie E. Pierce** and **Chris Capobianco** traveled there to get reacquainted.

The team spent several days exploring the site and collecting specimens to bring back to the MCZ for study. "The fossil layer is just underfoot," says Hanken, "and erosion has exposed some of that layer. Given there are turtles here, it would have been a lot wetter, like a lake."

Considering the interest of Prof. Pierce and Capobianco in these types of fossils, it's likely that the site will have renewed activity.

Prof. Pierce, who regularly takes students to dig sites in Arizona, feels the site would be a good place to learn. "The ease in which we found fossils will ensure that students would find something and learn during the experience," she says.



Stephanie Pierce





Melissa Aja

## Microbial Life

A world of astonishingly diverse, unseen lifeforms thrives around us, and they engage with and sustain the planet's biosphere in essential ways science is just beginning to understand. These lifeforms are explored in *Microbial Life: A Universe at the Edge of Sight*, an exhibition running through September 3, 2019, at the Harvard Museum of Natural History.

A model kitchen uses cutting-edge scientific research and interactive stations to introduce visitors to microbial life through this familiar space. From there, visitors can examine live colonies of soil bacteria that help sustain terrestrial environments, delve into the ocean depths to learn about microbial sea life and view stunning images of microbes that blend art and science.

MCZ staff provided multiple specimens from the collections for the exhibition. One of these is a hoopoe (*Upupa epops*), a bird that protects its unborn chicks by painting the eggs with microbes that produce powerful antibiotics, according to **Jeremiah Trimble**, Curatorial Associate in Ornithology.

**Adam Baldinger**, Curatorial Associate in Invertebrate Zoology and Malacology, assisted HMNH with two specimens. "The deep sea-dwelling giant tube worm (*Riftia pachyptila*) lives in symbiosis with bacteria that help it derive energy from the hydrogen sulfide around hydrothermal vents," says Baldinger. He also provided a specimen of a stout bobtail squid that has a symbiotic relationship with bioluminescent bacteria.

**Mark Omura**, Curatorial Associate in Mammalogy, contributed a palm civet (*Paradoxurus hermaphroditus*), a brown-throated sloth (*Bradypus variegatus*), a dog (*Canis familiaris*) and a brown howler monkey (*Alouatta fusca*).



Melissa Aja



## Orb-Weavers

A special exhibit, *Orb-Weavers: Web Masters of the Spider World*, supported by a National Science Foundation grant, debuted in the Harvard Museum of Natural History's *Arthropods: Creatures that Rule* gallery in October 2017.

Combining specimens from the MCZ, stunning photography and multimedia technology, *Orb-Weavers* examines the evolution of the orb-style web and explores how capture strategies have shaped web design.

Spiders make diverse styles of webs to capture their prey, and the finely crafted webs of the orb-weavers are distinctive—simultaneously a key evolutionary milestone, an engineering marvel and a work of art.

But did they evolve to create orb-style webs just once, or multiple times?



Melissa Aja



Melissa Aja

Surprising new research by **Gonzalo Giribet**, Alexander Agassiz Professor of Zoology and Curator of Invertebrate Zoology, and colleagues suggests that this seemingly complex design has been repurposed and may have been wholly reinvented in different spider groups over 140 million years of evolution.

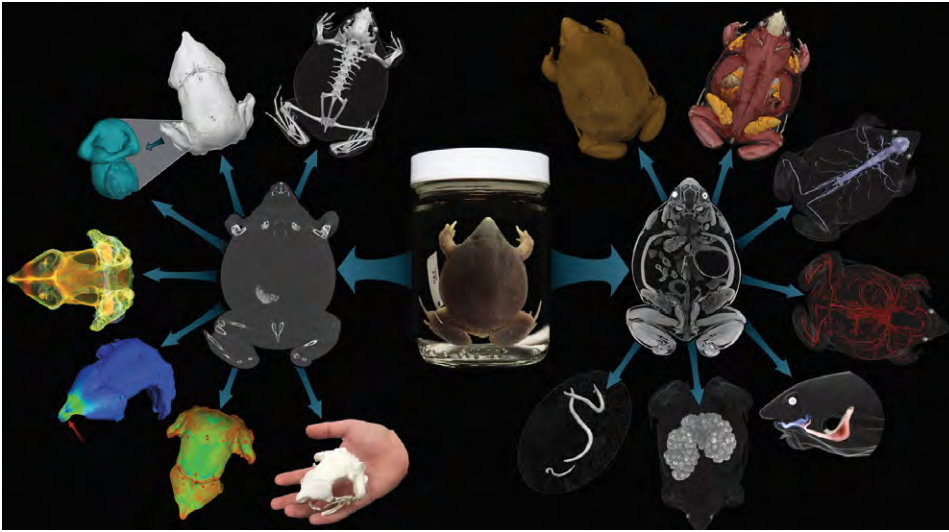
Giribet and colleagues used a recently developed approach to examine 2,500 genes from 159 spider species, and their findings suggest that orb-style webs evolved multiple times since the late Triassic-Jurassic.

“Through collaborative work between Harvard and The George Washington University, we have been able to uncover new relationships among spider lineages, illustrating that the evolution of the orb-style web is much more complex than originally thought, with many losses across the spider tree of life,” says Giribet.



# PROJECTS & INITIATIVES

## Visualizing Vertebrates in 3D



Edward Stanley

What began as the passion of individual scientists to CT scan species in their area of study has turned into a multi-institution effort to visualize all vertebrate anatomy.

The initiative is called [openVertebrate](#), or oVert, and over the next four years it will digitize 20,000 specimens carefully selected to represent 80 percent of vertebrate genera. The majority of fluid-preserved specimens will be digitized with CT scanners, which use X-rays to produce highly detailed 3D views of the skeleton and other internal features.

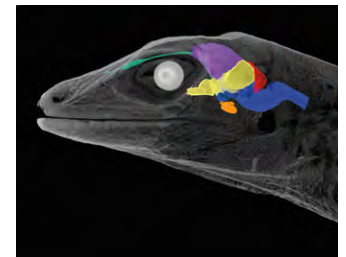
The project is supported with a \$2.5 million National Science Foundation grant, with 18 participating universities and institutions in the U.S., including Harvard University and Principal Investigator **James Hanken**. The oVert Thematic Collections Network will create 3D vertebrate scans and make them freely available for researchers, educators, students and the public.



Zach Randall

The scans, which will include micro-CT scans of tiny specimens as well as those up to six feet long, will be available through MorphoSource ([morphosource.org](#)). A few species will be chemically treated to reveal their soft tissues. These detailed 3D models can be manipulated, downloaded and segmented, allowing organ structures, blood vessels and other internal features to be viewed and studied.

For education and outreach efforts, the oVert team will train museum specialists to produce, curate and distribute 3D anatomical data and offer guidance to researchers on how to use the data. The team will teach high school and undergraduate students to create 3D anatomical models and also conduct workshops for K–12 STEM educators on the use of digital specimens in their classrooms.



Edward Stanley

## Workshops Hosted by the MCZ

In March 2018, **Linda S. Ford**, Director of Collections Operations, and **Breda Zimkus**, Cryogenics Collections Manager for Genetic Resources, hosted a National Science Foundation-funded workshop for the Biodiversity Collections Network. Using compliance with the Nagoya Protocol as a platform, invited participants discussed how to manage legal issues associated with the collection and exchange of biological specimens using cyberinfrastructure and how to advise stakeholders in the face of changing policies.

Also in March, the MCZ, Harvard University Herbaria and the Peabody Museum of Archaeology & Ethnology at Harvard University co-hosted the annual meeting of the Integrated Pest Management Working Group, whose purpose is to collect and disseminate resources for IPM in museum settings. The group updated [museumpests.net](#), gave presentations and set future priorities. Collection staff also attended a workshop introducing IPM principles.



## Encyclopedia of Life Learning + Education Group

The Encyclopedia of Life ([eol.org](http://eol.org)) is an open-science project that aggregates biodiversity content and data from partners such as the Smithsonian Institution, the Global Biodiversity Information Facility, the MCZ and citizen science projects, including iNaturalist. The **EOL Learning + Education Group**, based at the MCZ, encourages the development of innovative and effective uses of species information and data in educational settings.

### EOL Biodiversity Cards

EOL Biodiversity Cards, which can be made on the EOL website by anyone, provide an image and list of traits for each species in a deck. The card maker is currently available in Catalan, English, French and Spanish, with other languages planned.

### City Nature Challenge

The 2018 City Nature Challenge took place across 68 cities in 17 countries, engaging 17,000 observers and logging 442,000 nature sightings. EOL led the effort to create the CNC Education Toolkit and helped organize the Boston event. In addition, 4,075 research-grade images flowed to EOL from the iNaturalist platform, including observations of 599 rare, endangered and threatened species globally.

### Biodiversity Data Quality

EOL collaborates with Integrated Digitized Biocollections (iDigBio) to coordinate the broader impacts for Kurator, a biodiversity data-quality project funded by the National Science Foundation and led by Harvard and the University of Illinois Urbana-Champaign. Outcomes include tutorials for using Kurator's data cleaning tools and co-developing collections-based data literacy activities for undergraduates through BLUE (Biodiversity Literacy in Undergraduate Education).

## Ernst Mayr Library

### William Brewster Collections Digitized

Thanks to grants from the Institute of Museum and Library Services and the Council for Library and Information Resources, EML has been digitizing William Brewster's journals, diaries, correspondence, notes and photographs. Brewster was Curator of Mammals and Birds from 1885 until his death in 1919. More than 11,000 items have been digitized and 7,105 pages transcribed.

### Biodiversity Heritage Library (BHL)

EML has contributed 10,116 scanned volumes (3,317,544 pages) to BHL, which have been downloaded nearly 10 million times, mostly by users in the U.S., Europe, Australia, Brazil and Mexico.

### Laura Bush 21st-Century Librarian Award

The grant-funded project *Foundations to Actions: Extending Innovations in Digital Libraries* is now complete. This work enabled Full Text Search in BHL and the addition of transcriptions, including William Brewster's journals.

### Expanding Access to Biodiversity Literature (EABL)

Awarded in 2015 to the New York Botanical Garden with partners Ernst Mayr Library and Missouri Botanical Garden and completed this year, this grant increased access to biodiversity literature by seeking out smaller content providers and negotiating with copyright holders for more recent publications.

**eol**  
Ocells

**Mallerenga petita**  
*Periparus ater*



Rol a la xarxa tròfica
Alpi
Estatus UICN

OMNI
Risc mínim

Envergadura alar	17 - 21 cm
Pes de l'adult	6 - 10 g
Esperança de vida	2 anys (mitjana)
Posta/Cria	1 -12; 1 -2/anys
Tipus de niu	Cavitats dels arbres

AMENACES I ADAPTABILITAT

Amenaces importants: Reducció de recursos tròfics

Adaptabilitat: Rang molt ample

Tendència poblacional: Reducció global

Image: Biopix CC-BY-NC



Mary Sears



## AWARDS & RECOGNITION



Jon Black Photography, Tyler Prize

James McCarthy

### Faculty-Curators

**James J. McCarthy** was awarded the 2018 Tyler Prize for Environmental Achievement, often described as the “Nobel Prize for the Environment,” for decades of leadership in understanding and communicating the impacts of climate change.

Prof. McCarthy's research on marine nutrient cycles contributed significantly to the understanding of human activity on Earth's climate. He led the International Geosphere-Biosphere Programme, producing science that was an important component of the Nobel Peace Prize-winning Intergovernmental Panel on Climate Change, which he co-chaired in 2001. He also served as President of the American Association for the Advancement of Science.



Gonzalo Giribet

**Gonzalo Giribet** received an honorary doctorate from the University of Copenhagen.

**Hopi E. Hoekstra** was elected a fellow of the American Philosophical Society, and the Hoekstra lab was awarded the Bjorkman-Strominger-Wiley Award for collaborative research.

**George V. Lauder** was awarded a Harvard College Professorship for excellence in undergraduate teaching.

**Naomi E. Pierce** was elected to the American Academy of Arts and Sciences and won the Edward O. Wilson Naturalist Award from the American Society of Naturalists.

**Mansi Srivastava** received a Maximizing Investigators' Research Award (R35 MIRA) from the National Institute of General Medicine at the National Institutes for Health.

### Emeritus

**Edward O. Wilson** received the World Ecology Award, presented by the Missouri Botanical Garden. Six of his books were selected for the Library of America, a collection of classical American literature made available in new editions.

### Staff

**Paul Dwyer**, OEB Administration, and **Kristin Pennarun**, Assistant Director of Research Administration, were awarded a 2018 FAS Dean's Distinction Award.



Hoekstra Lab

**Kyle Turner**, Hoekstra lab manager, led the lab to victory in the National Green Labs Freezer Challenge.

Three members of the collections staff completed their careers at the MCZ: **Judith Chupasko**, Curatorial Associate in Mammalogy; **Karsten Hartel**, Curatorial Associate in Ichthyology; and **Philip Perkins**, Curatorial Associate in Entomology.



### Postdoctoral Researchers

**Albert Kao** received an Omidyar Postdoctoral Fellowship and Baird Scholarship at the Santa Fe Institute.

**Andi Kautt** received an EMBO Long-Term Fellowship.

**Sangeet Lamichhaney** won the Young Investigator Award for Evolutionary Studies from the Royal Society of Sciences.

**Yi-Jyun Luo** received a postdoctoral fellowship from the Human Frontiers Science Program.

### Graduate Students



Wei-Ping Chan

**Wei-Ping Chan** received a Kao Fellowship from the Harvard Graduate School of Arts and Sciences (GSAS).

**Richard Childers** received a Royal T. Moore award from the Harvard University Herbaria.

**Tauana Cunha** was awarded a Schlumberger Foundation Faculty for the Future Fellowship.

**Alyssa Hernandez** was the 2018 Mentor of the Year for the Women in STEM Mentorship Program and was elected as a Diversity and Inclusion Fellow at GSAS (inaugural year).

**Tauana Cunha, Alyssa Hernandez, Ryan Hulett, Julian Kimura, Vanessa Knutson, Mara Laslo, Brianna McHorse, Zachary Morris, Shayla Salzman, Kira Treibergs** and **Zane Wolf** each received a Certificate of Distinction in Teaching from the Derek Bok Center.

**Patrick Goring** was awarded a Huron Mountain Wildlife Foundation research award.

**Mara Laslo** received a research grant from the Graduate Women in Science.

**Dave Matthews** was awarded a National Science Foundation Graduate Research Fellowship Program grant.

**Olivia Meyerson** and **Brock Wooldridge** received an American Society of Mammalogists Grant-in-Aid of Research.

**Shayla Salzman** received the Arthur K. Bell Award for significant achievement in the study of the non-protein amino acid BMAA from the Brain Chemistry Labs at the Institute for EthnoMedicine.

### Undergraduate Students

**Brendan Zhi Min Dean** was awarded a Harvard Herchel Smith Undergraduate Fellowship.

**Annika Gompers** won a Thomas T. Hoopes Prize for her senior thesis, "Identification of transcriptional regulators of whole-body regeneration."

**Rebecca Greenberg** was awarded a National Science Foundation Graduate Research Fellowship Program grant.

**Dajia Ye** won first place at the undergraduate ten-minute paper competition for the President's Prize at the Entomological Society of America's annual meeting.



Paul Alan Cox

Shayla Salzman



Tauana Cunha



# GRANT RECIPIENTS



Tomáš Lackner

## Grants-in-Aid of Undergraduate Research (GUR)

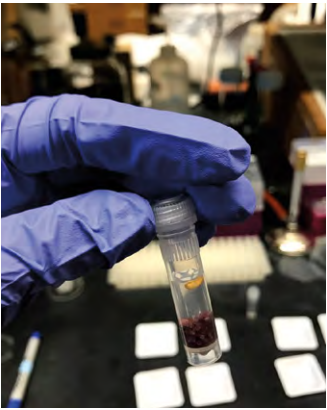
**GUR grants** support research by Harvard College undergraduates under faculty supervision. Priority is given to projects that utilize MCZ, Harvard University Herbaria (HUH) and Arnold Arboretum (AA) research collections, laboratories and facilities. Support for these grants comes from the MCZ's Myvanwy M. and George M. Dick Scholarship for Students, HUH and AA.

Recipient	Faculty Sponsor/ Academic Dept.	Project Title	Amount
Johnathan Clark	Scott V. Edwards/ Organismic and Evolutionary Biology	Comparative genomic study of two North American thrush species	\$2,330
Emmanuel D'Agostino	Jonathan B. Losos/ Organismic and Evolutionary Biology	Estimating behavioral, morphological, and genomic divergence in precopulatory isolation of <i>Anolis sagrei</i>	\$2,500
Camille DeSisto	Charles Davis/ Organismic and Evolutionary Biology	A multidimensional evaluation of the conservation implications of the invasive strawberry guava in Madagascar	\$2,500
Annika Gompers	Mansi Strivastava/ Organismic and Evolutionary Biology	Identification of transcriptional regulators of whole-body regeneration	\$2,500
Rebecca A. Greenberg	Hopi E. Hoekstra/ Organismic and Evolutionary Biology	Effect of reproductive status on social burrow construction in <i>Peromyscus polionotus</i>	\$500
Catherine Hua	Naomi E. Pierce/ Organismic and Evolutionary Biology	An investigation of the gut microbiota and evolution of feeding habits of <i>Ceratophaga</i> moths	\$2,500



Lori Shapiro

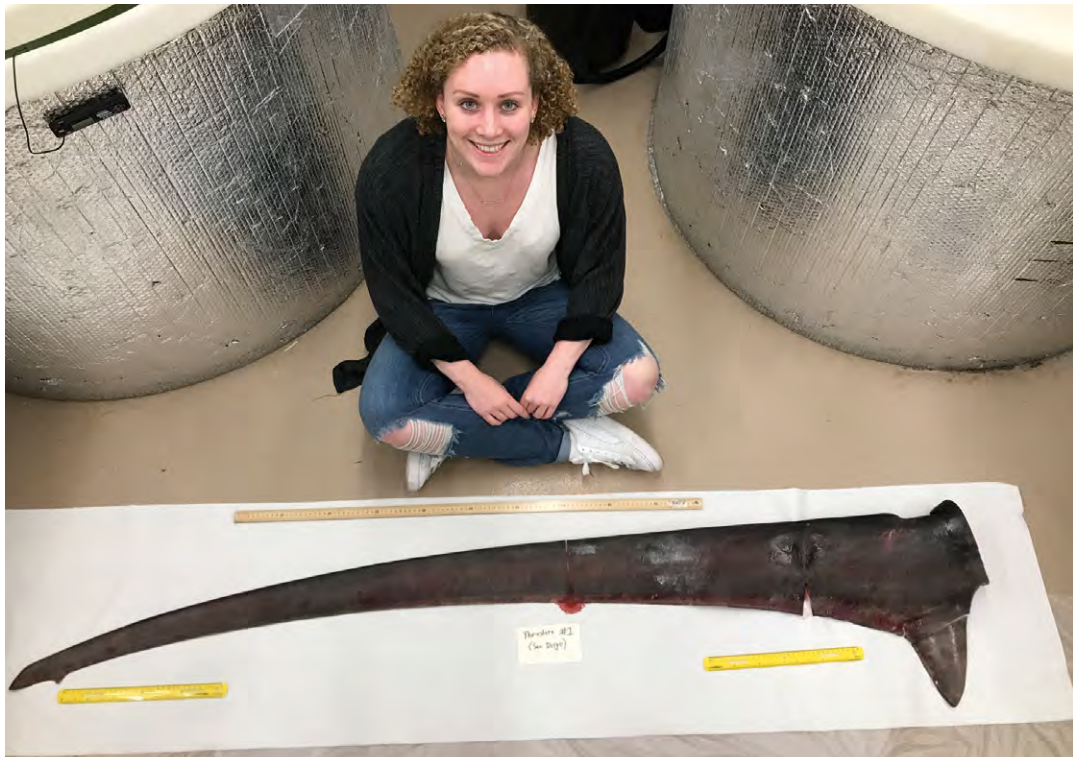
Laura Jenny



Catherine Hua



Scott Edwards



Meagan Popp

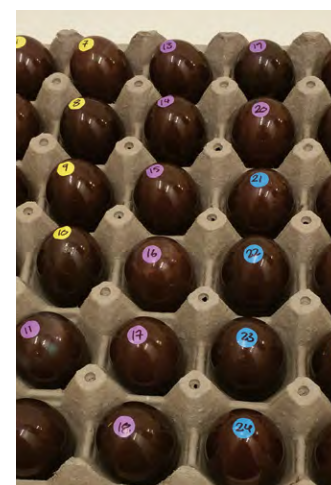




Recipient	Faculty Sponsor/ Academic Dept.	Project Title	Amount
Laura Jenny	Naomi E. Pierce/ Organismic and Evolutionary Biology	Geographic variation in the <i>Cucurbita pepo</i> microbiome	\$2,500
Maria Park	Noel Holbrook/ Organismic and Evolutionary Biology	Carbohydrate transport patterns of woody trees: Studies on loading type, sink removal, and drought	\$1,600
Meagan Popp	George V. Lauder/ Organismic and Evolutionary Biology	Denticle pattern of the caudal fin of thresher sharks: Locomotion and feeding strategy advantages	\$810
Allison Rabe	David Haig/ Organismic and Evolutionary Biology	Changes in arthropod availability and diet and morphology of lizards following a hurricane	\$2,374
Elizabeth Roux	Gonzalo Giribet/ Organismic and Evolutionary Biology	Senior thesis research: Population genetics and phylogeography of <i>Bdelloura candida</i> , an ectocommensal symbiont of the American horseshoe crab	\$2,500
Dann B. Stevens	Noel Holbrook/ Organismic and Evolutionary Biology	Light-dependent plasticity in polytrichid mosses	\$2,370
Victoria Tong	Hopi E. Hoekstra/ Organismic and Evolutionary Biology	Comparative looming project in <i>Peromyscus</i>	\$500
Lien Tran	Ikue Shingu/East Asian Languages	Computer-assisted Japanese pronunciation training for English speakers: Pitch accent, duration contrast and moraic duration self-assessment tool	\$2,500
Adele Woodmansee	Charles Davis/ Organismic and Evolutionary Biology	Native maize, transgenic contamination and agricultural change in a Zapotec community	\$2,100
		<b>Total Awards</b>	<b>\$30,084</b>



Elizabeth Roux



Philip Grayson

## Robert G. Goelet Research Awards

Goelet Awards support MCZ graduate student research projects. These grants are made possible through a gift from Mr. Robert G. Goelet.

Recipient	MCZ Department	Project Title	Amount
Philip Grayson	Ornithology	Insights into the early limb development of a volant palaeognath, the Chilean tinamou ( <i>Nothoprocta perdicaria</i> )	\$2,500
Mara Laslo	Herpetology	The role of the thyroid hormone in limb development of a direct-developing frog	\$1,525
Samantha Royle	Herpetology	Molecular Biology Summer Workshop, New England Biolabs	\$4,300
		<b>Total Awards</b>	<b>\$8,325</b>



Samantha Royle





Sayali Sheth



Sarah Maunsell



Jessica Colavite

## Ernst Mayr Travel Grants in Animal Systematics

**Ernst Mayr Grants** support travel for research in animal systematics and are open to the scientific community worldwide. The principal objective of these grants is to stimulate taxonomic work on neglected taxa and/or poorly described species. Ernst Mayr Grants typically facilitate visits to institutional collections, with preference given to research that uses MCZ's collections. These grants are made possible by a gift from Professor and former MCZ Director Ernst Mayr.

Recipient	Institutional Affiliation	Project Title	Amount
Salvatore S. Anzaldo	Arizona State University	Identifying and delimiting mimetic species and genera through analysis of type specimens of the fly-mimicking weevils <i>Mnemynurus</i> Heller and <i>Hoplocopturus</i> Heller (Coleoptera: Curculionidae)	\$1,300
Heather E. Braid	Auckland University of Technology	Catalogue of the cephalopods in the Scripps Institute of Oceanography	\$1,000
Jessica Colavite	University of São Paulo State, UNESP	Taxonomy of <i>Macrocoeloma</i> Miers, 1879 (Crustacea: Decapoda: Brachyura: Majoidea)	\$1,000
Vinicius de Souza Ferreira	Montana State University	Critical types of Lycidae (Insecta, Coleoptera) in the Gundlach and Zayas collections in Cuba: A revision of the Leptolycini and <i>Thonalmus</i> Bourgeois	\$1,175
Gustavo Ernesto Flores	Consejo Nacional de Investigaciones Científicas y Técnicas (CONICET)	Revision of type material of the Neotropical tribe Praociini (Coleoptera: Tenebrionidae)	\$1,000
Arlo Hinckley	Estación Biológica de Doñana-CSIC	Approaching integrative taxonomy on two difficult genera of squirrels from Southeast Asia	\$1,500
Tomáš Lackner	Bavarian State Collection of Zoology	Histeridae of Morocco (Coleoptera: Histeroidea)	\$1,200
Maria Cecilia Melo	Consejo Nacional de Investigaciones Científicas y Técnicas (CONICET)	Diversity of the Reduviidae (Hemiptera: Heteroptera) from Argentina	\$1,500
Roberta G. Mendes	Museu Paraense Emílio Goeldi	Taxonomy of <i>Monopeltis</i> (Reptilia: Amphisbaenia) and the description of a new genus for Africa	\$1,500
Zeeshan Ayaz Mirza	National Centre for Biological Sciences	Taxonomy and phylogeny of the <i>Metopilio</i> group (Opiliones: Eupnoi: Phalangioidea)	\$1,500
Allan Rodrigo Oliveira Rodrigues	Federal University of Para, Brazil	Revision of pharyngodonid nematodes of mammals and fishes	\$1,500
Jiawei Shen	Russian Academy of Sciences	<i>Anochetus</i> Mayr, 1861 (Hymenoptera: Formicidae: Ponerinae) of the MCZ	\$1,500
Sayali Dilip Sheth	MES's Abasaheb Garware College	Assessment of Indian aquatic Coleoptera collection deposited in the National Museum, Prague, Czech Republic	\$1,500
Mariana Viglino	Universidad de Buenos Aires	Fossil platanistoids from Patagonia (Argentina) as a key to understand their evolutionary history during the enigmatic early Miocene	\$1,300
<b>Total Awards</b>			<b>\$18,475</b>



## Putnam Expedition Grants

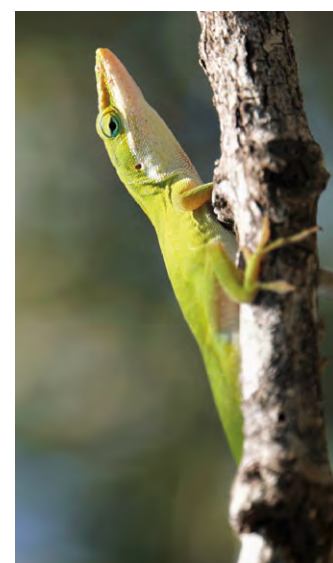
**Putnam Expedition Grants** are intended to support MCZ faculty-curators, postdoctoral fellows and graduate students in collecting specimens and data relating to the study of comparative zoology. Priority is given to projects that collect living specimens in regions where habitats are threatened or fossil specimens in regions most likely to hold important clues for unraveling evolutionary strategies. These grants are made possible by a gift from Mr. George Putnam, Jr., AB 1949 and MBA 1951, and Mrs. Nancy Putnam.

Recipient	Institutional Affiliation	Project Title	Amount
Dan Bock	Herpetology	The contribution of intraspecific admixture to colonization success in a widespread invasive species	\$5,000
Gustavo Bravo	Ornithology	Genomic basis of phenotypic divergence associated to environmental conditions in the Thamnophilidae	\$5,474
Shahan Derkarabetian	Invertebrate Zoology	The unknown triaenonychid harvestmen of Australia	\$7,030
Scott V. Edwards	Ornithology	Genomic resources for Mongolian birds, with a focus on geographic variation in gene expression in habitat generalists	\$16,980
Gonzalo Giribet	Invertebrate Zoology	<i>Mollusca caribaeana</i> pursuit: In search of the first velvet worm	\$5,371
Nicholas Herrmann	Herpetology	Experimental test for the evolutionary consequences of ecological release	\$3,340
Sarah Maunsell	Entomology	Evolution of private communication channels in endemic New Zealand butterflies	\$9,912
Kathrin Nöpflin	Ornithology	Disentangling the evolutionary causes and consequences of a pathogen spill-over into a novel host	\$6,687
Naomi E. Pierce	Entomology	Ants and myrmecophiles from New World ant plants	\$8,902
Stephanie E. Pierce	Vertebrate Paleontology	The rise of tetrapods during the Carboniferous	\$9,000
Sofia Prado-Irwin	Ornithology	Diversification of island and mainland <i>Anolis lemurinus</i>	\$6,200
C. Jonathan Schmitt	Ornithology	Phylogeography, genetic basis, and evolution of carotenoid coloration in Andean birds	\$6,900
Flavia Termignoni Garcia	Ornithology	Genomics and neurobiology of cooperative breeding in birds	\$6,226
		<b>Total Awards</b>	<b>\$97,022</b>



Florenzia Paolucci

Mariana Vigino



Nick Herrmann

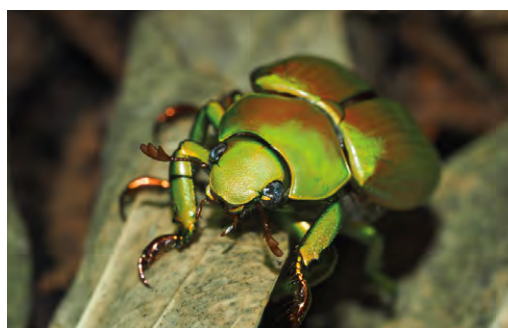


Miguel Camacho

Arlo Hinckley

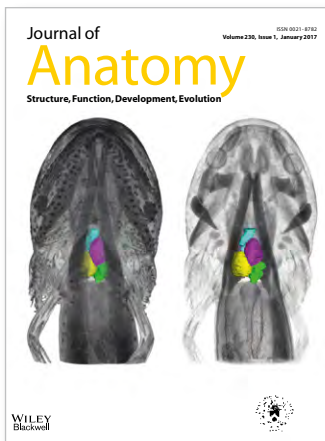


Israel Escalante Aviles



Sofia Prado-Irwin

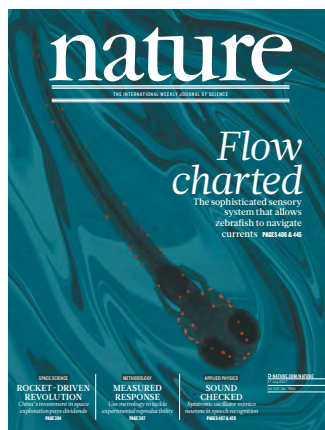




Z.R. Lewis and James Hanken contributed the cover story on lungless salamanders for *Journal of Anatomy*.



Research by **George V. Lauder** and colleagues was featured on the cover of *Journal of Fluid Mechanics*.



**George V. Lauder** and colleagues contributed research on larval zebrafish for the cover story of *Nature*.

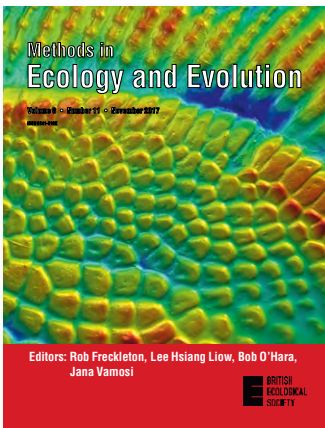
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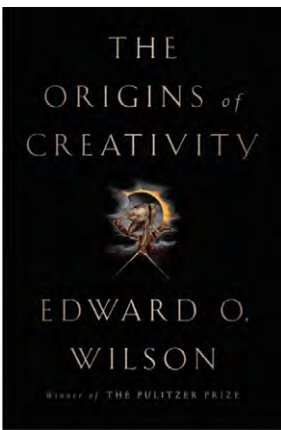


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Research by **D.K. Wainwright** and **George Lauder** on biological surface topography was featured as the cover story of *Methods in Ecology and Evolution*.



In *The Origins of Creativity*, **Edward O. Wilson** explores the genesis of humanity's innate quest for originality.



Research on the communication of solitary bees by **L.E.K. Murphy**, **Naomi Pierce** and **S.D. Kocher** was featured on the cover of *PNAS*.

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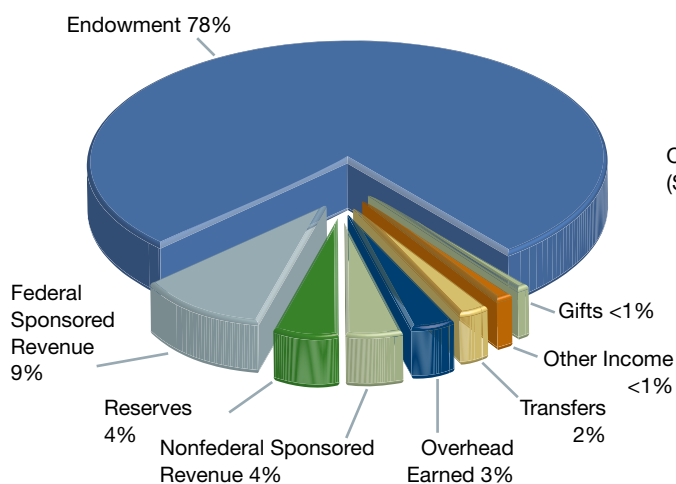
# FINANCIAL DATA

These charts describe the income and expenses of the Museum of Comparative Zoology in fiscal year 2018.

Endowment income funds much of the Museum’s activities, including acquisition and maintenance of collections, faculty and staff salaries, capital projects, facilities renovation and maintenance. Included in **Endowment Income** is the annual distribution (payout) and endowed funds decapitalized per donor request. **Transfers** include financial support for the Ernst Mayr Library and other Harvard-funded projects. **Other Income** comprises miscellaneous income from publication subscriptions, royalties, sales and fees, and cost recovery from other MCZ-sponsored activities. **Overhead** is funding paid from MCZ-based sponsored projects to cover facilities and administrative costs for those projects. It is shown as both income (**Overhead Earned**) and expenses (**Overhead Charged**). **Reserves** indicates balances utilized to fund operations. **Capital**

**Projects** include payment of the balance of deployment of collections to the newly constructed space in the Northwest Building and renovation of the MCZ’s ground floor prep lab. Building expenses such as maintenance, facility improvements and utilities are captured in the **Space & Occupancy** category. **Operating Expenses** consist of equipment purchases, supplies, and consultant and conference fees, as well as annual subventions to the Department of Organismic and Evolutionary Biology (OEB) for administrative services and MCZ support for faculty-curator research. Support for MCZ-affiliated graduate students in OEB is included in **Scholarships, Awards & Travel**. **Institutional Expenses** are support for other University activities outside the MCZ, including FAS and University initiatives and general operating support to the Harvard Museums of Science and Culture.

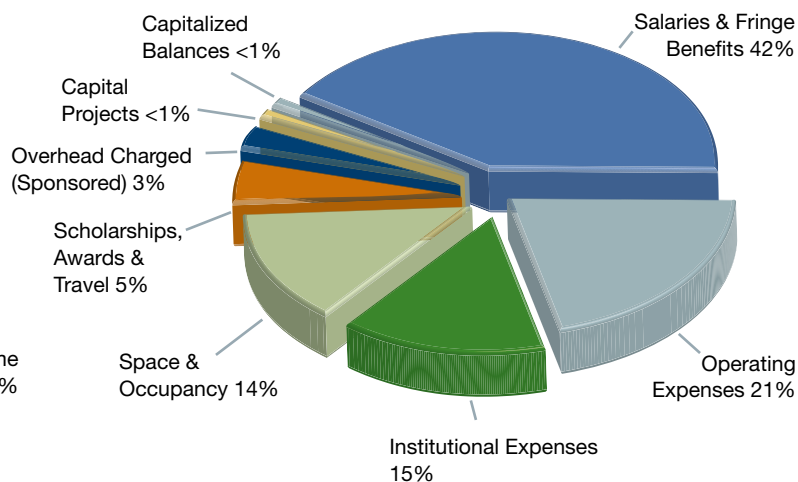
**INCOME**



**Income**

Endowment	\$16,140,267
Federal Sponsored Revenue	\$1,891,360
Reserves	\$737,122
Nonfederal Sponsored Revenue	\$706,847
Overhead Earned	\$588,480
Transfers	\$470,741
Gifts	\$56,000
Other Income	\$46,770
<b>Total</b>	<b>\$20,637,587</b>

**EXPENSES & NON-OPERATING FUNDS**



**Expenses**

Salaries & Fringe Benefits	\$8,660,237
Operating Expenses	\$4,333,639
Institutional Expenses	\$3,114,590
Space & Occupancy	\$2,863,280
Scholarships, Awards & Travel	\$1,046,091
Overhead Charged (Sponsored)	\$588,480
Capitalized Balances	\$29,605
Capital Projects	\$1,664
<b>Total</b>	<b>\$20,637,587</b>



# PERSONNEL

## Faculty-Curators

Andrew A. Biewener  
*Charles P. Lyman Professor of Biology;*  
*Director, Concord Field Station*

Scott V. Edwards  
*Professor of Organismic & Evolutionary*  
*Biology; Alexander Agassiz Professor of*  
*Zoology; Curator of Ornithology*

Brian D. Farrell  
*Professor of Biology; Curator of*  
*Entomology; Director, David Rockefeller*  
*Center for Latin American Studies*

Gonzalo Giribet  
*Professor of Organismic & Evolutionary*  
*Biology; Alexander Agassiz Professor of*  
*Zoology; Harvard College Professor;*  
*Curator of Invertebrate Zoology*

James Hanken  
*Professor of Biology; Alexander Agassiz*  
*Professor of Zoology; Curator of*  
*Herpetology; Director, MCZ*

Hopi E. Hoekstra  
*Professor of Organismic & Evolutionary*  
*Biology; Professor of Molecular &*  
*Cellular Biology; Alexander Agassiz*  
*Professor of Zoology; Curator of*  
*Mammalogy; Howard Hughes Medical*  
*Institute Investigator; Harvard College*  
*Professor*

George V. Lauder  
*Professor of Biology; Henry Bryant*  
*Bigelow Professor of Ichthyology; Curator*  
*of Ichthyology*

Jonathan B. Losos  
*Professor of Organismic & Evolutionary*  
*Biology; Monique & Philip Lehner*  
*Professor for the Study of Latin America;*  
*Curator of Herpetology*

James J. McCarthy  
*Professor of Biological Oceanography;*  
*Alexander Agassiz Professor of Biological*  
*Oceanography; Acting Curator of*  
*Malacology*

Naomi E. Pierce  
*Sidney A. & John H. Hessel Professor of*  
*Biology; Curator of Lepidoptera*

Stephanie E. Pierce  
*Assistant Professor of Organismic*  
*& Evolutionary Biology; Curator of*  
*Vertebrate Paleontology*

Mansi Srivastava  
*Assistant Professor of Organismic*  
*& Evolutionary Biology; Curator of*  
*Invertebrate Zoology*

Robert M. Woollacott  
*Professor of Biology; Curator of Marine*  
*Invertebrates*

## Emeritus Faculty

A.W. "Fuzz" Crompton  
*Faculty-Curator, Emeritus; Fisher*  
*Professor of Natural History, Emeritus*

Richard C. Lewontin  
*Professor of Biology, Emeritus; Alexander*  
*Agassiz Professor of Zoology, Emeritus*

Edward O. Wilson  
*Honorary Curator in Entomology;*  
*University Research Professor, Emeritus*

## Postdoctoral Fellows, Research Associates & Visiting Scholars

Simon Baeckens  
*Herpetology, Losos Lab*

Christopher Baker  
*Entomology, N. Pierce Lab*

Leandro Becker  
*Ornithology, Edwards Lab*

Ligia Benavides Silva  
*Invertebrate Zoology, Giribet Lab*

Dan Bock  
*Herpetology, Losos Lab*

Marcela Bolaños  
*Invertebrate Zoology, Srivastava Lab*

Michael Braby  
*Entomology, N. Pierce Lab*

Gustavo Bravo  
*Ornithology, Edwards Lab*

Jeremy Cohen  
*Mammalogy, Hoekstra Lab*

Jesus Alberto Cruz Lopez  
*Invertebrate Zoology, Giribet Lab*

Shahan Derkarabetian  
*Invertebrate Zoology, Giribet Lab*

Valentina Di Santo  
*Ichthyology, Lauder Lab*

Terry Dial  
*Ichthyology, Lauder Lab*

Colin Donihue  
*Herpetology, Losos Lab*

Claire Dufour  
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Jan Engelhardt  
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*Ichthyology, Lauder Lab*

Ariane Gouvea  
*Ornithology, Edwards Lab*

Aaron Hartmann  
*Hrdy Fellow, Giribet Lab*

Caroline Hu  
*Mammalogy, Hoekstra Lab*

Charlotte Jandér  
*Entomology, N. Pierce Lab*

Katrina Jones  
*Vertebrate Paleontology, S. Pierce Lab*

Robert Kambic  
*Vertebrate Paleontology, S. Pierce Lab*

Albert Kao  
*Entomology, N. Pierce Lab*

Andreas Kautt  
*Mammalogy, Hoekstra Lab*

Melissa Kemp  
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Jean-Marc Lassance  
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Fabio Laurindo da Silva  
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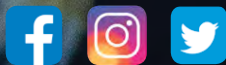




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