



MUSEUM *of*  
COMPARATIVE  
ZOOLOGY

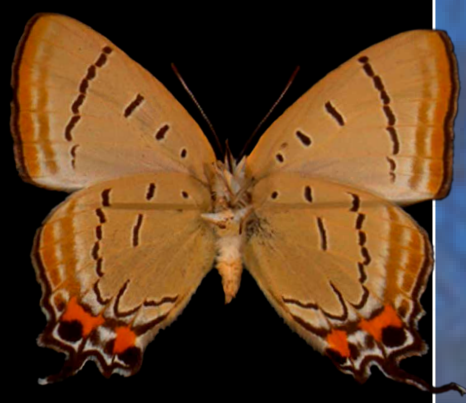


HARVARD UNIVERSITY



ANNUAL REPORT

2022 • 2023





## ABOUT THE MCZ

The Museum of Comparative Zoology at Harvard University is a global center for research and education focused on the biology 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 students and researchers around the globe.

## CONTENTS

Feature	2
Faculty-Curator Profiles	4
Emeritus Profiles	7
MCZ History	7
Courses Led by Faculty-Curators	8
Highlights of Faculty-Curator Grants	10
Research Making Headlines	12
Highlights from the Collections	14
Projects & Initiatives	17
Awards & Recognition	20
Grant Recipients	22
Publications in 2022	26
Financial Data	30
Personnel	31

# DIRECTOR'S MESSAGE

This has been another busy year at the MCZ. We filled numerous curatorial positions and our collections continued to grow through new field expeditions and large acquisitions, while departments hosted numerous visitors from all over the world.

We also learned that Mansi Srivastava was awarded tenure only a year after Stephanie Pierce. Mansi and Stephanie have actively collaborated to deliver new innovative zoology courses and expand the research profile of the MCZ in novel and exciting directions.

We have also welcomed a new member to our advisory board, the MCZ Faculty: Dr. Elizabeth Kane, who has a background in neurobiology and biotech and a deep interest in paleontology and biodiversity.

This year has been a fantastic one for our growing Biodiversity Fellows program. Major donations and pledges will allow us to double the number of two-year fellowships starting in 2024. At a time of biodiversity crisis, the ability to continue attracting and training modern museum researchers that can describe and document obscure biodiversity is a privilege that few institutions can maintain. On behalf of the entire MCZ, I would like to thank our benefactors, the late Edward O. Wilson, George Putnam III, Barbara Wu and Eric Larson, for supporting this unique program.

This year we have also seen important renovations in our collections and departments, including Herpetology and several satellite facilities for Mammalogy. We completed the renovation of bunker #1 at the Concord Field Station (see pages 2 and 7) and relocated a large number of skulls to the 5th floor of the MCZ building.

It is my hope that larger-scale renovations to our facilities will be

announced in the next year as we look forward to improving our common spaces and research facilities to make the MCZ a more interactive and collaborative space.

The MCZ has been especially thoughtful in determining how to disseminate and share its resources. Several Ernst Mayr Grant recipients have visited our collections to study type material from their countries of origin, a program we hope to expand in the future.

Museum specimens are most useful when shared with the broader community, so we are continuing digitization efforts with our amazing curatorial and data entry staff and database and biodiversity informatics team.

Thanks to their collective efforts, we have reached an incredible landmark in digitization, with over 2.3 million records now available in [MCZbase](#), most georeferenced, and over 325,000 records with a total of more than 500,000 media objects such as images and video. In the same way that collecting specimens is important to understand biodiversity, putting our dark data online is perhaps the most important task for future generations.

In my third year as director of the MCZ, I continue to learn more and more about our esteemed institution and its personnel. I hope that we can all continue to make the MCZ a rewarding place to work for all of us who love any and every aspect that animals and biodiversity bring to the world.



Melissa Aja

**Gonzalo Giribet**  
Director

### Cover & facing page:

A multispectral imaging system, developed by the Naomi Pierce lab at the MCZ, captures multispectral wavelength bands ranging from ultraviolet to near-infrared in a high-throughput manner.

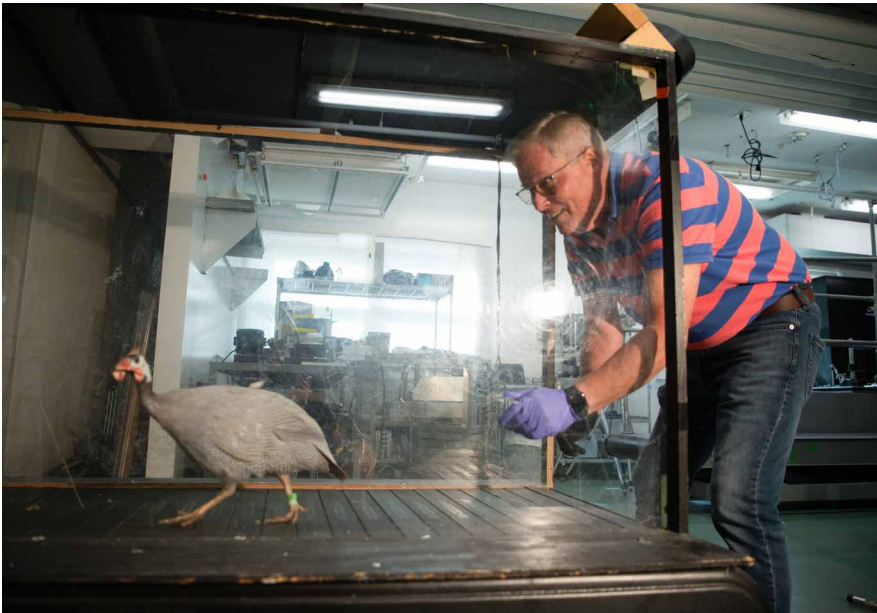
The butterfly images featured on the cover represent how butterflies appear in visible RGB bands, while the images displayed on the inside cover provide a summarized false-color view of multispectral bands after running a principal component analysis.

Photos by the Naomi Pierce lab



# DECODING THE BIOLOGY OF MOTION

Located 16 miles from Cambridge in Bedford, Massachusetts, the MCZ's **Concord Field Station** is a unique facility that is specially equipped to conduct comparative physiology and biomechanics research.



Dr. Andrew Biewener with a guinea hen on the treadmill. Photo by Melissa Aja

The station was established in the early 1960s and Dr. Charles P. Lyman, curator of Mammalogy, was acting director beginning in 1963. He was succeeded in 1969 by Dr. C. Richard Taylor, the first Faculty Director.

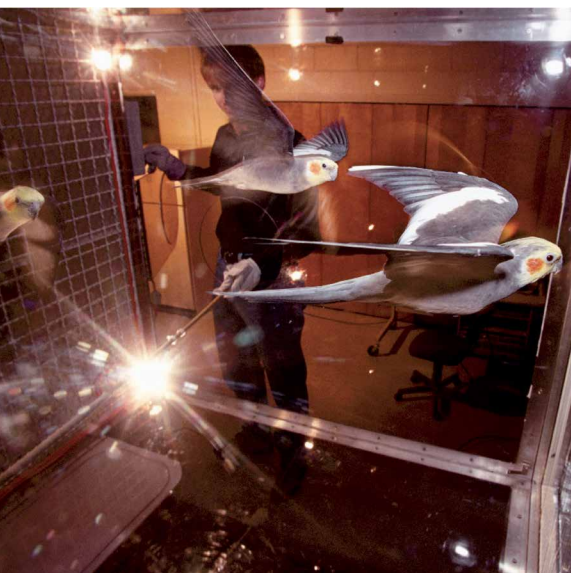
Taylor studied mammalian environmental physiology and locomotor energetics and, continuing a series of firsts, was the first to train animals to run on treadmills and, together with his students, built the first treadmill with an integrated plate that could record the forces exerted by an animal's limbs while it was running. Other early laboratory work at the station included insect development and animal behavior, while field studies investigated plant life history strategies; resource allocation in plant populations; warbler vocalizations; and the study of local wasp, fungi, beetle and dragonfly species.

Dr. Andrew Biewener was appointed in 1998 as the second Faculty Director. "Despite working in very different fields, I always considered Andy a close MCZ colleague," says Gonzalo Giribet. "Since becoming director of the MCZ, I have enjoyed visiting the CFS and spending a little bit more time with him and witnessing the incredible research facility he has run so well and for so long. I'm looking forward to seeing how this incredible facility continues to be home for truly exciting research."

Biewener studies the neuromuscular control and biomechanics of animal movement on land and in the air. He was initially attracted to Harvard for multiple reasons—the legacy of research at the Concord Field Station, its excellent animal care facilities and the space to study large animals—but also because he could build a large-scale wind tunnel to study animals in flight.

A blueprint for this type of wind tunnel did not exist at the time, so Biewener and postdoctoral researcher Bret Tobalske designed it themselves and found a firm that supplied mine ventilation systems to provide the fan and motor assembly. When construction was completed in 2000, it was the only wind tunnel of its size dedicated to the study of animal flight in the United States, and it is still in use today. "Even now, there are probably no more than a half-dozen labs dedicated to examining animal flight with experimental aerodynamics—caring for animals in adjacent facilities, training them to fly in a wind tunnel, and filming their flight with high-speed, 3D video," says Biewener.

When an animal flies against the wind in the tunnel, the balance of forces results in a stationary state relative to the tunnel that allows researchers to film their flight for analysis. Researchers have trained a number of species to fly in this way, including bats and a variety of perching birds like cockatiels,



Ty Hendrick flies cockatiels in the wind tunnel (circa 2001). Photo by Jim Harrison



turtle doves, peach-faced lovebirds and zebra finches. “Generally,” Biewener explains, “one needs birds that are fairly smart and potentially a little more aggressive than birds like pigeons, which are notoriously bad at flying in wind tunnels. They just can’t figure it out. Hummingbirds, however, hover and maneuver so naturally that they require no training at all.”

At 62 acres, the Concord Field Station is expansive. The main building consists of office space and two faculty laboratories—one for terrestrial locomotion studies and one for insect studies—with an adjoining animal care facility. The labs house three treadmills of various sizes, including the largest one with a force plate and an obstacle treadmill. The main building also has an electronics lab, a 3D-printing lab room and a surgical suite. Orthopedic studies have used the surgical suite to analyze the biomechanics of cartilage degeneration and hip loading/prosthesis design, using sheep as a model species. Indoor animal housing is supplemented with outdoor paddocks and animal shelters for a diverse range of insects and vertebrate species, including an emu that lived at the station for more than 20 years.

Biewener’s other major improvement to the station benefits not only research into animal movement, but also research in related fields. “Our videoradiography facility is where you can take high-speed X-ray movies of animals performing, whether they’re feeding or flying or running,” he says. The 2D films can then be combined to create 3D images for analysis of musculoskeletal movements.

Over the years, Biewener and his lab members have used these tools to identify general principles governing the biomechanical and physiological design of vertebrate neuro-musculoskeletal systems. “This involves studies of how limb structure and function relate to animal movement across body size, gaits and mode of travel,” he says, “as well as how these relate to underlying neuromuscular, tendon and skeletal function.”

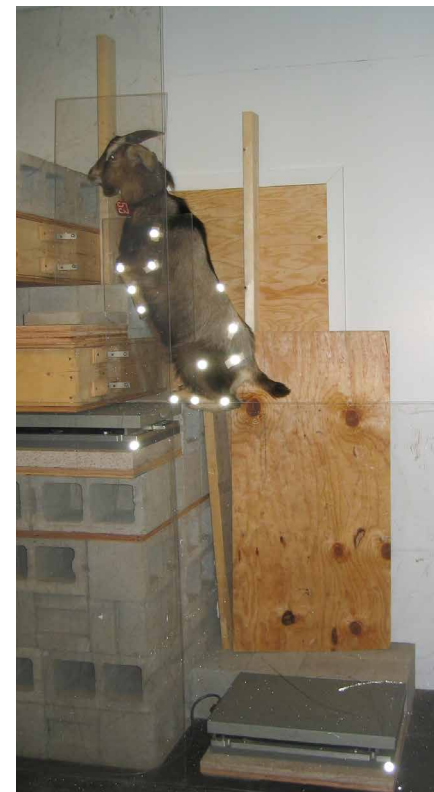


Dr. Andrew Biewener and his dog Lily at the wind tunnel. Photo by Melissa Aja

One of Biewener’s many memorable research efforts was a collaboration with MIT on the design of four-legged robots intended to climb and navigate rough terrain. This led to investigating how goats run so efficiently on rocky surfaces. The team even built a steep, 10-foot-high cinder-block hill with force plates to study the animals’ abilities as they scrambled to the top, which assisted with modifications that greatly improved the stability of the robot.

But in addition to using biology to build better robots, Biewener stresses that animal locomotion research is valuable in gaining insights that are relevant to human performance and health. “We make measurements of muscle performance in animals, doing basic science, but then apply it to human performance and improve the accuracy of muscle models used for rehabilitation, for example, like after a person has a stroke.”

As Biewener nears retirement in June 2024, the future of the station remains uncertain. “My absolute key hope is that my department will continue to support the MCZ and the need to hire a new Faculty Director of the lab. That will continue the legacy of the lab and allow for novel, exciting and, I think, valuable comparative physiology and biomechanics research.”



Pygmy goat on the climbing wall outfitted with force plates. Photo by Andrew Biewener



# FACULTY-CURATOR PROFILES



## Andrew A. Biewener

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

Prof. Biewener studies the biomechanics and neuromuscular control 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 movement in natural environments, work with engineers to develop bio-inspired robotic designs, and develop improved neuromuscular models for treating human movement disorders.

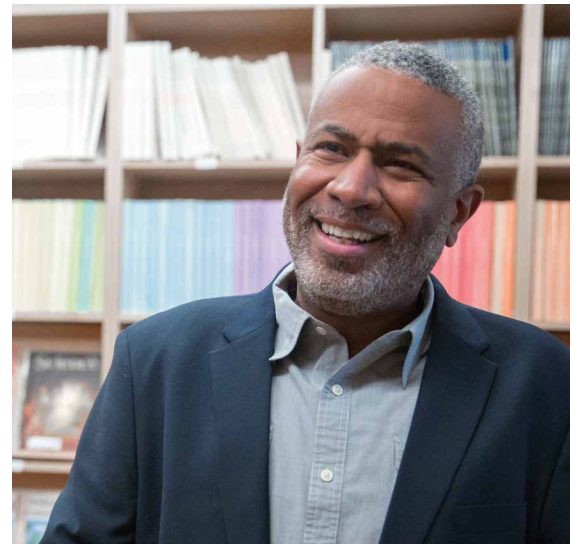


## Scott V. Edwards

*Professor of Organismic & Evolutionary 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 genomics technologies to study 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*. On July 1, 2022, Prof. Edwards assumed the Chair of the parent department of the MCZ, the Department of Organismic and Evolutionary Biology.



Kris Sribbe/Harvard University



## Brian D. Farrell

*Monique & Philip Lehner Professor for the Study of Latin America  
Professor of Organismic & Evolutionary Biology  
Curator of Entomology*

Prof. Farrell's research is broadly concerned with the evolution of ecological interactions between host plants and animals and their parasites, pests and pathogens, such as insects and other tiny consumers. His current projects include applying comparative genomics to speciation and phylogenetic studies of associated species of beetles and plants, documenting biodiversity in the Dominican Republic, and repatriating digital information from scientific specimens of insects and fossils in museums to their countries of origin.





Casey Dunn

**Gonzalo Giribet**

*Professor of Organismic & Evolutionary Biology  
Alexander Agassiz Professor of Zoology  
Curator of Invertebrate Zoology  
Acting Curator of Malacology  
MCZ Director*

Prof. Giribet's primary research focuses on the evolution, systematics and biogeography of invertebrate animals, including biodiversity discovery as well as genomics.

Current projects in the Giribet lab include a study to characterize the radiation of velvet worms in the Neotropics; exploring techniques to use degraded DNA from old museum specimens in phylogenomics and population genomics; and evolution of a diversity of arthropod lineages, including harvestmen and decapod crustaceans, as well as evolution of molluscs.



Kris Smitbbe/Harvard University

**Hopi E. Hoekstra**

*C.Y. Chan Professor of Arts & Sciences  
Professor of Organismic & Evolutionary Biology  
Professor of Molecular & Cellular Biology  
Alexander Agassiz Professor of Zoology  
Howard Hughes Medical Institute Investigator  
Curator of Mammalogy*

Prof. Hoekstra combines field and laboratory work to understand the evolution of mammalian diversity. Her research focuses on the genetic basis of morphological and behavioral variation, primarily in rodents, identifying both the evolutionary processes and the molecular mechanisms responsible for traits that help organisms survive and reproduce in the wild. Research in the Hoekstra lab integrates ecological, behavioral, genetic, developmental and neurobiological approaches.



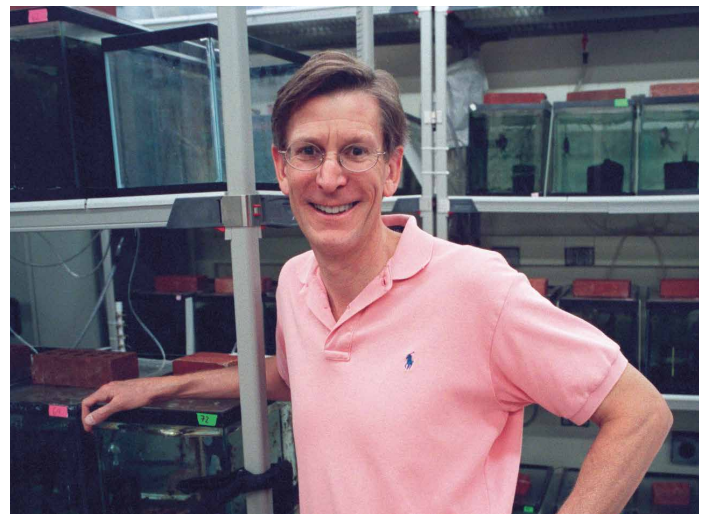
Catherine Weisel

**James Hanken**

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

Prof. Hanken utilizes laboratory-based analyses and field surveys to examine morphological evolution, developmental biology and systematics.

Current areas of research include the developmental basis of morphological novelty and life-history evolution, the systematics and evolution of Neotropical and Southeast Asian frogs and salamanders, and museum-based digital imaging technology.



Stephanie Mitchell

**George V. Lauder**

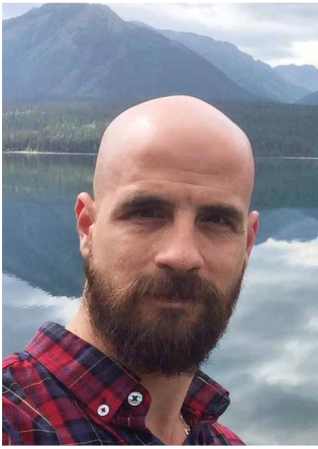
*Henry Bryant Bigelow Professor of Ichthyology  
Harvard College Professor  
Curator of Ichthyology*

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 structure and function of shark skin and other fish surface structures and research with various robotic fish models, including a tuna robot. Additional broad interests include biological fluid mechanics and theoretical approaches to the analysis of form and function in organisms.



## FACULTY-CURATOR PROFILES



### Javier Ortega-Hernández

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

Prof. Ortega-Hernández's research focuses on the evolution of metazoans that first appeared and rapidly diversified during the Paleozoic Era (ca. 538 to 251 million years ago).

His group specializes in

the study of exceptionally preserved Cambrian and Ordovician fossil biotas around the world, with a strong interest in the morphology, phylogeny and development of invertebrate animals, particularly panarthropods and their relatives. The lab combines traditional paleontology with cutting-edge techniques to investigate exceptional fossils, test macroevolutionary hypotheses through deep time, and better understand the origin of the major animal groups that have shaped the biosphere for more than 500 million years.



Paul Whatmough

### Stephanie E. Pierce

*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 focus on two key events in the fossil record, the fish-to-tetrapod and "reptile"-to-mammal transitions.



Isabella Kirkland

### Naomi E. Pierce

*Sidney A. & John H. 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.

### Mansi Srivastava

*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 an understudied phylum that is distantly related to other well-studied regenerative species, which allows her group to study genetic mechanisms from a comparative perspective. 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 evolution of centralized nervous systems.



Melissa Aja



# EMERITUS PROFILES

Justin Ide

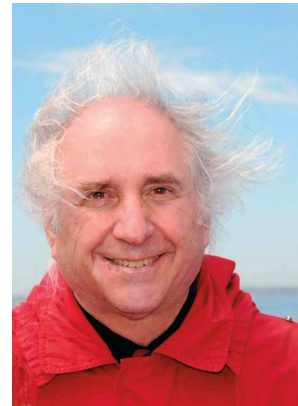


## A. W. "Fuzz" Crompton

*Fisher Professor of Natural History, Emeritus*

Prof. Crompton, former curator in 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.



## Robert M. Woollacott

*Professor of Biology, Emeritus  
Former Curator of Marine Invertebrates*

Prof. Woollacott joined the faculty in 1972 and retired in 2018. During his tenure at

Harvard, he served as the first Chair of the Department of Organismic and Evolutionary Biology. His teaching and research focus on the reproduction of marine invertebrates and human impacts on life in the sea.

## MCZ History

The Concord Field Station houses cockatiels, lovebirds and parrots for flight studies, but in its earlier iteration it housed another group of fliers: Nike surface-to-air missiles. The Nike missile program was active during the first decade of the Cold War to defend industrial centers from aerial attack, and the site that is now the CFS was originally part of that program. In the early 1950s, the US government obtained, via eminent domain, 62 acres in Bedford, Massachusetts, from the Pickman family in order to build a military facility with underground missile bunkers. If deployed, missiles would be hoisted through massive metal doors and taken to the launchpad. The Nike program became obsolete when the US and Russia shifted their military strategy to intercontinental ballistic missiles (ICBMs), so the installation was decommissioned in the early 1960s and returned to the Pickmans.

At that time, MCZ Director Ernst Mayr and Mammalogy Curator Charles P. Lyman were in search of a site for a field research station adjacent to Harvard's 650 acres in the Estabrook Woods located in Concord, Massachusetts—the subject of many of Henry David Thoreau's journal entries and essays—and they purchased the abandoned military facility with the help of a Nature Conservancy grant. The barracks were turned into offices and lab space for research, and in 1970, a new lab facility was built over the first bunker and the bunkers were renovated to provide below-ground space to grow plants and keep insects and lizards. At around 80 feet long and 40 feet deep the bunkers can accommodate exceptionally large specimens, so in the mid-1980s the MCZ Mammalogy Department moved the skulls and skeletons of whales, dolphins and porpoises from their growing cetacean collection to bunker #1. Bunker #2 is used for specimen preparation and houses the dermestid beetle colony that cleans flesh from skeletons, and bunker #3 stores plaster-encased vertebrate paleontology specimens, corals and ocean sediment cores. More recently, bunker #1 has undergone significant updates to improve lighting, storage and humidity control for the cetacean specimens.



Melissa Aja

Bunker #1 after recent renovations



# COURSES LED BY FACULTY-CURATORS

Academic Year 2022–2023



OEB 167: Herpetology

## Organismic & Evolutionary Biology

### OEB 10: Foundations of Biological Diversity

*Brian D. Farrell, Mansi Srivastava (and Mark Cornwall, N. Michele Holbrook, Anne Pearson)*

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, including the development, adult anatomy, biology and evolutionary relationships of the main animal phyla including sponges, molluscs, annelids and arthropods, among others.

### OEB 56: The History and Evolution of Life on Earth

*Javier Ortega-Hernández*

Investigation of the ways that Earth and life interact, focusing on the biogeochemical cycles of major elements, providing a framework for interpreting the history of life reconstructed from fossils and phylogeny.

### OEB 57: Animal Behavior

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

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, Mansi Srivastava*

Explores the wonders of animal biology through the study of form and function and embryonic development. By introducing a number of scientific areas, including comparative anatomy, functional morphology, phylogenetics, genomics and experimental embryology, this course provides a basic understanding of animal evolution and development and how these processes combine to shape the diversity of life on Earth.

### OEB 130: Biology of Fishes

*George V. Lauder*

The study of the unparalleled diversity of fish species and habitats they occupy, emphasizing bridging traditional academic boundaries with integrative analyses of the biology underlying rapid evolutionary radiations and stasis.



Serena Wurmser

OEB 56: The History and Evolution of Life on Earth



**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 275R: Comparative Genomics: Phylogenetic Approaches to Linking Genomes and Phenotypes***Scott V. Edwards*

A review of recent literature on methods of analysis in phylogenomics and phylogeography, with particular attention to analysis of large-scale data sets; accommodating gene tree heterogeneity; adequacy of models at the level of DNA sequence evolution and demographic history; and estimation of critical parameters of population history, such as phylogenetic relationships, reticulate evolutionary histories, rates of gene flow and species boundaries.

**Freshman Seminar****FRSEMR 21R: The Evolutionary Transition from Dinosaurs to Birds: Fossils, Genomes and Behavior***Scott V. Edwards*

Explores the transition of dinosaurs to modern birds, an excellent model for how science builds on incremental discoveries and undergoes paradigm shifts as new data are collected. Examines dinosaurian origins of modern birds through exploration of Harvard's excellent collections of dinosaur fossils, skeletons and specimens of extant birds, and focused readings and discussions.

**Life Sciences****LIFESCI 2: Evolutionary Human Physiology and Anatomy***Andrew A. Biewener, George V. Lauder (and Daniel E. Lieberman, Joanne Clark Matott)*

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



OEB 51: Biology and Evolution of Invertebrate Animals

**Graduate Courses of Reading & Research****OEB 306: Invertebrate Paleobiology and Evolution***Javier Ortega-Hernández***OEB 310: Metazoan Systematics***Gonzalo Giribet***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 334: Behavioral Ecology***Naomi E. Pierce***OEB 341: Coevolution***Brian D. Farrell***OEB 355: Evolutionary Developmental Biology***James Hanken***OEB 362: Research in Molecular Evolution***Scott V. Edwards***OEB 370: Mammalian Evolutionary Genetics***Hopi E. Hoekstra***OEB 399: Topics in Organismic and Evolutionary Biology***George V. Lauder*

Meaghan Sorce

OEB 130: Biology of Fishes



# HIGHLIGHTS OF FACULTY-CURATOR GRANTS

In addition to their teaching responsibilities, curatorial duties and research efforts, MCZ faculty-curators obtain grants for and lead long-range, often multi-institutional research projects.



*Diemenipatus taiti*. Photo by Gonzalo Giribet

“Faculty-Curator grants constitute the basis for a large component of the research happening in the MCZ,” says Director Giribet. “They showcase the cutting-edge nature of the work undertaken by our faculty-curators and their students and postdocs. The competitive grants highlighted here are examples of such diverse research on evolution, biogeography, paleobiology and biologically inspired design.”

**Gonzalo Giribet** is the Principal Investigator for *Collaborative Research: PurSUI: Understanding the Neotropical Velvet Worms (Onychophora, Peripatidae, Neoplatida), a Cretaceous Radiation of Terrestrial Panarthropods*, a three-year \$809,585 research grant from the National Science Foundation. Velvet worms (Onychophora) are ancient terrestrial invertebrates whose body structures have remained largely unchanged over their 300-million-year history, and because they are rare and mainly inhabit remote forests, they are relatively poorly studied. These “living fossils” are an ideal model to investigate how animals successfully colonize different environments and locations over long periods of geological time in the absence of any significant morphological change.

The research focuses on the least-understood group of velvet worms, the Neotropical Peripatidae. The researchers will document and describe all newly discovered species, assess their conservation status, and analyze the evolutionary processes affecting species diversity and distribution through geological time. The resulting evolutionary groupings will be used to test hypotheses related to Caribbean biogeography, including specific radiations in Jamaica and Puerto Rico and the colonization of the Lesser Antilles.

The research team and several trainees will combine cutting-edge molecular approaches with modern anatomical methods to advance our knowledge of the diversity and evolutionary history of this understudied group. All specimens and genetic products of the study taxa will be deposited in the MCZ and all specimen data, including images, videos and genomic data, will be linked to publicly available specimen records through our centralized database, MCZbase. Outreach will include developing a 100-square-foot exhibit for the Harvard Museum of Natural History to explore the biodiversity, biogeography, ecology and evolution of velvet worms. The exhibit will also provide the opportunity for associated public programs, including lectures and K–12 activities.

**Javier Ortega-Hernández** is the Principal Investigator for *Reconstructing Water-to-Land Transitions in Arthropod Evolution Combining Atoms, Genes and Fossils*, a \$380,000 (\$1.1M collaboration) three-year research grant from the Human Frontier Science Program. The objective of this research is to investigate the early evolution of air breathing among arthropods, animals with jointed legs whose living representatives include arachnids, millipedes, crustaceans and insects. Arthropods represent ideal case studies because, as informed by the fossil record, they are among the first animals that evolved to breathe air and have well-developed structures for oxygen exchange such as external and internal gills.

The transition from breathing underwater to breathing air represents one of the most important steps in animal evolution by allowing these animals to first explore dry land approximately 420 million years ago. However, the precise mechanisms responsible for the water-to-air transition of breathing and oxygen consumption remain largely unknown due to the complexity of this drastic



Underside of Atlantic horseshoe crab (*Limulus polyphemus*) showing fresh book gills used for respiration. Photo by Pauline Affatato



change in early animals. To better understand how animals acquired the capacity to consume oxygen from breathing air, the researchers will explore this question from three interdisciplinary approaches: exploring how the respiratory pigments of arthropods (hemocyanins) have evolved through time and investigating whether the oxygen-transporting function in different respiratory structures is due to similar or different genes; studying how respiratory structures have changed over millions of years by using the excellent fossil record of arthropods; and developing and using micro- and macroscopic physicochemical approaches to investigate hemocyanin reactivity and respiratory flux features for different respiratory architectures.

**George V. Lauder** is the Principal Investigator for *Revealing the Hydrodynamic Principles of Three-Dimensional Fish Schools: From Biology to Schooling Robotics*, a three-year \$742,500 research grant from the Office of Naval Research. The overall goals are to understand the motion and hydrodynamics of fish schooling behavior and to collaborate with other grant team members to implement schooling behavior in groups of fish-like robots.

The Lauder lab will conduct the research project's experiments using high-speed video to image schooling fish in the lab's recirculating flow tanks. In behavioral experiments, lab members will study the motion of fish swimming in schools of up to 20 individual fish over a variety of speeds by measuring the pattern of body and fin bending as fish swim at increasing speeds. The resulting measurements will be studied to assess the hydrodynamic flow patterns within fish schools. The experiments will image water flow patterns and analyze wake flow patterns to test hypotheses about how fish schools function as hydrodynamic entities. Additional behavioral experiments will examine fish schooling in the dark by filming with IR light, which is invisible to fish, to determine the effect of visual input on school structure.

Collaborative experiments on the swimming and schooling behavior of robotic models of fish will be conducted in conjunction with the laboratories of Profs. Hilary Bart-Smith

of the University of Virginia, Radhika Nagpal of Harvard University, and Keith Moored of Lehigh University. These experiments will involve high-speed video studies of fin motion and analysis of the hydrodynamic flows generated by movement of the fins and bodies of robotic fish.

**Stephanie E. Pierce** is the Principal Investigator for GEO-NERC Collaborative Research: *The First Actinopterygian "Adaptive Radiation": Integrating Fossils, Function and Phylogeny to Illuminate Innovation in a Post-Extinction World*, a three-year \$299,883 (\$820,000 collaborative) research grant from the National Science Foundation.

Ancient mass extinctions resulted in the loss of many species, but also provided new opportunities for surviving groups. Study of these events is central to understanding the origin of today's biological diversity as well as placing the threats from environmental change in context. This work focuses on a major interval of crisis and recovery, the Devonian/Carboniferous extinction, that took place around 360 million years ago. The research will determine the impact of this extinction event on the early history of actinopterygians—ray-finned fishes—key components of today's aquatic ecosystems and a major commercial resource.

The research will examine the role of the Devonian/Carboniferous extinction in precipitating an apparent explosion of diversity among ray-finned fishes, setting the stage for the group's dominance throughout the remainder of the Phanerozoic. The project will study Devonian and Carboniferous ray-finned fishes by combining microCT, functional anatomy, 3D morphometrics, combined-evidence phylogenetic inference and evolutionary comparative methods. The project will provide training at high school through postgraduate levels and develop educational materials for wide audiences, including those underrepresented in STEM fields. Outreach includes a module for high-school students at the University of Michigan, programs at three museums including the MCZ and resources for use in local communities.



Hydrodynamic flow patterns using particle image velocimetry. Photo courtesy of the Lauder lab



Ray-finned fish fossil (*Palaeoneiros clackorum*). Photo courtesy of Stephanie E. Pierce



# RESEARCH MAKING HEADLINES

## Back to the Future



Ecosystem reconstruction by Henry Sharpe

Our current human-generated planetary warming is not the first time that increased temperatures have drastically affected life on Earth. A series of climactic crises between the Permian and Triassic periods—caused in part by greenhouse-induced global warming from enormous volcanic eruptions—spanned nearly 60 million years and eliminated between 70% and 86% of all species worldwide in two mass extinction events. To investigate how such rapid environmental shifts impacted the evolution of terrestrial vertebrates in deep time, and possibly inform the future of biodiversity in our own time, **Tiago R. Simões, Stephanie E. Pierce** and colleagues turned to more than 50 fossil reptile collections worldwide.

Reptiles were relatively rare during most of the Permian compared to mammalian ancestors (early synapsids), but after most early synapsids were wiped out during the end-Permian mass extinction 252 million years ago, reptiles became incredibly diverse in number of species and body plans during the Triassic. But the researchers found that the extinction of early synapsids was not the only evolutionary

driver for the radiation of reptiles as previously thought—the process actually began at least 20 million years earlier with the onset of massive global temperature changes.

Using a vast morphological dataset generated through direct fossil analysis by the research team and newly developed techniques to study evolution across deep time, they found that periods of fast climate shifts and global warming correlated to exceptionally high rates of reptile evolution. In response to higher temperatures many reptiles evolved new body plans, while others migrated to temperate regions or became aquatic. However, early lepidosaurs—precursors of modern-day lizards, snakes and tuatara—did not undergo rapid evolution during this time. Their smaller bodies enabled easier heat exchange with the surrounding environment, so they underwent stabilizing selection during a critical period when others had to adapt incredibly fast.

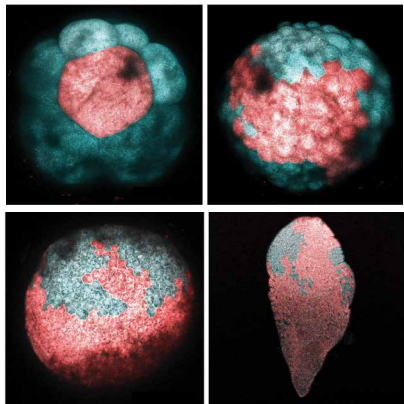
Simões TR, Kammerer CF, Caldwell MW, Pierce SE (2022) Successive climate crises in the deep past drove the early evolution and radiation of reptiles. *Sci Adv* 8:eabq1898 DOI:10.1126/sciadv.abq1898

## Embryonic Origins

The three-banded panther worm, *Hofstenia miamia*, is a stellar regenerator. A worm can be divided into many parts, and each of these parts will regenerate every type of missing tissue to again become a complete animal. This process is made possible by adult pluripotent stem cells that are found in many species, but how these cells are made is not known in any species. *Hofstenia miamia* was developed as a model system by **Mansi Srivastava** in order to study whole-body regeneration. With **Lorenzo Ricci**, she created a toolkit to study *H. miamia* by introducing fluorescent substances into cells to track their development, a process called transgenesis. In *Cell*, lead author **Julian Kimura**, along with Ricci, Srivastava and **Marcela Bolaños**, describe the methodical undertaking of tracing adult pluripotent stem cells (aPSCs) back to their embryonic origins. Ricci used transgenesis to create a line of *H. miamia* that caused embryonic cells to glow fluorescent

green, and when hit with a laser in a specific wavelength, a single cell can be turned red. For a group of embryos at the eight-cell stage, Kimura systematically converted one cell in each position to a red color and followed their development, suspecting that a particular pair of cells at the sixteen-cell stage became aPSCs called neoblasts. As those cells divided further they kept their red color, allowing the researchers to verify that only those cells made new tissue during regeneration, and single-cell sequencing technology identified which genes were being expressed in the cells that became stem cells. Knowing the molecular regulators of aPSCs will allow researchers to compare these mechanisms across species and understand how nature evolved a way to make and maintain pluripotent stem cells.

Kimura JO, Bolaños DM, Ricci L, Srivastava M (2022) Embryonic origins of adult pluripotent stem cells. *Cell* 185: 4756–4769 DOI:10.1016/j.cell.2022.11.008



*Hofstenia miamia* embryos



## Out of the Dark

In light of increasing commercial interest in the deep sea, researchers are braving the significant challenges of deep-sea exploration—both technical and financial—and utilizing museum and university collections in the race to document deep-sea diversity. Squat lobsters in the family Munidopsidae are such deep-sea dwellers, living in a cold, dark habitat miles deep. With 272 described species and more being found in the past few years, there are likely many more to be discovered.

Because of the difficulties exploring the deep sea, there are relatively few specimens of Munidopsidae in collections around the world. In joint research conducted by the MCZ and UC San Diego's Scripps Institution of Oceanography, **Paula Rodríguez-Flores**, **Gonzalo Giribet** and colleagues turned to the collections of the MCZ, Scripps and the Smithsonian to examine recently collected specimens from the East Pacific, ultimately discovering and describing five new species.

## Super Supper Sensors

Cephalopods, including octopus, squid and cuttlefish, have large distributed nervous systems that enable sophisticated sensing along their flexible arms, in turn facilitating some of the most sophisticated behaviors in invertebrates. Researchers from Harvard, including **Wendy Valencia-Montoya**, and structural biologists from the University of Texas at Austin decided to investigate the chemotactile (touch-by-taste) receptors in cephalopod arms—which turned out to be related to acetylcholine receptors similar to human brain and muscle neurotransmitter receptors—to gain insight into how these capabilities evolved and diverged among squid and octopuses, and how those differences drive their respective predation behavior.

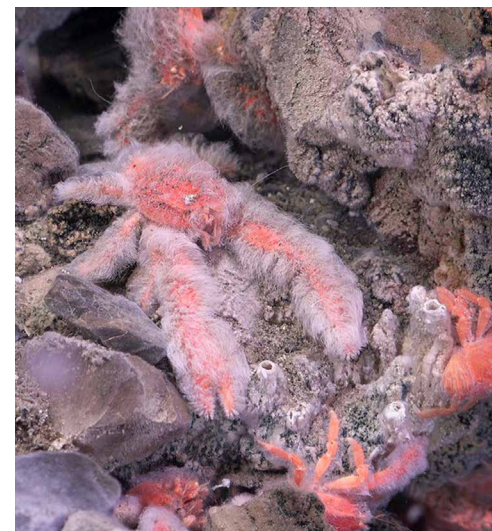
Octopuses rummage around the seafloor for food, and the chemical receptors in the suckers of their arms are activated by a diverse repertoire of chemical stimuli. The team found that these chemical receptors operate in a similar manner to smell or taste in other animals, helping the

Like many other deep-sea dwellers, four of the new species have a white appearance and limited vision. The fifth is a surprisingly pink fuzzy squat lobster found off the coast of California, which was christened *Munidopsis girguisi* in honor of Harvard Prof. Peter Girguis, who helped collect it. When morphological and genetic analyses were performed on the East Pacific species, the researchers confirmed that *Munidopsis* do not share a common ancestor and found that they have wider geographic ranges than other families. They also determined that an additional species should be included in Munidopsidae while others should be excluded, and recommended that the current taxonomic classification be revised to reflect evolutionary history.

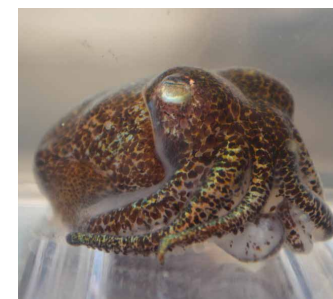
Rodríguez-Flores PC, Seid CA, Rouse GW, Giribet G (2023) Cosmopolitan abyssal lineages? A systematic study of East Pacific deep-sea squat lobsters (Decapoda: Galatheoidea: Munidopsidae). *Invertebr Syst* 37:14–60 DOI:10.1071/IS22030

octopus determine what is acceptable or toxic to eat by sensing poorly soluble molecules such as terpenes, naturally occurring molecules produced by plants, fungi and bacteria. Squid, on the other hand, find their food visually and use anatomical adaptations like barbs in their suckers to capture their prey in a stealth strike. While less numerous than in octopuses, the team found that squid also have sensory cells in their suckers that they use to evaluate the suitability of the prey once it is captured. By employing cryo-electron microscopy, the researchers generated 3D structures of two members of this novel family of sensory receptors, thus placing structural innovations of chemotactile and ancestral neurotransmitter receptors in both squid and octopus on an evolutionary timeline to illuminate how these evolutionary adaptations drove the development of diverse new behaviors, such as their predation strategies.

Kang G, Allard CAH, Valencia-Montoya WA, van Giesen L, Kim JJ, Kilian PB, Bai X, Bellono NW, Hibbs RE (2023) Sensory specializations drive octopus and squid behaviour. *Nature* 616:378–383 DOI:10.1038/s41586-023-05808-z



*Munidopsis girguisi*. Photo by ROV SuBastian, Schmidt Ocean Institute



Top, *Euprymna berryi*; bottom, *Octopus bimaculoides*

Anik Grearson (2)



# HIGHLIGHTS FROM THE COLLECTIONS

## What's in a Name?



Top, *Heligmaster pele*; bottom, *Moridilla maldivensis*

Every year taxonomists describe new extant and extinct species. This year nearly 50 new species were described using specimens from different MCZ departments:

- Entomology: 25 water beetles in the genus *Hydraena* and an army ant in amber (*Dissimulodorylus perseus*)
- Malacology: seven new molluscs, including a pen shell (*Pinna evexa*) and six new species of sea slugs and snails
- Invertebrate Zoology: eight new species, including echinoderms, harvestmen, spiders and deep-sea squat lobsters
- Ichthyology: a new species of hagfish (*Eptatretus fudgei*)
- Herpetology: five snake species and a tetraploid parthenogenetic lizard (*Aspidoscelis townsendae*)
- Vertebrate Paleontology: a new species of late Devonian ray-finned fish (*Palaeoneiros clackorum*)

Holotype and paratype specimens are notable because they are the actual individuals used to formally describe a species, making them the most important specimens within natural history collections. The research to formally describe these new species was completed by Harvard researchers—including MCZ faculty-curators, graduate students, postdoctoral fellows and research associates—as well as researchers at other scientific institutions. Some of the specimens were collected by the researchers during fieldwork, while others were taken from the shelves of the MCZ after having been collected decades earlier by different researchers.

Some of the new species names are descriptive in nature or are dedicated to important researchers in the field, such as the hagfish *Eptatretus fudgei* named for Professor Douglas S. Fudge. Others are named in honor of benefactors, like *Eubranchius putnami* in tribute to George Putnam Jr. One new species—christened *Archaeopurcellia eureka*—celebrates the joy that comes when a newly identified species fills a distributional gap that has puzzled researchers for many years.

## Significant Salvage

In March 2023, Boston University donated hundreds of bat specimens from the collection of the late Tom Kunz, a premiere bat researcher from that institution. Kunz was a scientist, educator, ecologist, physiologist and conservation biologist, and many of the current bat researchers across the country started in his lab. Between 2005 and 2006, Kunz worked with Department of Health facilities across the country to salvage the bats they received that tested negative for disease. As the Kunz lab was closing, Kunz's former student Chris Richardson contacted **Mark Omura**, curatorial associate in Mammalogy, to see if the MCZ would be interested in taking the collection.

The Mammalogy collection has 14,300 bats from across the globe and 2,500 from the United States, and the Kunz collection makes an important contribution to the MCZ's bat holdings. "The specimens were collected from a wide geographic area of the US and many bat species are represented," explains

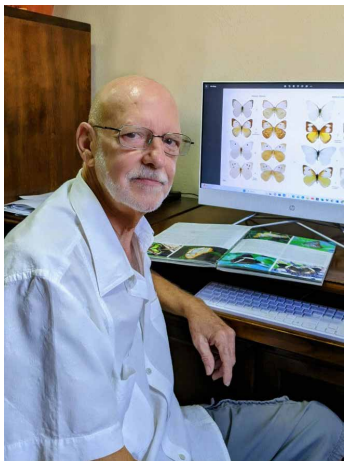
Omura. "The acquisition almost certainly fills gaps in species from the Western US and temporally supplements species in the Eastern US. Additionally, we will be able to provide fresh tissue samples from these bats to researchers." The timing of the specimen collection is also significant because white-nosed syndrome led to a massive crash in US cave bat populations in 2006, resulting in the death of up to 90% of bats in a colony. "This collection is an amazing sample of many bat species across a wide geographic area just before the arrival of white-nosed syndrome," says Omura.



*Myotis septentrionalis*. Photo by Mark Omura



## From Puerto Rico to Cambridge



Antonio Pérez-Asso

The MCZ's Entomology collection acquired 4,394 butterflies and 8,547 other insect specimens from Antonio Pérez-Asso in Puerto Rico. "Mr. Pérez-Asso is a prolific insect collector and author of *The Butterflies of Puerto Rico* (with Julio A. Genaro and Orlando H. Garrido) and *The Butterflies of Hispaniola* (with Julio A. Genaro and Ruth H. Bastardo), and his collection includes many type specimens, unique representatives of uncommon species, and vouchers from Pérez-Asso's work on speciation in butterflies," says **Crystal Maier**, curatorial associate in Entomology.

Pérez-Asso began collecting butterflies in 2002, inspired by the beauty and diversity of this insect group in the West Indies. "Most of the specimens from the collections have been the basis for our publications," he explains, "and in a very short period, the collection has been an invaluable asset for other published scientific works. I am proud that the collection is finally located at the MCZ and at the disposal of the scientific community who are interested in Antillean butterflies."



The MCZ Lepidoptera collection is worldwide in scope and consists of several hundred thousand specimens almost equally divided between butterflies and moths. Thanks to the efforts of **Naomi E. Pierce**, curator in Entomology, the butterfly collection is entirely photographed and in MCZbase, allowing remote access to the wealth of historical and biological data contained in it. In the coming years, there are plans to digitize the entire Pérez-Asso butterfly collection, as well. The beetle and other insect collections from Pérez-Asso bolster the MCZ's already strong Caribbean collections, especially material collected by Curator **Philip J. Darlington** in the first half of the 20th century and material collected by Faculty-Curator **Brian D. Farrell** in the Dominican Republic, and includes beetles identified by Cuban coleopterist Orlando H. Garrido.

## Denizens of the Deep

The Exploration Vessel *Nautilus* has added nearly 5,000 specimen lots to the MCZ Departments of Ichthyology, Invertebrate Zoology and Malacology since 2013. Biological specimens are collected via remotely operated vehicles (ROVs), and remain aboard ship preserved in ethanol, frozen or dry until they are sent to the MCZ. "Specimens collected by the E/V *Nautilus* augment our existing collections quite well," says **Adam Baldinger**, curatorial associate in Invertebrate Zoology. "Many of the specimens we receive are either not previously represented in our collections or represent a new locality for which a given species is found." Scientists use E/V *Nautilus* specimens housed in the MCZ and their records in MCZbase for research and as vouchers for new species.

In 2022, Christopher Mah described several new species of sea stars including *Heligmaster pele* (facing page), which represents a new genus. In 2023, several new squat lobster species were described and one species, *Munidopsis nautilus*, was named in honor of the E/V *Nautilus*. Postdoctoral researcher **Paula Rodríguez-Flores** was a scientist on that 2023 expedition and research assistant **Giuliana Fillion** was one of the technicians that processed the specimens once they were aboard ship.

Notable E/V *Nautilus* specimens in Invertebrate Zoology include a sea pen in the genus *Solumbellula* collected in 2022—the first record of it in the Pacific Ocean and only specimen in the MCZ—and in 2016, Malacology received

the mysterious and newsworthy "purple orb" (an undescribed species of velutinid snail) discovered 5,300 feet deep off the coast of California. "Nearly all of the invertebrate and mollusc specimens received from E/V *Nautilus* complement existing projects in the MCZ," says **Jennifer Trimble**, curatorial associate in Malacology, "including the NSF-funded grant *Documenting Marine Biodiversity through Digitization of Invertebrate Collections (DigIn)*."



Michelle Tang (2)



*Walteria* sp. At left:  
*Chrysogorgia* sp.

## COLLECTIONS

### Staff Highlight

**Stevie Kennedy-Gold** has been the curatorial associate in Herpetology since July 2022. “The MCZ is a pioneer in the museum field, the gold-star standard,” she says. “It’s a remarkable honor to be able to say that I manage one of the best herpetology collections in the world.” The MCZ’s collection contains approximately 350,000 specimen records, but because a single lot can contain many specimens, she estimates that it is closer to a half-million individual preserved amphibians and reptiles. On tours, one of her favorite specimens to share is a tortoise shell from the Galapagos with the collection date of 1835 carved into the shell. “People’s jaws drop to the ground. It’s like looking at a piece of history.”

In addition to her curatorial experience, her research has focused on the ecology of reptiles and the effects of introduced or invasive species on native communities. Because she did her masters on anoles at the University of Hawai’i at Mānoa and studied invasive anoles in Southern California, she was also drawn to the strong legacy of anole research at the Museum. “MCZ curators have been pillars of anole work. Walking down the aisles of the collection and seeing those names is awe-inspiring, and Jim Hanken is right up there with his work on amphibians.”

Besides her work with anoles, she also interned with University of Florida’s “Croc Docs,” cruising around the Everglades in an airboat and trapping and removing invasive black-and-white tegus, Burmese pythons and Nile monitors in what she says is some of the craziest fieldwork she’s ever done. “We were looking for alligators by shining lights in pitch-black night, just looking for glowing red eyes in the water. It was the most creepy but beautiful thing ever.”



Melissa Aja

### Ornithological Standouts



Jeremiah Trimble

When determining stories to include in a publication, editors often consider the quality of the visuals as well as the content. Two pieces about the MCZ Ornithology collection delivered on both counts, offering compelling stories with stunning photos. For “[What Birds’ Nests Tell Us](#)” in *Harvard Magazine*, John S. Rosenberg joined **Jeremiah Trimble**, curatorial associate in Ornithology, to tour the collection of nests and eggs—estimated to number about 40,000—in their storage space beneath the courtyard that connects the MCZ with the Northwest Building. Many of the items were amassed by William Brewster and John Thayer in the late 19th or early 20th centuries and are still used in research today.

In *The Harvard Crimson* story “[Bird Brilliance](#),” Ben Y. Cammarata visited the Ornithology collection, which was founded in 1859 and has grown to become the fifth-largest ornithological collection in the world with around 400,000 items from 8,300 species. “The specimens are used in all kinds of ways,” says Trimble. “They’re used



Ben Y. Cammarata

in anything from artists creating field guides to taking feather samples to look at isotopes to understand diet or environmental contaminants.” Cammarata focuses on visually dramatic species, sharing images of the minuscule Bee Hummingbird (*Mellisuga helenae*), the distinctive horn of the Rhinoceros Hornbill (*Buceros rhinoceros*, at left) and the spectacular plumage of the Vulturine Guinea fowl (*Acryllium vulturinum*). The showy tail feathers of the King Bird-of-Paradise (*Cicinnurus regius*) and Wilson’s Bird-of-Paradise (*Diphyllodes respublica*, above right) make a notable appearance, along with one of the few remaining specimens of the extinct Black Mamo (*Drepanis funerea*).



Ben Y. Cammarata



# PROJECTS & INITIATIVES

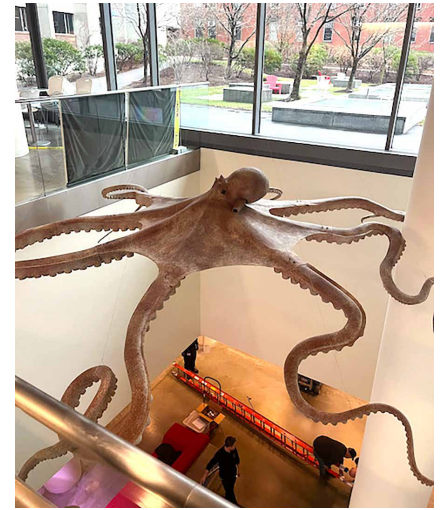
## A Giant Restoration

After almost 140 years, the MCZ's giant octopus model has received a long-overdue makeover. Constructed around 1883 at Yale University by scientific illustrator James H. Emerton under the direction of zoologist and Harvard alumnus Addison E. Verrill, the life-sized model reaches 14 feet across (and with arms fully extended would be 22 feet), has glass eyes and eight-foot arms, one of which is a hectocotylus, a modified arm used in reproduction, indicating that it is male. According to **Breda Zimkus**, director of Collections Operations, the species is found in the Pacific Ocean from Asia to North America.



The 70-pound model, made from papier-mâché, rubber and other 19th-century materials, was originally displayed at the Harvard Museum of Natural History and was later a central feature of the Living Invertebrates Hall that opened in 1974. At the time of its restoration the model had been out of public view, hanging from an HMNH classroom ceiling and deteriorating.

Terry Chase, a designer and builder of natural history exhibits, used original materials in the repair to maintain the model's historical accuracy. From its new position in an open stairwell of the Northwest Labs building, the model can be viewed from multiple angles and even from outside the building. "We are excited that the public, including many Harvard students that come to the building for classes, will be able to appreciate the giant octopus in its new home," says Zimkus.



Kris Snibbe/Harvard University

Breda Zimkus (2)

## Marine Science Day

On December 15, 2022, students from a marine biology class at Cambridge Rindge and Latin School, led by their teacher Paul McGuiness, visited Harvard to participate in Marine Science Day. The 60 high school juniors and seniors were treated to a full day of talks and visits to the labs at the MCZ, departments of Organismic and Evolutionary Biology and Molecular and Cellular Biology, with a networking luncheon where students could chat with the researchers and staff. The program was run by **Julius Tabin**, graduate outreach coordinator, and **Jean Dao**, manager of high school programming and professional development. Tabin became involved in the effort as a new member of the OEB's Diversity, Inclusion & Belonging Committee. "The purpose of this day was to show the students some really cool science and get them excited about potentially having a career in science," he says, "and build these networking connections that students might not otherwise have."

**Gonzalo Giribet** and lab members **Paula Rodríguez-Flores**, **Katherine Angier** and **Ella Frigyk** gave tours of the Invertebrate Zoology and Malacology collections and explained how scientific zoological collections work and how they are used in research, while **Aaron Hartmann** gave a talk about corals, coral reefs and reef restoration technologies. At the Lauder lab, **Yangfan Zhang**, **Andy Williston** and **Meaghan Sorce** provided a behind-the-scenes look at the Ichthyology collection, and, at the Harvard Museum of Natural History, students toured the new shark exhibit curated in partnership with the Lauder lab. Student feedback from a post-visit survey was overwhelmingly positive and Tabin has received grant funding for the coming year's event, to be renamed Evolution Day to appeal to a wider variety of academic interests.



Jon Chase/Harvard University



## More Than Just Dinosaurs



On October 8, 2022, the [Harvard Museum of Natural History](#) hosted National Fossil Day to the delight of children and adults alike. This year's event focused on the non-dinosaur fossils that paleontologists study, including early mammals, ancient invertebrates, whales, crabs and other extinct species. During short talks and tabletop presentations, MCZ paleontological students, staff and faculty-curators shared their favorite fossils, talked about their research and answered questions. They also described new techniques and technologies being used to study life in the past and how fossils are key to understanding how life on Earth has evolved over millions of years.



Participating in the day's presentations and talks were **Javier Ortega-Hernández**, curator in Invertebrate Paleontology, and lab members **Joy Julius**, **Javier Luque**, **Jared Richards** and **Lucas del Mouro**; **Stephanie E. Pierce**, curator in Vertebrate Paleontology, and lab members **Peter Bishop**, **Robert Brocklehurst**, **Amandine Gillet**, **Magdalen Mercado** and **Gabby Neves Guilhon**; and curatorial staff members **Christina Byrd** and **Scott Johnston**. The event was conducted in English and Spanish to help reach a broader audience and in an effort to be more inclusive.



Julietta Sarmiento-Ponce (all)

## Celebrating Alfred Russel Wallace



On April 22, 2023, the MCZ sponsored an Earth Day celebration of the bicentenary of Alfred Russel Wallace's birth at the Harvard Museum of Natural History. Alfred Russel Wallace (1823–1913) proposed natural selection as a mechanism to explain evolution independently of Charles Darwin and was a pioneer in the study of biogeography, but he is not nearly as well known as Darwin. Wallace's birthday celebration honored his contributions to our understanding of biodiversity, highlighted why they are relevant to science today, and showcased a few specimens collected by him or named after him from the MCZ collections.

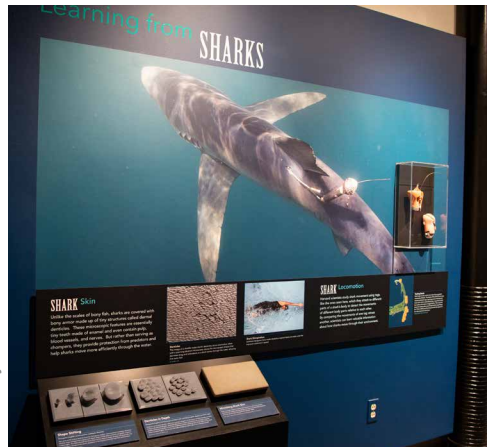
The event featured talks by **Gonzalo Giribet**, director of the MCZ; Andrew Berry; **Wendy Valencia-Montoya**, a graduate student in the MCZ; and Wallace and Darwin biographers Jim Costa and Janet Browne, while Harvard students shared his legacy as a visionary scientist, daring naturalist and passionate human rights advocate through enacted stories and objects that reflect his professional achievements and travels in the Amazon and Indonesia.

Gonzalo Giribet



## Swimming with Sharks

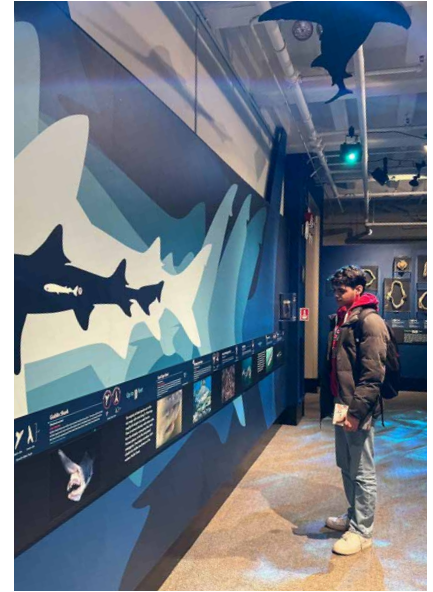
*Swimming with Sharks: A Deep Dive into Shark Biology and Behavior*, which opened at the Harvard Museum of Natural History on November 3, 2022, focuses on the science and beauty of sharks rather than their ill-deserved reputation as killing machines. “Visitors will learn some amazing facts about shark biology, and we hope that they walk away with a greater appreciation and understanding of the significant ecological role sharks play,” says **Meaghan Sorce**, curatorial assistant in Ichthyology. The exhibit also explores how sharks are inspiring new cutting-edge designs. “Shark biology provides nearly endless inspiration for the design of improved aquatic propulsion systems,” says **George V. Lauder**, curator in Ichthyology. “By studying how sharks swim and how anatomical features such as their remarkable skin denticles function, we will be able to manufacture new types of underwater devices that move and maneuver more effectively.”



Meilissa Aja

Prof. Lauder and members of his lab were active participants in the exhibit development, helping with the conceptual design, sourcing materials for display and providing scientific guidance. Postdoctoral researcher **Molly Gabler Smith** contributed research, 3D-printed denticles and skin samples, and graduate student **Connor White**

shared videos and shark tags for display. “The MCZ’s Ichthyology collection contributed shark jaws and other specimens and—because any shark exhibit would be incomplete without representing the ancestors of modern-day sharks—the Vertebrate Paleontology department contributed fossil specimens to round out the exhibit,” says Sorce. The exhibition was made possible by the Harvard Museums of Science & Culture with financial support from Jonathan Goldstein, MBA ’90, and Kaia, Annika, and Skylar Goldstein in honor of **Professor James J. McCarthy** and Sue McCarthy.



Toni Rinaldo



Toni Rinaldo

## Spotlight on MCZ Faculty-Curators



The *HMSC Connects!* podcast *Accessing Nature and Science* features **Scott V. Edwards**, MCZ curator in Ornithology and the chair of the Department of Organismic and Evolutionary Biology. Prof. Edwards is a longtime champion of promoting diversity in the sciences, and in this podcast he discusses how those issues have come into focus in recent years and outlines ways in which we can strive to make nature and science accessible to everyone.

In the podcast *Caring for the MCZ’s Collections*, **Breda Zimkus** discusses her role as director of Collections Operations. MCZ’s collections staff are responsible for maintaining its ten museum collections—items as varied as preserved specimens in cabinets and jars to tissues in cryogenic storage to massive fossils still in plaster jackets—and researchers depend on the specimens and their digital records for their work. Zimkus describes how she coordinates activities among the MCZ’s collections, connects staff to the resources they need and ensures the various departments are implementing best practices.

Listen to these podcasts at [hmsc.harvard.edu/online-resources/hmsc-connects-podcast/](https://hmsc.harvard.edu/online-resources/hmsc-connects-podcast/).



## AWARDS & RECOGNITION



Kris Snibbe/Harvard University

Hopi E. Hoekstra (center)

### Faculty-Curators

**Brian D. Farrell** received the Dean's Competitive Fund for Promising Scholarship for "The genomic basis of stasis and change in host-use evolution in milkweed beetles and other tiny consumers."

**Gonzalo Giribet** was elected a foreign member of the Spanish Royal Academy of Sciences.

**Hopi E. Hoekstra** was named the Edgerley Family Dean of the Faculty of Arts and Sciences and appointed the C.Y. Chan Professor of Arts and Sciences. She was one

of six recipients of the 2022 Lowell Thomas Award from The Explorers Club, presented to those who have pushed the limits of discovery, knowledge and human endurance and have excelled in communicating the importance of exploration and the field sciences to the general public.



Kris Snibbe/Harvard University

Mansi Srivastava

**Javier Ortega-Hernández** received an award from the Lemann Brazil Research Fund for his project, "Tracking the rise of the earliest animals during the Cambrian Explosion—a Brazilian perspective from the Global South."

**Naomi Pierce** was elected into the National Academy of Sciences in recognition of her distinguished and continuing achievements in original research.

**Mansi Srivastava** was awarded tenure and received Harvard's Roslyn Abramson Award for excellence in teaching undergraduates.

### Postdoctoral Researchers

**Sonali Garg**, Biodiversity Postdoctoral Fellow in the Hanken lab, won the Medal for Young Scientists from the Indian National Science Academy.

**Elsa Goerig**, in the Lauder lab, was awarded an Early-Career Research Board Fellowship, making her part of the Great Lake Fishery Commission Research Board.

**Shuonan He**, in the Hoekstra lab, was awarded a research fellowship from the Helen Hay Whitney Foundation for his project, "The genetic basis of hair morphology evolution driven by altitudinal adaptation in the deer mouse *Peromyscus maniculatus*."

**Allison Kann**, in the Srivastava lab, was awarded the Jane Coffin Childs Postdoctoral Fellowship for her project, "How to build (and rebuild) an animal."

### Graduate Students

**Julius Tabin** received a grant from the Small Grants Program for Local and Regional Outreach Promoting the Understanding of Evolutionary Biology from the Society for the Study of Evolution; the Elizabeth Horner Award and a Grant-in-Aid of Research from the American Society of Mammalogists; the DeLill Nasser Award for Professional Development in Genetics from the Genetics Society of America; and a Summer Institute



Courtesy of the Indian National Science Academy



Sonali Garg (right)

in Statistical Genetics scholarship and travel grant from the University of Washington.

**Jocelyn Wang** was awarded the Hoopes Prize for her senior thesis, “The role of soil micronutrients in the symbiosis between the African ant plant, *Vachellia drepanolobium*, and its resident ant species.”

### Staff

**Brendan Haley**, senior database manager, celebrated his 25-year anniversary of working at Harvard and the MCZ.

**Mark Omura**, curatorial associate in Mammalogy, celebrated his 20-year anniversary.

**Scott Johnston**, vertebrate paleontology technician and preparator, was the first person to be highlighted in Harvard University’s video series *Meet Harvard*.

Christina Byrd



Scott Johnston

## In Memoriam: Constance A. Rinaldo

On October 27, 2022, Constance Alvina Rinaldo, recently retired Librarian of the **Ernst Mayr Library of the MCZ**, passed away after a brief and sudden illness. Rinaldo, known to all as Connie, transformed the Library between 1999 and early 2021. Connie led the Library through technological changes and developed connections between libraries and museums worldwide.

As Librarian at the MCZ, Connie focused on the needs of Library users, pioneered digital content and services, and fostered an inclusive and welcoming atmosphere. Library staff remember her as a collegial leader who brought us “from the 19th century into the 21st.” She taught innumerable sessions on library skills and tools and instituted class visits to the Library, which included MCZ specimens.

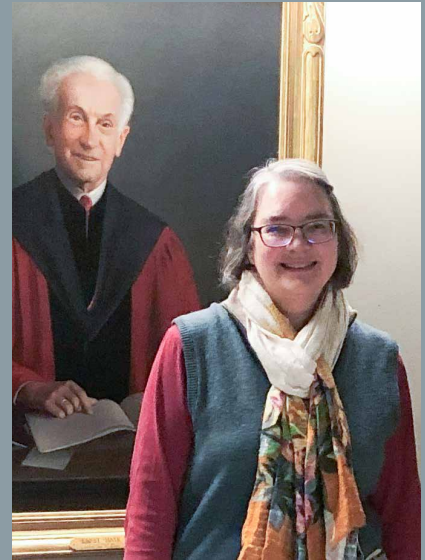
Before her library career, Connie was a naturalist with degrees in biology and zoology. While a student at UMass Boston, she worked with curator Barbara Lawrence in the MCZ Mammalogy Department. As a collector, she contributed specimens to the MCZ, Yale Peabody Museum, Field Museum, University of Connecticut and IBUNAM in Mexico. Collecting trips included Baja California in 1972 and Guangdong, China, in 1983.

Connecting museum and library data was her passion, especially through the Biodiversity Heritage Library, Global Biodiversity Information Facility, and Biodiversity Information Standards (TDWG). Beyond the MCZ, she spoke at conferences, published papers, wrote grants and linked the Ernst Mayr Library to collaborators worldwide. Connie joined the leadership team of the BHL at its founding in 2006 and continued after her retirement.

Connie’s email signature expressed her connection to nature and books:

*To a person uninstructed in natural history, his country or seaside stroll is a walk through a gallery filled with wonderful works of art, nine-tenths of which have their faces turned to the wall.* Thomas Henry Huxley, On the Educational Value of the Natural History Sciences” (1854)

Mary Sears



Mary Sears



# GRANT RECIPIENTS

## 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.



Rudy Lerosey-Aubril, Javier Ortega-Hernández & Lucas Del Mouro



Gonzalo Giribet

Shahan Derkarabetian, Arianna Lord & Shoyo Sato



Gonzalo Giribet

Paula Rodríguez-Flores



A. J. Iojii

Sathyabhama Biju, James Hanken & Sonali Garg

Recipient	MCZ Department/ Faculty Sponsor	Project Title	Amount
Katherine Angier	Invertebrate Zoology/ Giribet	Termite communities of the Republic of the Congo and the effects of large-scale anthropogenic salt additions	\$9,280
Kaylin Chong	Entomology/Farrell	Comparative analysis of <i>Psorophora ferox</i> populations in Massachusetts and Florida	\$2,050
Scott V. Edwards	Ornithology	Collection of high-quality genetic resources for karyotypes and long-read genomes of scrub-jays ( <i>Aphelocoma</i> ) and other passerine birds of the southwestern US	\$5,894
Gonzalo Giribet	Invertebrate Zoology	In search of the rarest of all living fossils, <i>Allonautilus scrobiculatus</i> in Papua New Guinea	\$11,704
Gunnar Kramer	Ornithology/Edwards	Untangling the roles of genetic and regulatory mechanisms in adaptive responses to climate change	\$5,545
Javier Ortega-Hernández and Rudy Lerosey-Aubril	Invertebrate Paleontology	The Marjum Burgess-Shale biota: A mid-Cambrian fossilized Eden in the desert of Utah	\$7,495
Arianna Lord	Invertebrate Zoology/ Giribet	Geographic bounds and species diversity in the New Zealand egg-laying velvet worms (genus: <i>Ooperipatellus</i> )	\$5,810
Arianna Lord	Invertebrate Zoology/ Giribet	Phylogenomics and conservation genomics of Tasmanian and New Zealand Onychophorans	\$11,360
Paula Rodríguez-Flores	Invertebrate Zoology/ Giribet	Intra and interspecific patterns of diversity in widespread crustaceans present in the western Atlantic	\$4,200
Shoyo Sato	Invertebrate Zoology/ Giribet	Jamaican velvet worms: Colonization and radiation on a Caribbean island	\$4,850
Wendy Valencia-Montoya	Entomology/N. Pierce	Surveying heat-seeking pollinators of ancient plants across South America	\$9,950
		<b>Total Awards</b>	<b>\$78,138</b>

## Ken Miyata Grants

The Ken Miyata Fund in Herpetology and Ken Miyata Fund for Field Research support students who share Ken's interests as a naturalist, biogeographer and writer/photographer by defraying the costs of research by graduate students in herpetology. The funds were established by generous gifts from Barbara Wu, PhD 1981, and Eric Larson, AB 1977, and other close friends of Ken.

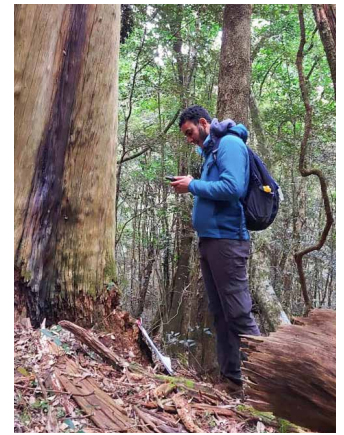
Recipient	MCZ Department/ Faculty Sponsor	Project Title	Amount
James Hanken and Sonali Garg	Herpetology	Integrative approaches to unravel frog diversity in India	\$14,750
		<b>Total Awards</b>	<b>\$14,750</b>



## Grants-in-Aid of Undergraduate Research

GUR grants support research by Harvard College undergraduates under faculty supervision. Priority is given to projects that utilize MCZ research collections, laboratories and facilities. Support for these grants comes from the MCZ’s Myvanwy M. and George M. Dick Scholarship for Students.

Recipient	Academic Dept./ Faculty Sponsor	Project Title	Amount
Arturo Aguilar	OEB/Charles Davis	Floral scent dynamics and mediation of pollinator interactions in two members of <i>Polemoniaceae</i>	\$6,506
Aiden Aguirre	OEB/Charles Davis	The effects of agriculture on soil health as assessed through microbial diversity across land plots	\$6,000
Ella Bradford	OEB/Andrew Davies	Population ecology & dietary preference of the last rainforest-dwelling population of spotted hyena	\$6,000
Ella Bradford	OEB/Andrew Davies	Quantifying rainforest hyena populations in Odzala-Kokoua National Park, Congo, with camera trapping	\$1,000
Ella Bradford	OEB/Andrew Davies	Understanding the role of forest clearings in promoting biodiversity in rainforest ecosystems	\$1,000
Mattheus Carpenter	History/Joyce Chaplin	A historical analysis of breeding programs and declining apple diversity in the northeastern US	\$2,500
Sophia Chen	OEB/Mansi Srivastava	Identifying a role for the extracellular matrix during whole-body regeneration in <i>Hofstenia miamia</i>	\$1,000
Deshawn Ejiogu	OEB/Hopi Hoekstra	Assessing dexterity and corticospinal tract size in <i>Peromyscus maniculatus</i>	\$3,750
Julian Handler	OEB/Andrew Davies	Surveys of Amathole Mistbelt forests using remote sensing to map Cape Parrot habitat quality	\$6,000
Eliza Hirsch	OEB/Mansi Srivastava	Clarifying the embryonic expression of putative stem cell markers	\$5,000
Olivia Johnson	OEB/Hopi Hoekstra	Parallel evolution of behavioral strategy in skilled climbing in deer mice	\$5,000
Isabel Kim	OEB/Hopi Hoekstra	Play behavior in <i>Peromyscus</i>	\$1,000
Emma MacKenzie	OEB/Naomi Pierce	Imaging the past: MicroCT on Dominican amber specimens	\$1,000
Elijah McGill	OEB/Andrew Davies	Comparative study of conservation outcomes inside and outside Odzala-Kokoua National Park	\$1,000
Elijah McGill	OEB/Andrew Davies	Comparing ecological responses to conservation inside and outside of national parks	\$2,500
Sakiko Miyazaki	OEB/Stephanie Pierce	Vertebral morphology of chiroptera to understand bats' evolutionary history	\$6,000
Julia O'Donnell	OEB/Andrew Davies	Evaluating the impact of elephants as seed and sodium distributors within Odzala-Kokoua National Park	\$1,200
Samantha Tseng	OEB/Mansi Srivastava	A closer look at mating behavior in simultaneous hermaphrodites	\$1,000
Beatrice Youd	OEB/Andrew Davies	Baseline forest structural dynamics and abiotic conditions for Marantaceae Forest, Congo Basin	\$1,000
Beatrice Youd	OEB/Andrew Davies	A comparative analysis of Marantaceae forests and open understory forests	\$3,000
Beatrice Youd	OEB/Andrew Davies	Landscape trends in Odzala-Kokoua National Park and their connection to aboveground carbon sequestration	\$1,000
		<b>Total Awards</b>	<b>\$62,456</b>



Julian Handler



Aiden Aguirre



Ella Bradford



Beatrice Youd (right)

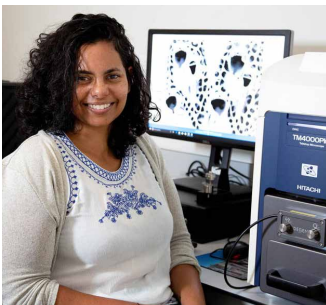




Leonel A. Martínez



Marisol Hidalgo-Cossio



Melissa Boonzaaier-Davids



Jonas de Andrade Santos

## 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.

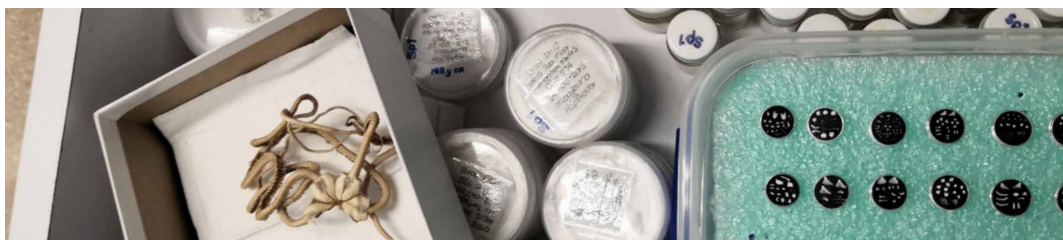


Soledad Leonardi

*Antartctophthirus*

Recipient	Institutional Affiliation	Project Title	Amount
Melissa Boonzaaier-Davids	Iziko South African Museum	Revising historic museum collections of South African bryozoan species described by Herman Kluge and Ernst Marcus using modern scanning electron microscopy (SEM)	\$1,960
Luz A. Botero Cobo	Institute of Marine Science and Limnology	Revision of glass sponges (Porifera: Hexactinellida) from Mexico deposited in the Museum of Comparative Zoology, Harvard	\$1,710
Yessica Chavez-Lopez	The College of the Southern Border, Mexico	Revision of Ampharetini (Ampharetidae: Terebellida) annelids in the Museum of Comparative Zoology, Harvard	\$2,000
Miguel Ángel García García	National Polytechnic Institute of Mexico	Review of the <i>Anyphaena</i> Sundevall, 1833 species (Araneae: Anyphaenidae) from Mexico	\$1,519
Ritesh K. Gautam	Wildlife Institute of India	Resolving old-world taxonomic problems of poorly-studied genus <i>Andrena</i> (Hymenoptera: Andrenidae) in the western Himalayas	\$2,500
David General	University of the Philippines Los Baños	The ant diversity of Mt. Isarog Natural Park	\$2,000
Luisa B. Guimaraes	Federal University of Rio de Janeiro	Taxonomic review of the <i>Pteroglossus aracari</i> (Linnaeus, 1758) complex (Aves: Piciformes: Ramphastidae)	\$2,500
Andres Herrera Florez	Friedrich Schiller University, Jena	Taxonomic revision of <i>Pimpla</i> Fabricius, 1804 (Hymenoptera: Ichneumonidae) from Colombia	\$2,500
Marisol Hidalgo-Cossio	Museum of Natural History, La Paz, Bolivia	The Southern Mountain vizcacha ( <i>Lagidium viscacia</i> ) (G. I. Molina, 1782), determining limits in its wide distribution	\$2,000
John Kole	Montana State University	Lifting the taxonomic impediment from the Chelonariidae (Insecta, Coleoptera) by examining the types housed in the Muséum National d'Histoire Naturelle	\$2,500
Katarzyna Koszela	Polish Academy of Sciences	Revision of small Paederina genera—the first step to understanding mega-diverse subtribe	\$2,330
Shabnam Kumari	Wildlife Institute of India	Integrative taxonomic study of selected cryptic genera of subfamily Sterrhinae (Lepidoptera: Geometridae) from the Indian Himalayan region	\$2,000
Soledad Leonardi	Institute of Biology of Marine Organisms, Argentina	Morphometric, phylogenetic, and molecular characterization of the seal lice genus <i>Antartctophthirus</i> (Anoplura, Echinophthiriidae)	\$2,000





Soledad Leonardi

Recipient	Institutional Affiliation	Project Title	Amount
Claudia V. Mamani	Argentine Museum of Natural Sciences	Taxonomy of higher groups within Samooidea (Opiliones: Laniatores)	\$2,500
Leonel A. Martínez	Argentine Museum of Natural Sciences	Systematic revision of the genus <i>Josa</i> Keyserling, 1891 (Araneae: Anyphaenidae)	\$1,300
Luciana Martins	Oceanographic Institute, São Paulo University	Morphological phylogeny of the families Phyllophoridae and Sclerodactylidae (Echinodermata: Holothuroidea: Dendrochirotida)	\$1,924
Micaela Nicoletta	Center for Renewable Natural Resources of the Semi-arid Zone, Argentina	Systematics of the tarantula genus <i>Grammostola</i> (Araneae, Theraphosidae) from Argentina: Integrative taxonomy based on morphology, biogeography and molecules	\$2,000
Maria Paula Pereira	Argentine Museum of Natural Sciences	Taxonomic review of the family Kimulidae (Arachnida: Opiliones: Laniatores)	\$2,000
Rafael Pereira da Silva	Federal University of Bahia	Biodiversity knowledge shortfalls and challenges revealed by a systematics study with snail-case caddisflies (Trichoptera, Helicopsychidae) from Neotropical region	\$2,500
Aline Sampaio da Silva	National Institute for Research in the Amazon	Taxonomic review and phylogenetic analysis of <i>Deuterocampta</i> Chevrolat, 1836 (Coleoptera: Chrysomelidae: Chrysomelinae)	\$2,000
Alvaro D. Santos	University of São Paulo	Taxonomic review and phylogenetic analysis of <i>Microcharops</i> Roman, 1910 (Hymenoptera: Ichneumonidae: Campopleginae)	\$2,500
Jonas de Andrade Santos	Federal University of Rio de Janeiro	Taxonomic review of Stelliferinae Sasaki, 1989 (Teleostei: Sciaenidae)	\$2,500
Yossellin Tapia-De la O	National Autonomous University of Mexico	Revision of ophiuroids (Echinodermata: Ophiuroidea) from the Gulf of California deposited in the Museum of Comparative Zoology, Harvard	\$2,280
Oswaldo Villarreal	Museum of the Institute of Agricultural Zoology, Central University of Venezuela	Taxonomic contribution to the Andean cranid harvestmen from Ecuador and Colombia	\$1,889
Kyle Whorral	University of Auckland	Systematics and evolution of New Zealand debris-catching beetles (Coleoptera: Zopheridae)	\$2,300
		<b>Total Awards</b>	<b>\$53,212</b>



Alvaro D. Santos

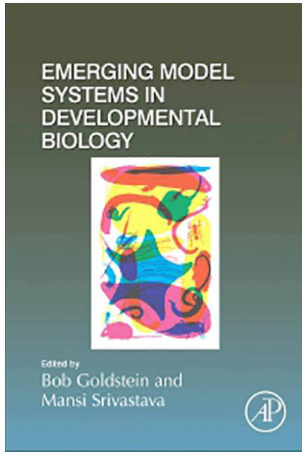


Luz A. Botero Cobo



Yessica Chavez-Lopez

# PUBLICATIONS IN 2022



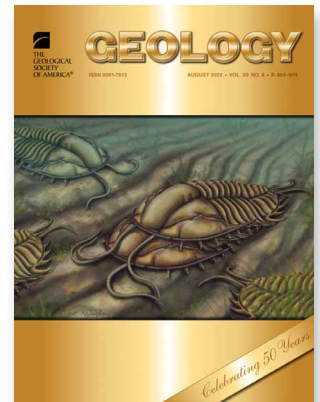
- Adams OA, Zhang Y, et al (2022) An unusually high upper thermal acclimation potential for rainbow trout. *Conserv Physiol* 10:coab101 DOI: [10.1093/conphys/coab101](https://doi.org/10.1093/conphys/coab101)
- Adler Miserendino RA, Meyer RS, Zimkus BM, et al (2022) The case for community self-governance on access and benefit sharing of digital sequence information. *BioScience* 72:405–408 DOI: [10.1093/biosci/biac019](https://doi.org/10.1093/biosci/biac019)
- Akanyeti O, Di Santo V, Goerig E, Wainwright DK, Liao JC, Castro-Santos T, Lauder GV (2022) Fish-inspired segment models for undulatory steady swimming. *Bioinspir Biomim* 17:046007 DOI: [10.1088/1748-3190/ac6bd6](https://doi.org/10.1088/1748-3190/ac6bd6)
- Altman GH, Farrell BD (2022) Sericulture as a sustainable agroindustry. *Cleaner Circ Bioecon* 2:100011 DOI: [10.1016/j.clcb.2022.100011](https://doi.org/10.1016/j.clcb.2022.100011)
- Ballesteros JA, Santibáñez-López CE, Baker CM, Benavides LR, Cunha TJ, and 10 others including Giribet G (2022) Comprehensive species sampling and sophisticated algorithmic approaches refute the monophyly of Arachnida. *Mol Biol Evol* 39:msac021 DOI: [10.1093/molbev/msac021](https://doi.org/10.1093/molbev/msac021)
- Bedford NL, Weber JN, Tong W, Baier F, Kam A, Greenberg RA, Hoekstra HE (2022) Interspecific variation in cooperative burrowing behavior by *Peromyscus* mice. *Evol Lett* 6:330–340 DOI: [10.1002/evl3.293](https://doi.org/10.1002/evl3.293)
- Biewener AA (2022) Physiology—Woodpecker skulls are not shock absorbers. *Curr Biol* 32:R767–R769 DOI: [10.1016/j.cub.2022.06.037](https://doi.org/10.1016/j.cub.2022.06.037)
- Biewener AA, Bompfrey RN, Daley MA, Isjpeert AJ (2022) Stability and maneuverability in animal movement: Lessons from biology, modelling, and robotics. *Proc R Soc B* 289:0212492 DOI: [10.1098/rspb.2021.2492](https://doi.org/10.1098/rspb.2021.2492)
- Bishop PJ, Brocklehurst RJ, Pierce SE (2022) Intelligent sampling of high-dimensional joint mobility space for analysis of articular function. *Methods Ecol Evol* 14:569–582 DOI: [10.1111/2041-210X.14016](https://doi.org/10.1111/2041-210X.14016)
- Bittleston LS, Benson EL, Bernardin JR, Pierce NE (2022) Characterization and comparison of convergence among *Cephalotus follicularis* pitcher plant-associated communities with those of *Nepenthes* and *Sarracenia* found worldwide. *Front Plant Sci* 13:887635 DOI: [10.3389/fpls.2022.887635](https://doi.org/10.3389/fpls.2022.887635)
- Blaxter M and 24 others including Edwards SV (2022) Why sequence all eukaryotes? *Proc Natl Acad Sci USA* 119:e2115636118 DOI: [10.1073/pnas.2115636118](https://doi.org/10.1073/pnas.2115636118)
- Brocklehurst R, Fahn-Lai P, Regnault S, Pierce SE (2022) Musculoskeletal modeling of sprawling and parasagittal forelimbs provides insight into synapsid postural transition. *iScience* 25:103578 DOI: [10.1016/j.isci.2021.103578](https://doi.org/10.1016/j.isci.2021.103578)
- Brum AS, Simões TR, et al (2022) Ontogeny and evolution of the cervical vertebrae in elasmosaurid plesiosaurs and greater taxonomic diversity of Antarctic plesiosaurs. *Palaeontology* 65:e12593 DOI: [10.1111/pala.12593](https://doi.org/10.1111/pala.12593)
- Card DC, Van Camp AG, Santonastaso T, Jensen-Seaman MI, Anthony NM, Edwards SV (2022) Structure and evolution of the squamate major histocompatibility complex as revealed by two *Anolis* lizard genomes. *Front Genet* 13:979746 DOI: [10.3389/fgene.2022.979746](https://doi.org/10.3389/fgene.2022.979746)
- Castro-Santos T, Goerig E, He P, Lauder GV (2022) Chapter 3—Applied aspects of locomotion and biomechanics. In: *Conservation physiology for the Anthropocene—A systems approach* (eds. Cooke SJ, Fangué NA, Farrell AP, Brauner CJ, Eliason EJ). *Fish Physiol* 39:91–140 DOI: [10.1016/bs.fp.2022.04.003](https://doi.org/10.1016/bs.fp.2022.04.003)
- Chan W-P, Rabideau-Childers R, Ashe S, Tsai C-C, Elson C, Keleher KJ, Hawkins Sipe RL, Maier CA, Sourakov A, Gall LF, Bernard GD, Soucy ER, Yu N, Pierce NE (2022) A high-throughput multispectral imaging system for museum specimens. *Commun Biol* 5:1318 DOI: [10.1038/s42003-022-04282-z](https://doi.org/10.1038/s42003-022-04282-z)
- Corahua-Espinoza T, Nakahara S, et al (2022) Early stage biology of three satyrine butterfly species in the Peruvian Amazon (Lepidoptera: Nymphalidae: Satyrinae: Satyrini). *Trop Lepid Res* 32:38–46 DOI: [10.5281/zenodo.6588513](https://doi.org/10.5281/zenodo.6588513)
- Corahua-Espinoza T, Nakahara S, et al (2022) Immature stages and new host plant records for three satyrine species feeding on herbaceous bamboos in southeastern Peru (Lepidoptera: Nymphalidae: Satyrinae: Satyrini). *Zootaxa* 5125:37–62 DOI: [10.11646/zootaxa.5125.1.3](https://doi.org/10.11646/zootaxa.5125.1.3)
- Corahua-Espinoza T, Nakahara S, et al (2022) Immature stages and new host plant records for three species in the “Taygetis clade” of Euptychiina in southeastern Peru (Lepidoptera: Nymphalidae: Satyrinae). *Neotrop Entomol* 52:67–80 DOI: [10.1007/s13744-022-00998-z](https://doi.org/10.1007/s13744-022-00998-z)
- Cuff AR, Wiseman ALA, Bishop PJ, et al (2022) Anatomically grounded estimation of hindlimb muscle sizes in Archosauria. *J Anat* 242:289–311 DOI: [10.1111/joa.13767](https://doi.org/10.1111/joa.13767)
- Cunha TJ, Reimer JD, Giribet G (2022) Investigating sources of conflict in deep phylogenomics of vetigastropod snails. *Syst Biol* 71:1009–1022 DOI: [10.1093/sysbio/syab071](https://doi.org/10.1093/sysbio/syab071)
- Edwards SV, Robin VV, Ferrand N, Moritz C (2022) The evolution of comparative phylogeography: Putting the geography (and more) into comparative population genomics. *Genome Biol Evol* 14:evab176 DOI: [10.1093/gbe/evab176](https://doi.org/10.1093/gbe/evab176)
- Egawa S, Griffin CT, Bishop PJ, et al (2022) The dinosaurian femoral head experienced a cryptic evolutionary shift in morphogenetic process. *Proc Biol Sci* 289:20220740 DOI: [10.1098/rspb.2022.0740](https://doi.org/10.1098/rspb.2022.0740)
- Ellepola G, Pie MR, Pethiyagoda R, Hanken J, Meegaskumbura M (2022) The role of climate and



islands in species diversification and reproductive-mode evolution of Old World tree frogs. *Commun Biol* 5:347 DOI: [10.1038/s42003-022-03292-1](https://doi.org/10.1038/s42003-022-03292-1)

- Enbody ED, Sin SYW, Boersma J, Edwards SV, et al (2022) The evolutionary history and mechanistic basis of female ornamentation in a tropical songbird. *Evolution* 76:1720–1736 DOI: [10.1111/evo.14545](https://doi.org/10.1111/evo.14545)
- Ferrão M, de Souza RA, Colatreli OP, Hanken J, Lima AP (2022) Hidden in the litter: Cryptic diversity of the leaf-litter toad *Rhinella castaneotica*–*proboscidea* complex revealed through integrative taxonomy, with description of a new species from south-western Amazonia. *Syst Biodivers* 20:1–24 DOI: [10.1080/14772000.2022.2039317](https://doi.org/10.1080/14772000.2022.2039317)
- Ferrão M, Hanken J, Lima AP (2022) A new nurse frog of the *Allobates tapajos* species complex (Anura: Aromobatidae) from the upper Madeira River, Brazilian Amazonia. *PeerJ* 10:e13751 DOI: [10.7717/peerj.13751](https://doi.org/10.7717/peerj.13751)
- Ferrão M, Moravec J, Ferreira AS, Moraes LJCL, Hanken J (2022) A new snouted treefrog of the genus *Scinax* (Anura, Hylidae) from the white-sand forests of central Amazonia. *Breviora* 573:1–36 DOI: [10.3099/0006-9698-573.1.1](https://doi.org/10.3099/0006-9698-573.1.1)
- Gabler-Smith MK, Lauder GV (2022) Ridges and riblets: Shark skin surfaces versus biomimetic models. *Front Mar Sci* 9:975062 DOI: [10.3389/fmars.2022.975062](https://doi.org/10.3389/fmars.2022.975062)
- Gatesy SM, Manafzadeh AR, Bishop PJ, et al (2022) A proposed standard for quantifying 3-D hindlimb joint poses in living and extinct archosaurs. *J Anat* 241:101–118 DOI: [10.1111/joa.13635](https://doi.org/10.1111/joa.13635)
- Gilbert KJ, Goldsborough T, Lam WN, Leong F, Pierce NE (2022) A semi-detritivorous pitcher plant, *Nepenthes ampullaria* diverges in its regulation of pitcher fluid properties. *J Plant Interact* 17:956–966 DOI: [10.1080/17429145.2022.2123567](https://doi.org/10.1080/17429145.2022.2123567)
- Gilbert P, Bergmann KD, Boekelheide N, Tambutte S, Mass T, Marin F, Adkins JF, Erez J, Gilbert B, Knutson V, Cantine M, Ortega-Hernández J, Knoll AH (2022) Biomineralization: Integrating mechanism and evolutionary history. *Sci Adv* 8:eabl9653 DOI: [10.1126/sciadv.abl9653](https://doi.org/10.1126/sciadv.abl9653)
- Gillet A, Frédéric B, Pierce SE, Parmentier E (2022) Iterative habitat transitions are associated with morphological convergence of the backbone in delphinoids. *J Mammal Evol* 29:931–946 DOI: [10.1007/s10914-022-09615-7](https://doi.org/10.1007/s10914-022-09615-7)
- Giribet G, Shaw M, Lord A, Derkarabetian S (2022) Closing a biogeographic gap: A new pettalid genus from South Australia (Arachnida: Opiliones: Cyphophthalmi: Pettalidae) with a UCE-based phylogeny of Cyphophthalmi. *Invertebr Syst* 36:1002–1016 DOI: [10.1071/IS22043](https://doi.org/10.1071/IS22043)
- Goldstein B, Srivastava M, eds. (2022) Emerging model systems in developmental biology. In: *Current topics in developmental biology*, Vol. 147. Elsevier: Cambridge DOI: [10.1016/S0070-2153\(22\)00035-7](https://doi.org/10.1016/S0070-2153(22)00035-7)

- Gozashti L, Roy SW, et al (2022) Transposable elements drive intron gain in diverse eukaryotes. *Proc Natl Acad Sci USA* 119:e2209766119 DOI: [10.1073/pnas.2209766119](https://doi.org/10.1073/pnas.2209766119)
- Hager ER, Harringmeyer OS, Wooldridge TB, Theingi S, Gable JT, McFadden S, Neugeboren B, Turner KM, Hoekstra HE (2022) A chromosomal inversion contributes to divergence in multiple traits between deer mouse ecotypes. *Science* 377:399–405 DOI: [10.1126/science.abg0718](https://doi.org/10.1126/science.abg0718)
- Hardisty AR, Ellwood ER, Nelson G, Zimkus BM (2022) Digital extended specimens: Enabling an extensible network of biodiversity data records as integrated digital objects on the internet. *BioScience* 72:978–987 DOI: [10.1093/biosci/biac060](https://doi.org/10.1093/biosci/biac060)
- Harringmeyer OS, Hoekstra HE (2022) Massive inversion polymorphisms shape the genomic landscape of deer mice. *Nat Ecol Evol* 6:1965–1979 DOI: [10.1038/s41559-022-01890-0](https://doi.org/10.1038/s41559-022-01890-0)
- Heil JA, Wolock CJ, Pierce NE, Pringle A, Bittleston LS (2022) *Sarracenia* pitcher plant-associated microbial communities differ primarily by host species across a longitudinal gradient. *Environ Microbiol* 24:3500–3516 DOI: [10.1111/1462-2920.15993](https://doi.org/10.1111/1462-2920.15993)
- Hinckley A, Camacho-Sanchez M, Ruedi M, Hawkins MTR, Mullon M, et al (2022) Evolutionary history of Sundaland shrews (Eulipotyphla: Soricidae: *Crocidura*) with a focus on Borneo. *Zool J Linnean Soc* 194:478–501 DOI: [10.1093/zoolinnean/zlab045](https://doi.org/10.1093/zoolinnean/zlab045)
- Hoekstra HE, Robinson GE (2022) Behavioral genetics and genomics: Mendel's peas, mice, and bees. *Proc Natl Acad Sci USA* 119:e21221541119 DOI: [10.1073/pnas.21221541119](https://doi.org/10.1073/pnas.21221541119)
- Hu CK, York RA, Metz HC, Bedford NL, Fraser HB, Hoekstra HE (2022) cis-Regulatory changes in locomotor genes are associated with the evolution of burrowing behavior. *Cell Rep* 38:110360 DOI: [10.1016/j.celrep.2022.110360](https://doi.org/10.1016/j.celrep.2022.110360)
- Infantes E, Carroll D, Silva WTAF, Härkönen T, Edwards SV, Harding KC (2022) An automated workflow for pinniped surveys: A new tool for monitoring population dynamics. *Front Ecol Evol* 10:905309 DOI: [10.3389/fevo.2022.905309](https://doi.org/10.3389/fevo.2022.905309)
- Irschick DJ, and 23 others including Lauder GV (2022) 3D visualization processes for recreating and studying organismal form. *iScience* 25:104867 DOI: [10.1016/j.isci.2022.104867](https://doi.org/10.1016/j.isci.2022.104867)
- Ji Y, Baker CCM, Popescu VD, Wang J, Wu C, Wang Z, Li Y, Wang L, Hua C, Yang Z, Yang C, Xu CCY, Diana A, Wen Q, Pierce NE, Yu DW (2022) Measuring protected-area effectiveness using vertebrate distributions from leech iDNA. *Nat Commun* 13:1555 DOI: [10.1038/s41467-022-28778-8](https://doi.org/10.1038/s41467-022-28778-8)
- Jonasson J, Härkönen T, Sundqvist L, Edwards SV, Harding KC (2022) A unifying framework for estimating generation time in age-structured



populations: Implications for phylogenetics and conservation biology. *Am Nat* 200:48–62 DOI: [10.1086/719667](https://doi.org/10.1086/719667)

• **Khadraoui M**, Merritt JR, **Hoekstra HE**, Bendesky A (2022) Post-mating parental behavior trajectories differ across four species of deer mice. *PLoS One* 17:e0276052 DOI: [10.1371/journal.pone.0276052](https://doi.org/10.1371/journal.pone.0276052)

• **Kim S**, Jung S, Choi J, Tsai C-L, **Farrell BD**, Shin S (2022) History does not repeat itself; it rhymes: Range expansion and outbreak of *Plecia longiforceps* (Diptera: Bibionidae) in East Asia. *J Integr Pest Manag* 13:31 DOI: [10.1093/jipm/pmac026](https://doi.org/10.1093/jipm/pmac026)

• **Kimura JO**, Bolaños DM, Ricci L, **Srivastava M** (2022) Embryonic origins of adult pluripotent stem cells. *Cell* 185:4756–4769.e13 DOI: [10.1016/j.cell.2022.11.008](https://doi.org/10.1016/j.cell.2022.11.008)

• **Koochekian N**, Ascanio A, Farleigh K, **Card DC**, et al (2022) A chromosome-level genome assembly and annotation of the desert horned lizard, *Phrynosoma platyrhinos*, provides insight into chromosomal rearrangements among reptiles. *GigaScience* 11:gjab098 DOI: [10.1093/gigascience/gjab098](https://doi.org/10.1093/gigascience/gjab098)

• **Lauder GV** (2022) Robotics as a comparative method in ecology and evolutionary biology. *Integr Comp Biol* 62:721–734 DOI: [10.1093/icb/icac016](https://doi.org/10.1093/icb/icac016)

• **Lauer J**, and 14 others including **Di Santo V**, **Lauder GV** (2022) Multi-animal pose estimation, identification and tracking with DeepLabCut. *Nat Methods* 19:496–504 DOI: [10.1038/s41592-022-01443-0](https://doi.org/10.1038/s41592-022-01443-0)

• **Lee KY**, Park S-J, **Matthews DG**, Kim SL, Antonio Marquez C, Zimmerman JF, Ardoña HAM, Kleber AG, **Lauder GV**, Parker KK (2022) An autonomously swimming biohybrid fish designed with human cardiac biophysics. *Science* 375:639–647 DOI: [10.1126/science.abh0474](https://doi.org/10.1126/science.abh0474)

• **Leiva C**, Riesgo A, **Combosch D**, Belén Arias M, **Giribet G**, Downey R, Kenny NJ, Taboada S (2022) Guiding marine protected area network design with comparative phylogeography and population genomics: An exemplary case from the Southern Ocean. *Divers Distrib* 28:1891–1907 DOI: [10.1111/ddi.13590](https://doi.org/10.1111/ddi.13590)

• **Lerosey-Aubril R**, **Ortega-Hernández J** (2022) A new lobopodian from the middle Cambrian of Utah: Did swimming body flaps convergently evolve in stem-group arthropods? *Pap Palaeontol* 8:e1450 DOI: [10.1002/spp2.1450](https://doi.org/10.1002/spp2.1450)

• **Lewin HA** and 81 others including **Edwards SV** (2022) The Earth BioGenome Project 2020: Starting the clock. *Proc Natl Acad Sci USA* 119:e2115635118 DOI: [10.1073/pnas.2115635118](https://doi.org/10.1073/pnas.2115635118)

• **Lewis ZR**, Kerney R, **Hanken J** (2022) Developmental basis of evolutionary lung loss in plethodontid salamanders. *Sci Adv* 8:eabo6108 DOI: [10.1126/sciadv.abo6108](https://doi.org/10.1126/sciadv.abo6108)

• **Liénard MA**, **Valencia-Montoya WA**, **Pierce NE** (2022) Molecular advances to study the function, evolution and spectral tuning of arthropod visual opsins. *Phil Trans R Soc B* 377:20210279 DOI: [10.1098/rstb.2021.0279](https://doi.org/10.1098/rstb.2021.0279)

• **López-Antoñanzas R**, Mitchell J, **Simões TR**, et al (2022) Integrative phylogenetics: Tools for palaeontologists to explore the tree of life. *Biology* 11:1185 DOI: [10.3390/biology11081185](https://doi.org/10.3390/biology11081185)

• **Losso SR**, **Ortega-Hernández J** (2022) Claspers in the mid-Cambrian *Olenoides serratus* indicate horseshoe crab-like mating in trilobites. *Geology* 50:897–901 DOI: [10.1130/G49872.1](https://doi.org/10.1130/G49872.1)

• **Luo Z-X**, Bhullar BAS, **Crompton AW**, Neander AJ, Rowe TB (2022) Reexamination of the mandibular and dental morphology of the Early Jurassic mammaliaform *Hadrocodium wui*. *Acta Palaeontol Pol* 67:95–113 DOI: [10.4202/app.00949.2021](https://doi.org/10.4202/app.00949.2021)

• **Matthews DG**, Zhu R, Wang J, Dong H, Bart-Smith H, **Lauder G** (2022) Role of the caudal peduncle in a fish-inspired robotic model: How changing stiffness and angle of attack affects swimming performance. *Bioinspir Biomim* 17:066017 DOI: [10.1088/1748-3190/ac9879](https://doi.org/10.1088/1748-3190/ac9879)

• **Memet E**, **Farrell BD**, Mahadevan L (2022) An allometric prior enhances acoustic niche partitioning signal. *J R Soc Interface* 19:20220421 DOI: [10.1098/rsif.2022.0421](https://doi.org/10.1098/rsif.2022.0421)

• **Moncada E**, **Lord A**, Simone LRL, Adjei-Boateng D, Bouchet P, Strong EE, Bieler R, **Giribet G** (2022) Marine surf to freshwater: A molecular phylogeny of Donacidae (Bivalvia: Heterodonta). *Invertebr Syst* 36:984–1001 DOI: [10.1071/IS22026](https://doi.org/10.1071/IS22026)

• **Morris ZS**, Vliet KA, Abzhanov A, **Pierce SE** (2022) Developmental origins of the crocodylian skull table and platyrostral face. *Anat Rec* 305:2838–2853 DOI: [10.1002/ar.24802](https://doi.org/10.1002/ar.24802)

• **Nakahara S**, Janzen DH, et al (2022) Revision of the “*celia* clade” of *Pseudodebis* Forster, 1964, with two new species and notes on *Papilio phorcys* Fabricius, 1793 (Lepidoptera: Nymphalidae: Satyrinae). *Neotrop Entomol* 51:536–556 DOI: [10.1007/s13744-022-00954-x](https://doi.org/10.1007/s13744-022-00954-x)

• **Nakahara S**, Piovesan M, Baine Q, **MacKenzie EC**, et al (2022) A new species of *Caeruleptychia* Forster, 1964 from the Amazon basin (Lepidoptera: Nymphalidae: Satyrinae: Satyrini). *Trop Lepid Res* 33:23–36 DOI: [10.5281/zenodo.7246643](https://doi.org/10.5281/zenodo.7246643)

• **Nakahara S**, Rodríguez MM, et al (2022) Systematic revision of the new butterfly genus

*Cisandina* Nakahara & Espeland, n. gen., with descriptions of three new taxa (Lepidoptera: Nymphalidae: Satyrinae). *Insect Syst Divers* 6:1–30 DOI: [10.1093/isd/ixab028](https://doi.org/10.1093/isd/ixab028)

• **Nakahara S**, Zilli A, et al (2022) Resolving two centuries of mistaken identity: Reinterpretation of *Papilio marcus* Fabricius, 1787 (Lepidoptera: Nymphalidae, Hesperiiidae). *Zootaxa* 5195:241–255 DOI: [10.11646/zootaxa.5195.3.3](https://doi.org/10.11646/zootaxa.5195.3.3)

• **Nunes R**, Storer C, Doleck T, Kawahara AY, **Pierce NE**, Lohman DJ (2022) Predictors of sequence capture in a large-scale anchored phylogenomics project. *Front Ecol Evol* 10:943361 DOI: [10.3389/fevo.2022.943361](https://doi.org/10.3389/fevo.2022.943361)

• **Opazo JC**, Hoffman FG, Zavala K, **Edwards SV** (2022) Evolution of the DAN gene family in vertebrates. *Dev Biol* 482:34–43 DOI: [10.1016/j.ydbio.2021.12.002](https://doi.org/10.1016/j.ydbio.2021.12.002)

• **Ortega-Hernández J**, **Lerosey-Aubril R**, **Losso SR**, Weaver JC (2022) Neuroanatomy in a middle Cambrian mollisoniid and the ancestral nervous system organization of chelicerates. *Nat Commun* 13:410 DOI: [10.1038/s41467-022-28054-9](https://doi.org/10.1038/s41467-022-28054-9)

• **Pates S**, **Wolfe JM**, **Lerosey-Aubril R**, Daley AC, **Ortega-Hernández J** (2022) New opabiniid diversifies the weirdest wonders of the euarthropod lower stem group. *Proc R Soc B* 289:20212093 DOI: [10.1098/rspb.2021.2093](https://doi.org/10.1098/rspb.2021.2093)

• **Pettinau L**, Lancien F, **Zhang Y**, et al (2022) Warm, but not hypoxic acclimation, prolongs ventricular diastole and decreases the protein level of Na<sup>+</sup>/Ca<sup>2+</sup> exchanger to enhance cardiac thermal tolerance in European sea bass. *Comp Biochem Physiol Part A Mol Integr Physiol* 272:111266 DOI: [10.1016/j.cbpa.2022.111266](https://doi.org/10.1016/j.cbpa.2022.111266)

• **Pierce NE**, **Dankowicz E** (2022) Behavioral, ecological and evolutionary mechanisms underlying caterpillar-ant symbioses. *Curr Opin Insect Sci* 52:100898 DOI: [10.1016/j.cois.2022.100898](https://doi.org/10.1016/j.cois.2022.100898)

• **Pierce NE**, **Dankowicz E** (2022) The natural history of caterpillar-ant associations. In: *Caterpillars in the Middle* (eds. Marquis RJ, Koptur S). Springer International Publishing: Cham DOI: [10.1007/978-3-030-86688-4](https://doi.org/10.1007/978-3-030-86688-4)

• **Porto W**, **Derkarabetian S**, Ramírez M, **Giribet G**, Pérez-González A (2022) Notes on South American triaenonychids, with the description of a new genus from Chile (Opiliones: Laniatores: Triaenonychidae). *Invertebr Syst* 36:681–713 DOI: [10.1071/IS21080](https://doi.org/10.1071/IS21080)

• **Rabideau-Childers R**, **Angier KIW**, **Dean BZM**, **Blumstein M**, **Darling WS**, **Kennedy-Yoon A**, **Ziemke CH**, **Perez-Martinez CA**, **Wu D**, **Ye W**, **Yekwayo I**, **Kimuyu DM**, **Martins DJ**, **Pierce NE** (2022) Evidence of nutrient translocation in response to smoke exposure by the East African



ant acacia, *Vachellia drepanolobium*. *Ecol Evol* 12:e8244 DOI: [10.1002/ece3.8244](https://doi.org/10.1002/ece3.8244)

• Rollot Y, Evers SW, Pierce SE, Joyce WG (2022) Cranial osteology, taxonomic reassessment, and phylogenetic relationships of the Early Cretaceous (Aptian-Albian) turtle *Trinitichelys hiatti* (Paracryptodira). *PeerJ* 10:e14138 DOI: [10.7717/peerj.14138](https://doi.org/10.7717/peerj.14138)

• Roy SW, Gozashti L, et al (2022) Intron-rich dinoflagellate genomes driven by Introner transposable elements of unprecedented diversity. *Curr Biol* 33:189–196 DOI: [10.1016/j.cub.2022.11.046](https://doi.org/10.1016/j.cub.2022.11.046)

• Saleh F, Vaucher R, Vidal M, El Hariri K, Laibl L, Daley AC, Gutierrez-Marco JC, Candela Y, Harper D, Ortega-Hernández J, et al (2022) New fossil assemblages from the Early Ordovician Fezouata Biota. *Sci Rep* 12:20773 DOI: [10.1038/s41598-022-25000-z](https://doi.org/10.1038/s41598-022-25000-z)

• Sato S, Law A, Giribet G (2022) Evidence for spatial niche partitioning in the ectocommensal *Symbion americanus* (Cycliophora) on its lobster host, *Homarus americanus* (Arthropoda, Malacostraca). *Invertebr Biol* 141:e12370 DOI: [10.1111/ivb.12370](https://doi.org/10.1111/ivb.12370)

• Schield DR, Perry BW, Card DC, et al (2022) The rattlesnake W chromosome: A GC-rich retroelement refugium with retained gene function across ancient evolutionary strata. *Genome Biol Evol* 14:evac116 DOI: [10.1093/gbe/evac116](https://doi.org/10.1093/gbe/evac116)

• Schmitt CJ, Edwards SV (2022) Passerine birds. *Curr Biol* 32:R1149–R1154 DOI: [10.1016/j.cub.2022.08.061](https://doi.org/10.1016/j.cub.2022.08.061)

• Schmidt M, Hou XG, Belojevic J, Zhai D, Mai J, Melzer RR, Ortega-Hernández J, Liu Y (2022) Before trilobite legs: *Pygmaclipeatus daziensis* reconsidered and the ancestral appendicular organization of Cambrian arthropods. *Philos T R Soc B* 377:20210030 DOI: [10.1098/rstb.2021.0030](https://doi.org/10.1098/rstb.2021.0030)

• Sheridan JA, Martin AK, James C, Kennedy-Gold SR (2022) Temperature and precipitation interact to predict size responses to climate change in fence lizards. *Herpetol Conserv Biol* 17:553–559

• Shirey V, and 17 others including Pierce NE (2022) LepTraits 1.0 A globally comprehensive dataset of butterfly traits. *Sci Data* 9:382 DOI: [10.1038/s41597-022-01473-5](https://doi.org/10.1038/s41597-022-01473-5)

• Simões TR, Broderick G, Pierce SE (2022) An exceptionally preserved *Sphenodon*-like sphenodontian reveals deep time conservation of the tuatara skeleton and ontogeny. *Commun Biol* 5:195 DOI: [10.1038/s42003-022-03144-y](https://doi.org/10.1038/s42003-022-03144-y)

• Simões TR, Kammerer C, Caldwell MW, Pierce SE (2022) Successive climate crises in the deep

past drove the early evolution and radiation of reptiles. *Sci Adv* 8:eabq1898 DOI: [10.1126/sciadv.abq1898](https://doi.org/10.1126/sciadv.abq1898)

• Sin SYW, Cloutier A, Nevitt G, Edwards SV (2022) Olfactory receptor subgenome and expression in a highly olfactory procellariiform seabird. *Genetics* 220:iyab210 DOI: [10.1093/genetics/iyab210](https://doi.org/10.1093/genetics/iyab210)

• Srivastava M (2022) Studying development, regeneration, stem cells, and more in the acoeel *Hofstenia miamia*. *Curr Top Dev Biol* 147:153–172 DOI: [10.1016/bs.ctdb.2022.01.003](https://doi.org/10.1016/bs.ctdb.2022.01.003)

• Stathopoulou T, Light J, Lamas LP, Pierce SE, Pelligand L (2022) A protocol for prolonged surgical anaesthesia with recovery in fire salamanders using tricaine mesylate (MS-222): A case series. *Lab Anim* 56:540–549 DOI: [10.1177/00236772221103706](https://doi.org/10.1177/00236772221103706)

• Stenseth NC, Andersson L, Hoekstra HE (2022) Gregor Johann Mendel and the development of modern evolutionary biology. *Proc Natl Acad Sci USA* 119:e2201327119 DOI: [10.1073/pnas.2201327119](https://doi.org/10.1073/pnas.2201327119)

• Strong CRC, Scherz MD, Caldwell MW (2022) Convergence, divergence, and macroevolutionary constraint as revealed by anatomical network analysis of the squamate skull, with an emphasis on snakes. *Sci Rep* 12:14469 DOI: [10.1038/s41598-022-18649-z](https://doi.org/10.1038/s41598-022-18649-z)

• Talavera G, Lukhtanov V, Pierce NE, Vila R (2022) DNA barcodes combined with multilocus data of representative taxa can generate reliable higher-level phylogenies. *Syst Biol* 71:382–395 DOI: [10.1093/sysbio/syab038](https://doi.org/10.1093/sysbio/syab038)

• Termignoni-Garcia F, Kirchman JJ, Clark J, Edwards SV (2022) Comparative population genomics of cryptic speciation and adaptive divergence in Bicknell's and Gray-Cheeked Thrushes (Aves: *Catharus bicknelli* and *Catharus minimus*). *Genome Biol Evol* 14:evab255 DOI: [10.1093/gbe/evab255](https://doi.org/10.1093/gbe/evab255)

• Wang Z, Da W, Negi CS, Ghimire PL, Wangdi K, Yadav PK, Pubu Z, Lama L, Yarpel K, Maunsell SC, Liu Y, Kunte K, Bawa KS, Yang D, Pierce NE (2022) Profiling, monitoring and conserving caterpillar fungus in the Himalayan region using anchored hybrid enrichment markers. *Proc Biol Sci* 289:20212650 DOI: [10.1098/rspb.2021.2650](https://doi.org/10.1098/rspb.2021.2650)

• Wang Z, Li Y, Jain A, Pierce NE (2022) Agent-based models reveal limits of mark-release-recapture estimates for the rare butterfly, *Bhutanitis thaidina* (Lepidoptera: Papilionidae). *Insect Sci* 29:550–566 DOI: [10.1111/1744-7917.12949](https://doi.org/10.1111/1744-7917.12949)

• Wang Z, Pierce NE (2022) Fine-scale genome-wide signature of Pleistocene glaciation in *Thitarodes* moths (Lepidoptera: Hepialidae),

host of *Ophiocordyceps* fungus in the Hengduan Mountains. *Mol Ecol* 32:2695–2714 DOI: [10.1111/mec.16457](https://doi.org/10.1111/mec.16457)

• Whitney MR, Otoo BKA, Angielczyk KD, Pierce SE (2022) Fossil bone histology reveals ancient origins for rapid juvenile growth in tetrapods. *Commun Biol* 5:1280 DOI: [10.1038/s42003-022-04079-0](https://doi.org/10.1038/s42003-022-04079-0)

• Whittington CM, Van Dyke JU, Liang SQT, Edwards SV, Shine R, Grueber CE (2022) Understanding the evolution of viviparity using intraspecific variation in reproductive mode and transitional forms of pregnancy. *Biol Rev* 97:1179–1192 DOI: [10.1111/brv.12836](https://doi.org/10.1111/brv.12836)

• Wilberg EW, Beyl AR, Pierce SE, Turner AH (2022) Cranial and endocranial anatomy of a three-dimensionally preserved teleosauroid thalattosuchian skull. *Anat Rec* 305:2620–2653 DOI: [10.1002/ar.24704](https://doi.org/10.1002/ar.24704)

• Wolf Z, Lauder GV (2022) A fish-like soft-robotic model generates a diversity of swimming patterns. *Integr Comp Biol* 62:735–748 DOI: [10.1093/icb/icac039](https://doi.org/10.1093/icb/icac039)

• Wooldridge TB, Kautt AF, Lassance JM, McFadden S, Domingues VS, Mallarino R, Hoekstra HE (2022) A novel enhancer of *Agouti* contributes to parallel evolution of cryptically colored beach mice. *Proc Natl Acad Sci USA* 119:e220286119 DOI: [10.1073/pnas.2202862119](https://doi.org/10.1073/pnas.2202862119)

• Wright M, Sears K, Pierce SE (2022) Comparison of hindlimb muscle architecture properties in small-bodied, generalist mammals suggests similarity in soft tissue anatomy. *J Mammal Evol* 29:477–491 DOI: [10.1007/s10914-022-09608-6](https://doi.org/10.1007/s10914-022-09608-6)

• Zhang M, Liu Y, Hou XG, Ortega-Hernández J, Mai H, Schmidt M, Melzer RR, Guo J (2022) Ventral morphology of the non-trilobite arthropod *Retifacies abnormalis* Hou, Chen & Lu, 1989, from the early Cambrian Chengjiang biota, China. *Biology* 11:1235 DOI: [10.3390/biology11081235](https://doi.org/10.3390/biology11081235)

• Zhang X, Liu Y, O'Flynn RJ, Schmidt M, Melzer RR, Hou X, Mai H, Guo J, Ortega-Hernández J (2022) Ventral organization of *Jianfengia multisegmentalis* Hou, and its implications for the head segmentation of megacheirans. *Palaeontology* e12624 DOI: [10.1111/pala.12624](https://doi.org/10.1111/pala.12624)

• Zhang Y, Farrell AP (2022) Testing the hypoxia tolerance and hypoxic performance of fishes: A two-tier screening approach. *Front Mar Sci* 9:939239 DOI: [10.3389/fmars.2022.939239](https://doi.org/10.3389/fmars.2022.939239)

• Zhang Y, Montgomery DW, White CF, et al (2022) Characterizing the hypoxic performance of a fish using a new metric: P AAS-50. *J Exp Biol* 225:jeb244239 DOI: [10.1242/jeb.244239](https://doi.org/10.1242/jeb.244239)



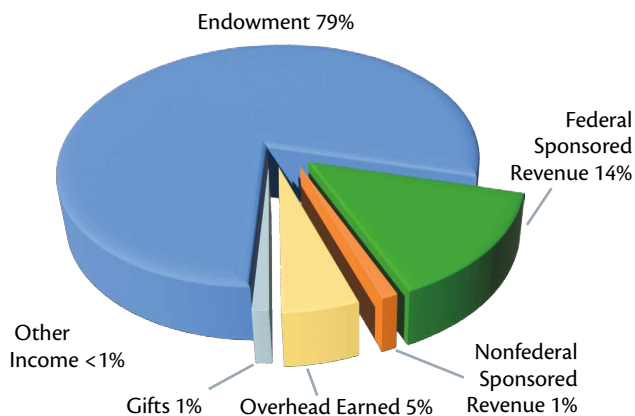
# FINANCIAL DATA

These charts describe the income and expenses of the Museum of Comparative Zoology in fiscal year 2022.

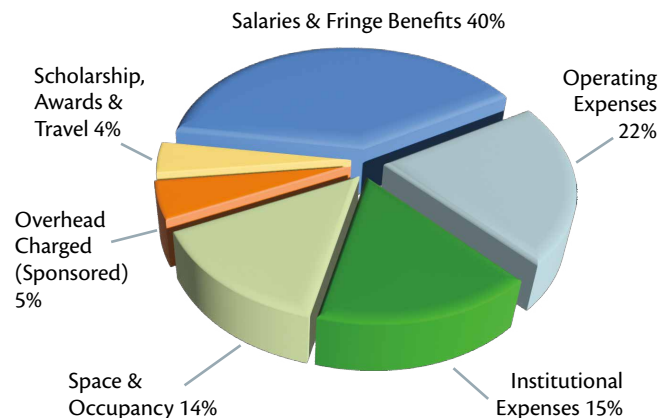
**Endowment** income funds much of the Museum’s activities, such as acquisition and maintenance of collections, faculty and staff salaries, capital projects, and facilities renovation and maintenance. It includes the annual distribution (payout) and endowed funds decapitalized per donor request. **Gifts** are donations received in support of Museum activities that are available for current use; this does not include donations for endowed funds. **Other Income** comprises miscellaneous income from publication subscriptions, royalties, sales and fees, and cost recovery from other MCZ-sponsored activities. **Overhead** is funds paid from sponsored projects to cover associated facilities and administrative costs. It is shown as both income (**Overhead Earned**) and expenses (**Overhead Charged**). **Accumulation of Unrestricted Reserves** indicates net growth of balances in unrestricted gifts and

endowments from, for example, interest payments and unspent portions of the current year’s endowment payouts. **Accumulation of Restricted Reserves** indicates net growth in highly restricted fund balances. 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 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



## EXPENSES & NON-OPERATING FUNDS



### Income

Endowment	\$18,933,474
Federal Sponsored Revenue	\$3,332,713
Overhead Earned	\$1,162,463
Nonfederal Sponsored Revenue	\$295,845
Gifts	\$270,750
Other Income	\$32,182
Accumulation of Restricted Reserves*	(\$36,472)
Accumulation of Unrestricted Reserves*	(\$2,407,560)
<b>Total</b>	<b>\$21,583,395</b>

### Expenses

Salaries & Fringe Benefits	\$8,580,549
Operating Expenses	\$4,707,776
Institutional Expenses	\$3,355,273
Space & Occupancy	\$2,982,070
Overhead Charged (Sponsored)	\$1,162,463
Scholarships, Awards & Travel	\$795,264
<b>Total</b>	<b>\$21,583,395</b>

\*Accounts for income received but not spent in FY22



# 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  
Monique & Philip Lehner Professor for  
the Study of Latin America; Professor  
of Organismic & Evolutionary Biology;  
Curator of Entomology

Gonzalo Giribet  
Professor of Organismic &  
Evolutionary Biology; Alexander  
Agassiz Professor of Zoology; MCZ  
Director; Curator of Invertebrate  
Zoology; Acting Curator of  
Malacology

James Hanken  
Professor of Biology; Alexander  
Agassiz Professor of Zoology;  
Curator of Herpetology

Hopi E. Hoekstra  
C.Y. Chan Professor of Arts &  
Sciences; Professor of Organismic  
& Evolutionary Biology; Professor  
of Molecular & Cellular Biology;  
Alexander Agassiz Professor of  
Zoology; Howard Hughes Medical  
Institute Investigator; Curator of  
Mammalogy

George V. Lauder  
Henry Bryant Bigelow Professor  
of Ichthyology; Harvard College  
Professor; Curator of Ichthyology

Javier Ortega-Hernández  
Assistant Professor of Organismic  
& Evolutionary Biology; Curator of  
Invertebrate Paleontology

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

Stephanie E. Pierce  
Professor of Organismic and  
Evolutionary Biology; Curator of  
Vertebrate Paleontology

Mansi Srivastava  
Professor of Organismic and  
Evolutionary Biology; Curator of  
Invertebrate Zoology

## Emeritus Faculty

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

Robert M. Woollacott  
Professor of Biology, Emeritus

## Postdoctoral Fellows, Research Associates & Visiting Scholars

Pauline Affatato  
Invertebrate Paleontology, Ortega-  
Hernández Lab

Alan Rodrigo Batistão  
Invertebrate Zoology, Giribet Lab

Chawalida Benjangkaprasert  
Vertebrate Paleontology, S. Pierce Lab

Peter Bishop  
Vertebrate Paleontology, S. Pierce Lab

Diego Biston Vaz  
Ichthyology, Lauder Lab

D. Marcela Bolaños  
Invertebrate Zoology, Srivastava Lab

Robert Boria  
Ornithology, Edwards Lab

Robert Brocklehurst  
Vertebrate Paleontology, S. Pierce Lab

Paul Bump  
Invertebrate Zoology, Srivastava Lab

Daren Card  
Ornithology, Edwards Lab

Vikram Chandra  
Invertebrate Zoology, Srivastava Lab

Júlia Chaumel Cerda  
Ichthyology, Lauder Lab

Richard Childers  
Entomology, N. Pierce Lab

Lucas Del Mouro  
Invertebrate Paleontology, Ortega-  
Hernández Lab

Shahan Derkarabetian  
Invertebrate Zoology, Giribet Lab

Niklas Dreyer  
Invertebrate Zoology, Giribet Lab

Bohao Fang  
Ornithology, Edwards Lab

Sonali Garg  
Herpetology, Hanken Lab

Patrick Gemmill  
Ornithology, Edwards Lab

Amandine Gillet  
Vertebrate Paleontology, S. Pierce Lab

Elsa Goerig  
Ichthyology, Lauder Lab

Sara González Delgado  
Invertebrate Zoology, Giribet Lab

Aaron Hartmann  
Invertebrate Zoology, Giribet Lab

Shuonan He  
Mammalogy, Hoekstra Lab

Katrina Jones  
Vertebrate Paleontology, S. Pierce Lab

Nicholas Jourjine  
Mammalogy, Hoekstra Lab

Joy Julius  
Invertebrate Paleontology, Ortega-  
Hernández Lab

Allison Kann  
Invertebrate Zoology, Srivastava Lab

Andreas Kautt  
Mammalogy, Hoekstra Lab

Julian Kimura  
Invertebrate Zoology, Srivastava Lab

Georgios Kolyfetis  
Ornithology, Edwards Lab

Gunnar Kramer  
Ornithology, Edwards Lab

Rudy Lerosey-Aubril  
Invertebrate Paleontology, Ortega-  
Hernández Lab

Cong Liu  
Entomology, N. Pierce Lab

Hector Lorente Martinez  
Ornithology, Edwards Lab

Javier Luque Cifuentes  
Invertebrate Paleontology, Ortega-  
Hernández Lab

Israel Moreno Contreras  
Ornithology, Edwards Lab

Shinichi Nakahara  
Entomology, N. Pierce Lab

Karma Nanglu  
Invertebrate Paleontology, Ortega-  
Hernández Lab

Gabby Neves Guilhon  
Vertebrate Paleontology, S. Pierce Lab

Michael Nicolai  
Ornithology, Edwards Lab

Daniel Paluh  
Herpetology, Hanken Lab

Yu Pan  
Ichthyology, Lauder Lab

Tiago Rodrigues Simões  
Vertebrate Paleontology, S. Pierce Lab

Whitney Preisser  
Invertebrate Zoology, Giribet Lab

Paula Rodríguez-Flores  
Invertebrate Zoology, Giribet Lab

Andres Rojas  
Invertebrate Zoology, Srivastava Lab

Mehdi Saadat  
Ichthyology, Lauder Lab

Nacho Sanguinetti-Scheck  
Mammalogy, Hoekstra Lab

Hevana Santana de Lima  
Ornithology, Edwards Lab

Shoyo Sato  
Invertebrate Zoology, Giribet Lab

Carl Schmitt  
Ornithology, Edwards Lab

Subir Shakya  
Ornithology, Edwards Lab

Molly Gabler Smith  
Ichthyology, Lauder Lab

Anshuman Swain  
Invertebrate Paleontology, Ortega-  
Hernández Lab

Flavia Termignoni Garcia  
Ornithology, Edwards Lab

Robin Thandiackal  
Ichthyology, Lauder Lab

Cheng-Chia Tsai  
Entomology, S. Pierce Lab

Kelsey Tyssowski  
Mammalogy, Hoekstra Lab

Zhengyang Wang  
Entomology, N. Pierce Lab

Megan Whitney  
Vertebrate Paleontology, S. Pierce Lab

Joanna Wolfe  
Invertebrate Paleontology, Ortega-  
Hernández Lab

Tyler Wooldridge  
Mammalogy, Hoekstra Lab

Xianfa Xie  
Ornithology, Edwards Lab

Magdalena Zagalska Neubauer  
Ornithology, Edwards Lab

Yangfan Zhang  
Ichthyology, Lauder Lab

## Graduate Students

Katherine Angier  
Invertebrate Zoology, Giribet Lab

Jennifer Austiff  
Herpetology, Hanken Lab

Catriona Breen  
Invertebrate Zoology, Srivastava Lab

Wei-Ping Chan  
Entomology, N. Pierce Lab

Kaylin Chong  
Entomology, Farrell Lab

Alexandria DiGiacomo  
Ornithology, Edwards Lab

Landen Gozashti  
Mammalogy, Hoekstra Lab

Olivia Harringmeyer  
Mammalogy, Hoekstra Lab

Evan Hoki  
Entomology, N. Pierce Lab

Ryan Hulett  
Invertebrate Zoology, Srivastava Lab

Breanna Jordan  
Invertebrate Zoology, Giribet Lab

Sang Il Kim  
Entomology, Farrell Lab

Richard Knecht  
Entomology, N. Pierce Lab

Kelsie Lopez  
Ornithology, Edwards Lab

Arianna Lord  
Invertebrate Zoology, Giribet Lab

Sarah Losso  
Invertebrate Paleontology, Ortega-  
Hernández Lab

Sophia MacRae Orzechowski  
Ornithology, Edwards Lab

Marc Mapalo  
Invertebrate Paleontology, Ortega-  
Hernández Lab

David Matthews  
Ichthyology, Lauder Lab

Jared Richards  
Invertebrate Paleontology, Ortega-  
Hernández Lab

Amber Rock  
Invertebrate Zoology, Srivastava Lab

Samantha Royle  
Herpetology, Hanken Lab



## PERSONNEL

Shoyo Sato  
*Invertebrate Zoology, Giribet Lab*

Catherine Strong  
*Vertebrate Paleontology, S. Pierce Lab*

Julius Tabin  
*Mammalogy, Hoekstra Lab*

Galen Tiong  
*Entomology, N. Pierce Lab*

Wendy Valencia Montoya  
*Entomology, N. Pierce Lab*

Connor White  
*Ichthyology, Lauder Lab*

R. Zane Wolf  
*Ichthyology, Lauder Lab*

Maya Woolfolk  
*Mammalogy, Hoekstra Lab*

Mark Wright  
*Vertebrate Paleontology, S. Pierce Lab*

### Associates

Bruce Archibald  
*Associate of Entomology  
Simon Fraser University*

Aaron Bauer  
*Associate of Herpetology  
Villanova University*

Reinier Beeuwkes III  
*Associate of the Concord Field  
Station; Ischemix, LLC (MA)*

James Blake  
*Associate of Invertebrate Zoology  
Independent Researcher*

Elizabeth Brainerd  
*Associate of Ichthyology  
Brown University*

Gustavo Bravo  
*Associate of Ornithology  
Humboldt Institute, Colombia*

Janet Collett  
*Associate of Population Genetics  
University of Sussex*

David Bruce Conn  
*Associate of Invertebrate Zoology  
Berry College*

James Costa  
*Associate of Entomology  
Western Carolina University*

Stefan Cover  
*Associate of Entomology  
Independent Researcher*

James Costa  
*Associate of Entomology  
Western Carolina University*

Catherine Craig  
*Associate of Invertebrate Zoology  
Independent Researcher*

Harlan Dean  
*Associate of Invertebrate Zoology  
University of Massachusetts, Boston*

Gregory D. Edgecombe  
*Associate of Invertebrate Zoology  
Natural History Museum, London*

Ben Evans  
*Associate of Herpetology  
McMaster University*

Brooke E. Flammang  
*Associate of Ichthyology  
New Jersey Institute of Technology*

Michael Hadfield  
*Associate of Marine Biology  
Kewalo Marine Laboratory*

Berthold Hölldobler  
*Associate of Entomology  
Arizona State University*

Gustavo Hormiga  
*Associate of Invertebrate Zoology  
The George Washington University*

Michael Huben  
*Associate of Entomology  
Independent Researcher*

Samuel Jaffe  
*Associate of Entomology  
The Caterpillar Lab*

Alan Kabat  
*Associate of Malacology  
Attorney, Bernabei & Wachtel*

Leslie S. Kaufman  
*Associate of Ichthyology  
Boston University*

Anthony E. Kiszewski  
*Associate of Entomology  
Bentley University*

Nicolai Konow  
*Associate of the Concord Field  
Station  
University of Massachusetts, Lowell*

Phillip Lobel  
*Associate of Ichthyology  
Boston University*

David Lohman  
*Associate of Entomology  
The City College of New York*

Vladimir A. Lukhtanov  
*Associate of Entomology  
Russian Academy of Sciences*

D. Luke Mahler  
*Associate of Herpetology  
University of Toronto*

James Mallet  
*Associate of Entomology  
Harvard University*

Bruno A.S. de Medeiros  
*Associate of Entomology  
Smithsonian Tropical Research  
Institute*

Axel Meyer  
*Associate of Ichthyology  
University of Konstanz*

Piotr Naskrecki  
*Associate of Entomology  
EO Wilson Biodiversity Library*

Paulo Petry  
*Associate of Ichthyology  
The Nature Conservancy*

Ricardo Pinto da Rocha  
*Associate of Invertebrate Zoology  
University of São Paulo*

Christian Rabeling  
*Associate of Entomology  
Arizona State University*

Michael Reed  
*Associate of Ornithology  
Tufts University*

Michael Rex  
*Associate of Malacology  
University of Massachusetts, Boston*

R. Graham Reynolds  
*Associate of Herpetology  
University of North Carolina,  
Asheville*

Jessica Rykken  
*Associate of Entomology  
Harvard University*

Carl Schmitt  
*Associate of Ornithology  
Independent Researcher*

Donna Schmitt  
*Associate of Ornithology  
Independent Researcher*

Andrea Sequeira  
*Associate of Entomology  
Wellesley College*

Steven O. Shattuck  
*Associate of Entomology  
Commonwealth Scientific &  
Industrial Research Organization*

Scott R. Shaw  
*Associate of Entomology  
University of Wyoming*

James Traniello  
*Associate of Entomology  
Boston University*

Marvilee Wake  
*Associate of Herpetology  
University of California, Berkeley*

Philip S. Ward  
*Associate of Entomology  
University of California, Davis*

Jacqueline Webb  
*Associate of Ichthyology  
University of Rhode Island*

Haven Wiley  
*Associate of Ornithology  
University of North Carolina,  
Chapel Hill*

Cheryl Wilga  
*Associate of Ichthyology  
University of Rhode Island*

Judith Winston  
*Associate of Invertebrate Zoology  
Virginia Museum of Natural History*

### Staff

Melissa Aja  
*Administrative Manager*

Sarah Arnold  
*Research Assistant, Srivastava Lab*

Tess Avery  
*Laboratory Assistant, Lauder Lab*

Adam Baldinger  
*Curatorial Associate, Invertebrate  
Zoology*

Tracy Barbaro  
*Faculty Coordinator, S. Pierce Lab*

Gerardo Barreda  
*Faculty Coordinator, Giribet Lab*

Penny Benson  
*Curatorial Assistant, Malacology*

Eva Biedron  
*Curatorial Assistant, Invertebrate &  
Vertebrate Paleontology*

Nina Black  
*Curatorial Assistant, Collections  
Operations*

Emily Blank  
*Curatorial Assistant, Collections  
Operations*

Ronnie Broadfoot  
*Coordinator of Access Services,  
Ernst Mayr Library*

Christina Byrd  
*Curatorial Associate, Vertebrate  
Paleontology*

April Collins  
*Acquisitions & Technology  
Specialist, Ernst Mayr Library*

Jessica Cundiff  
*Curatorial Associate, Invertebrate  
Paleontology*

Joseph deVeer  
*Library Project Manager & Museum  
Liaison, Ernst Mayr Library*

Kate Eldridge  
*Curatorial Assistant, Ornithology*

Charles Farnum  
*Curatorial Assistant, Entomology*

Zoe Flores  
*Curatorial Assistant, Entomology*

Matthew Gage  
*Curatorial Assistant, Herpetology*

Jennifer Goldstein  
*Curatorial Assistant, Invertebrate  
Zoology*

Cyrus Green  
*Curatorial Assistant, Vertebrate  
Paleontology  
Invertebrate Paleontology  
Technician & Preparator*

Cory Hahn  
*Animal Technician, Herpetology &  
Ichthyology*

Brendan Haley  
*Senior Database Manager*

Robert Higgins  
*Research Assistant, Vertebrate  
Paleontology*

Andra Hollis  
*Staff Assistant, Concord Field  
Station*

Kathleen Horton  
*Assistant with Professor Wilson,  
Entomology*

Samuel Howard  
*Curatorial Assistant, Entomology*

Nikki Hughes  
*Faculty Assistant, Mammalogy*

Scott Johnston  
*Vertebrate Paleontology Technician &  
Preparator*

Amie Jones  
*Faculty Assistant, Entomology*

Michelle Kennedy  
*Collections Information & Database  
Specialist*

Stevie Kennedy-Gold  
*Curatorial Associate, Herpetology*

Chris Kirby  
*Research Assistant, Mammalogy*

Jeremy Kisala  
*Curatorial Assistant, Collections  
Operations*



Lisa Litchfield  
*Coordinator, Concord Field Station*

David Lubertazzi  
*Research Scientist, Entomology*

Crystal Maier  
*Curatorial Associate, Entomology*

Joseph Martinez  
*Curatorial Assistant, Herpetology*

Patrick McCormack  
*Curatorial Assistant, Entomology*

Sade McFadden  
*Research Assistant, Hoekstra Lab*

Nicole Mejia  
*Laboratory Technician, Ornithology*

Melissa Merkel  
*Curatorial Assistant, Malacology & Invertebrate Zoology*

John Mewherter  
*Curatorial Assistant, Collections Operations*

Rina Morisawa  
*Curatorial Assistant, Invertebrate Zoology*

Paul J. Morris  
*Biodiversity Informatics Manager*

Madeleine Mullon  
*Curatorial Associate, Mammalogy*

Catherine Musinsky  
*Faculty Assistant, Mammalogy*

Mark Omura  
*Curatorial Associate, Mammalogy*

Melinda Peterson  
*Research Lab Coordinator, Edwards Lab*

Bridget Power  
*Faculty Coordinator, Herpetology & Invertebrate Paleontology*

Pedro Ramirez  
*Research Assistant, Concord Field Station*

Jennalee Ramnarine  
*Curatorial Assistant, Entomology*

Murat Recevik  
*Curatorial Assistant, Malacology*

Mark Renczkowski  
*Curatorial Assistant, Invertebrate Paleontology*

Phoebe Richardson  
*Research Assistant, Hoekstra Lab*

Alana Rivera  
*Curatorial Assistant, Malacology & Invertebrate Zoology*

Mary Sears  
*Head of Public Services, Ernst Mayr Library*

Meaghan Sorce  
*Curatorial Assistant, Ichthyology*

Margaret Starvish  
*Faculty Assistant, Entomology & Ichthyology*

Tsuyoshi Takahashi  
*Curatorial Assistant, Herpetology & Collections Operations*

Jennifer Thomson  
*Lab Administrator, Invertebrate Zoology*

Jennifer Trimble  
*Curatorial Associate, Malacology*

Jeremiah Trimble  
*Curatorial Associate, Ornithology*

Diana Turmenne  
*Curatorial Assistant, Collections Operations*

Kenneth Wilcox  
*Building Superintendent*

Andrew Williston  
*Curatorial Associate, Ichthyology*

Jonathan Woodward  
*Senior Curatorial Technician, Collections Operations*

Robert Young  
*Special Collections Librarian, Ernst Mayr Library*

Breda Zimkus  
*Director, Collections Operations*

### Temporary Staff

Johanna Arnet  
*Entomology*

Matthew Baldinger  
*Malacology*

Martin Bonder  
*Entomology*

Laura Borrelli  
*Mammalogy*

William Brister  
*Malacology*

Hlib Burtsev  
*Entomology*

Daren Card  
*MCZ Seminars*

Even Dankowicz  
*Entomology*

Anne Everly  
*Ichthyology*

Lillian Feldman  
*Entomology*

Giuliana Fillion  
*Invertebrate Zoology & Malacology*

Zoe Flores  
*Entomology*

Natalia Fuentes  
*Ornithology*

Josue Guerrero  
*Vertebrate Paleontology*

Sophia Hitt  
*Invertebrate Paleontology*

Jackson Kehoe  
*Entomology*

Adam Kowalczyk  
*Collections Operations*

Laura Leibensperger  
*Invertebrate Zoology*

Orlando Moreno  
*Concord Field Station*

Joseph Negreann  
*Entomology*

Alexis Rizzuto  
*Ornithology*

Andrew Tan  
*Entomology*

Michelle Tang  
*Invertebrate Zoology & Malacology*

Gary Taylor  
*Concord Field Station*

Chidambaram Thillairajah  
*Ornithology*

Jocelyn Wang  
*Entomology*

Cynthia Wang-Claypool  
*Ornithology & Collections Operations*

Jalen Winstanley  
*Entomology*

### Administration for the Department of Organismic & Evolutionary Biology

Ognenka Avramovska  
*Education & Outreach Manager*

Janelle Batista  
*Financial Associate*

Tiara Borneman  
*HR Coordinator*

Lydia Carmosino  
*Senior Academic Programs Administrator*

Rebecca Chetham  
*Executive Director*

Chaolyn Clay  
*Financial Associate*

Sarine Der Kaloustian  
*Associate Director of Administration*

Christian Flynn  
*Senior Administrative Coordinator*

Feven Girmay  
*Assistant Director, Graduate Program*

Diana Gjino  
*Senior Research Administrator*

Wendy Heywood  
*Communications Specialist*

Kathy Jean-Louis  
*Manager of Financial Operations*

Jasmine Khlieng  
*Financial Associate*

Julie Knippa Colby  
*Associate Director of Finance & Research Administration*

Jenna Legault  
*Senior Research Administrator*

Megan McHugh  
*Human Resources Administrator*

Kristin Pennarun  
*Assistant Director of Research Administration*

Christopher Preheim  
*Senior Academic Administrator*

Emily Reynolds  
*Senior Research Administrator*

Margaret (Peg) Richards  
*Financial Associate*

Liliana Teixeira-Davis  
*Senior Research Administrator*

The MCZ deeply appreciates the additional support and contributions of numerous interns and undergraduate students during the 2022–2023 academic year.

### MCZ Faculty

The MCZ's charter, signed in 1859, mandates that the Museum's activities will be overseen by a governing board, the Faculty of the Museum of Comparative Zoology.

Dr. Elizabeth Kane

Mr. George Putnam III

Mr. Jeff Tarr

Dr. Barbara Jil Wu

Harvard University  
President Lawrence S. Bacow

### Acknowledgements

This annual report was produced by the Office of the Director of the Museum of Comparative Zoology.

#### Editors

Melissa Aja, Administrative Manager  
Gonzalo Giribet, Director

#### Copy, Design & Production

Cyndi Wood  
Creative Project Management, Inc.  
creativeprojectmgmt.com





**HARVARD**  
MUSEUM OF COMPARATIVE ZOOLOGY



26 Oxford Street  
Cambridge, MA 02138  
617.495.2460  
mcz.harvard.edu



mczharvard