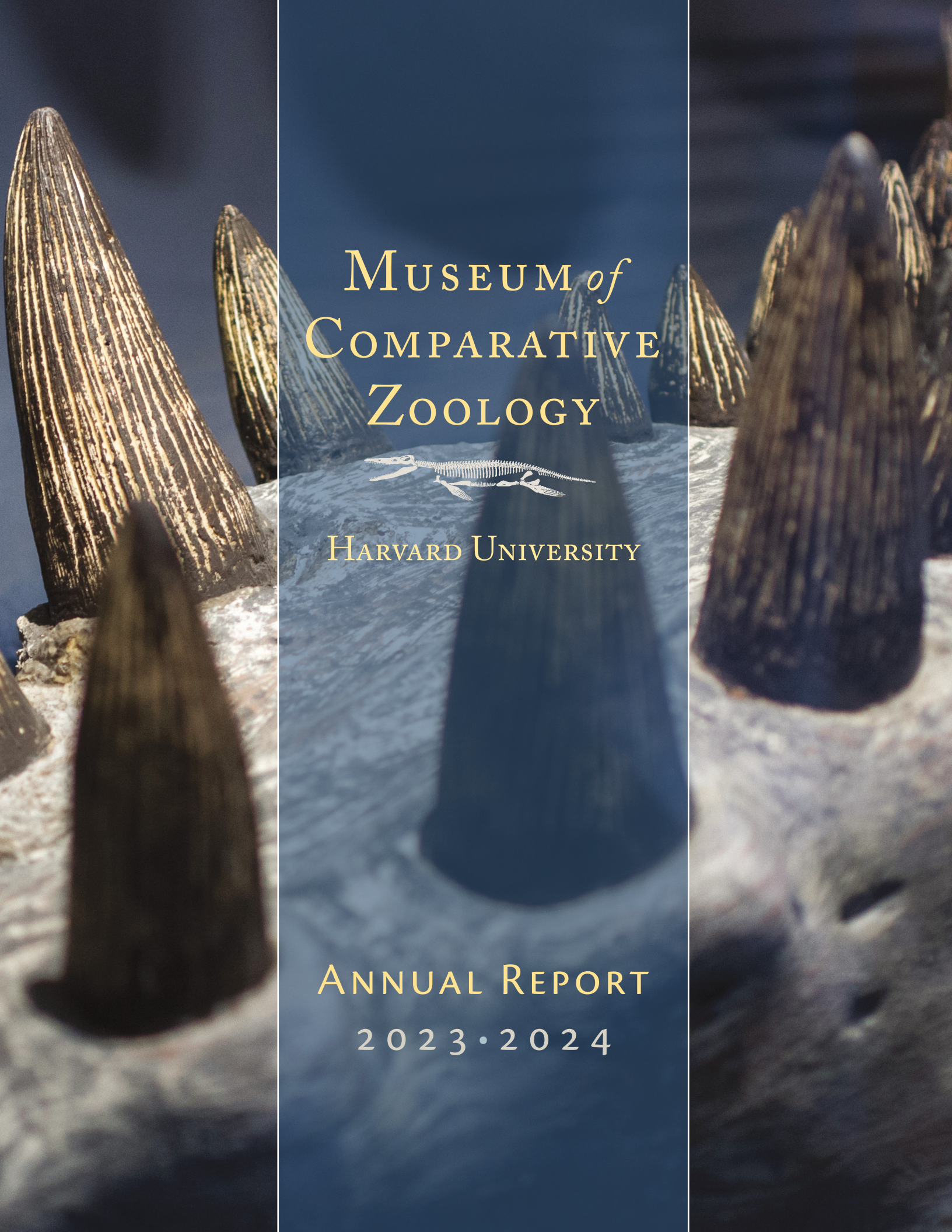
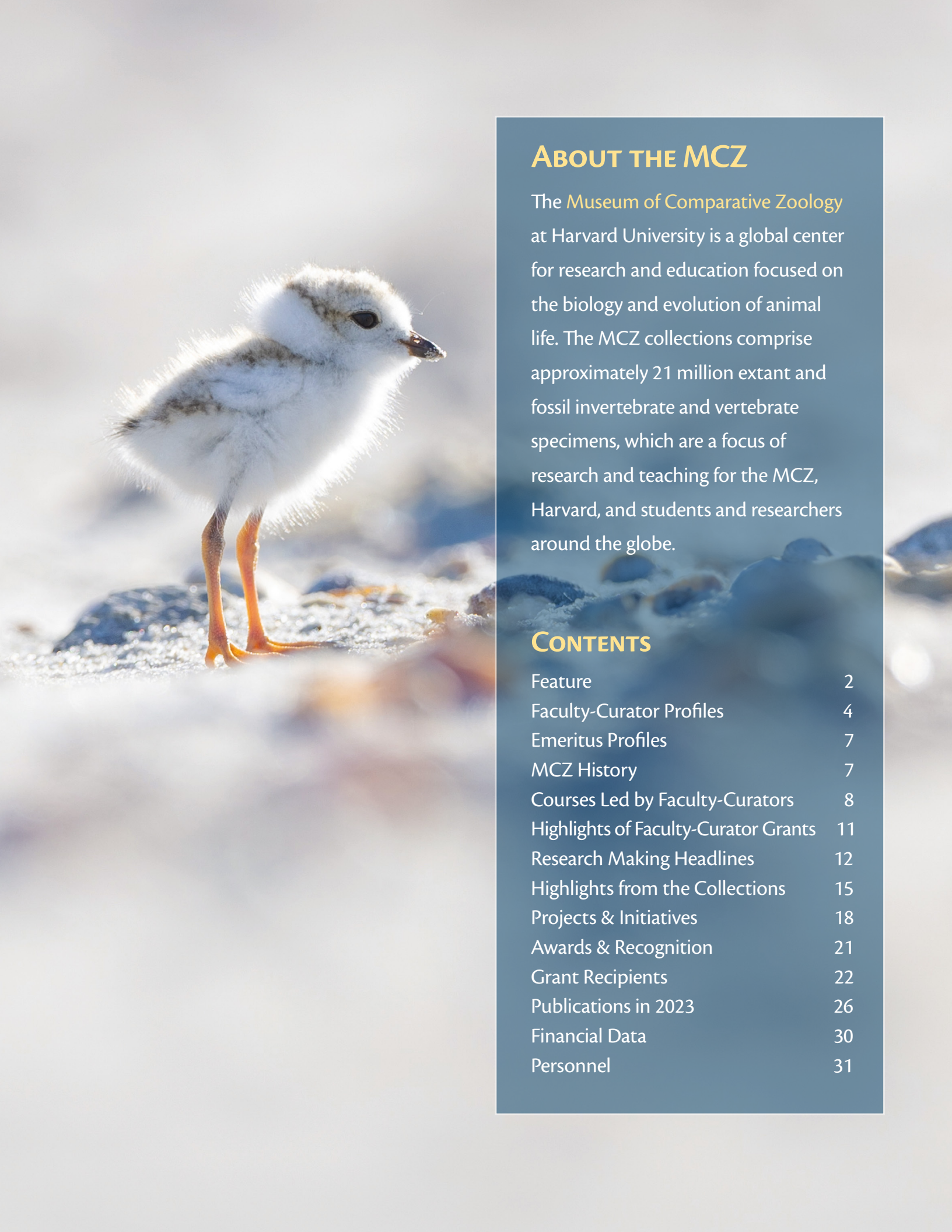


Museum of Comparative Zoology

Harvard University

Annual Report

2023•2024



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

Director's Message

The MCZ has been bursting with activity, and we have seen many changes in this busy year full of accomplishments.

James Hanken, our director from 2002 to 2021, retired after a long tenure at the MCZ. Jim's work at the helm of the Museum left us with state-of-the-art collection facilities and a database that is a beacon in the museum world. Likewise, Andrew Biewener retired this year, leaving the directorship of his beloved **Concord Field Station** that he led for 26 years. The MCZ and CFS are vibrant places thanks to their leadership, as reflected by the many colleagues and students who talked about their exemplary roles as colleagues and mentors during a celebratory lunch attended by MCZ staff, former students and close colleagues. Following their retirement, we were fortunate to have been approved for two faculty-curator searches, and we hope to fill these positions in 2025.

Our partner institution, the **Harvard Museums of Science and Culture**, has welcomed a new executive director, Caroline Fernald. Caroline joined us from the Phoebe A. Hearst Museum at the University of California, Berkeley, where she served as executive director for four years. In the short time since her arrival, she has been a wonderful partner to the MCZ. The exhibit *Sea Monsters: Wonders of Nature and Imagination* opened this summer, and it is the first of many exhibits featuring MCZ specimens to come under her direction.

People often ask me how hard it is being director of a large institution such as the MCZ. My first response has always been that it is not hard at all, as I am surrounded by an incredible team of wonderful colleagues. But it is not just me saying this. A recent visit from the **SIGNIFY** team to image all the Singapore types in the MCZ, which you can read about in this report, resulted in many compliments about how the MCZ staff welcomed them and facilitated their project. Darren C.J. Yeo, head of the Lee Kong Chian Natural History Museum, sent me this note after the visit from his team: "I'm jumping in now to express my heartfelt thanks for the fantastic support and brilliant hospitality that you and your colleagues at MCZ have given to us and our SIGNIFY team." Emails like this make me proud to be part of this wonderful institution, and I hear similar messages from visitors to all our collections. I hope the MCZ continues to be a welcoming and open place, for our mission is none other than making biodiversity research available to everyone and for everyone.

This year we have also started exploring and identifying MCZ specimens that may fall under the Native American Graves Protection and Repatriation Act (NAGPRA). Since 1990, federal law has provided for the protection and return of Native American human remains, funerary objects, sacred objects and objects of cultural patrimony. We are now engaging with tribes and appropriate stakeholders regarding MCZ specimens that may fall under this important Act.

All in all, the year has been full of events and efforts to make the Museum more accessible to outside researchers, more sensitive to past practices and more engaged with the role of a modern museum in our changing world.

Melissa Aja

Gonzalo Giribet
Director

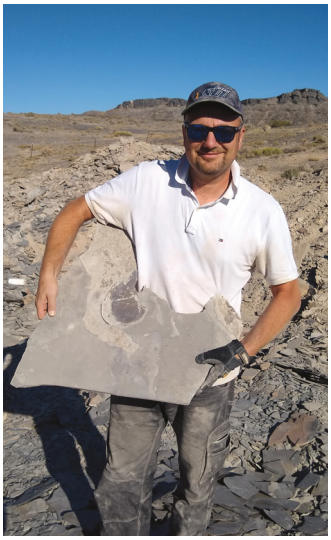
On the cover: Lower jaw and teeth of the *Kronosaurus queenslandicus* specimen on exhibit in the Harvard Museum of Natural History. Four teeth on display are fossils while others are reconstructed. This specimen, MCZ:VP:VPRA-1285, was collected in 1932. Photo by Thomas Earle, Harvard staff photographer

Inside cover: Piping plover chick on the white sands of Cape Cod, Massachusetts. Photo by Gonzalo Giribet

Discovering a Fossilized Marine Oasis in Utah

MCZ researchers have uncovered a treasure trove of 500-million-year-old fossils that greatly expands our understanding of early animal life.

Marjum biota reconstruction. Illustration by Holly Sullivan



Rudy Lerosey-Aubril holding a Marjum slab in 2022

Javier Ortega-Hernández, curator in Invertebrate Paleontology, and Research Scientist **Rudy Lerosey-Aubril** are interested in the origin of animals as informed by exceptionally preserved fossils from Lower Paleozoic deposits. Their main research expertise addresses the major evolutionary event popularly known as the Cambrian Explosion, a key period in the history of the planet that saw the first appearance of complex animals and their diverse body plans more than half a billion years ago.

"Today's biosphere is teeming with animals, and we want to understand where all of this biodiversity came from," says Ortega-Hernández. "The conventional fossil record consists of mineralized parts such as shells and bones, but we want to learn about the soft-bodied organisms that make up 80% of marine animal diversity today." The research team focuses on the study of exceptional fossil assemblages as critical windows into lost biodiversity, unique modes of life and ancient community structures. "This is why we go to Utah's West Desert and other remote parts of the world, to find these exceedingly rare fossils."

Exceptionally preserved fossils result from special geochemical conditions that prevent the degradation of delicate tissues and internal organs. These sites are rare around the world, with the most well-known being the mid-Cambrian Burgess Shale in British Columbia and the lower Cambrian Chengjiang site in Southern China. However, viewing the Cambrian evolution of life solely through the lens of these two biotas limits understanding of how animal life flourished in the oceans at that time, especially around Laurentia, the ancient geologic core of North America. This issue underscores the urgency to discover new fossil sites from other geographic areas that have comparable biodiversity and preservation quality to provide a more complete picture of animal origins in deep time.

Ortega-Hernández and Lerosey-Aubril have been collecting fossils in western Utah for over ten years. In 2019, they examined a new collection of Cambrian fossils at the Natural History Museum of Utah (NHMU) in Salt Lake City that piqued their interest. Because NHMU paleontologists are mainly focused on dinosaurs, they were excited to have Cambrian specialists helping with this collection. "They had recently received more than 2,250 fossils from the Wheeler, Marjum and Weeks formations, the three remarkable deposits we were investigating in western Utah," says Lerosey-Aubril. "We kept seeing amazing fossils every day for a week."

Later that summer, they returned to Utah to arrange a conference field trip. With their collaborators Jacob Skabelund, a professional fossil collector, and Robert Gaines, professor of geology at Pomona College, they visited a small, abandoned outcrop of the Marjum Formation. In an hour—and with hand tools only—they gathered a handful of soft-bodied fossils that immediately looked familiar to the two Harvard scientists. "Their preservation, and the rock containing them, reminded us of some of the nicest fossils we had just seen at NHMU," continues Lerosey-Aubril. The researchers had planned to return the following year, but the

Covid pandemic completely disrupted travel for two years.

In October 2022, the team finally headed back to the 500-million-year-old Marjum site with a permit from the Bureau of Land Management allowing them to open up a quarry for a large-scale dig. "The sight of the huge excavator moving slowly down the hill looking like a mechanical dinosaur was surreal," says Lerosey-Aubril. "The excavator churned up the rock quickly, saving us hundreds of hours of effort." The two-week dig, attended by Ortega-Hernández, Lerosey-Aubril, Skabelund, Lucas Del Mouro (then a MCZ postdoctoral researcher) and Robert Coleman (volunteer), led to the collection of over 900 specimens for the MCZ—85% of them soft-bodied—and identification of the strata associated with exceptional preservation.

Once the site's potential was demonstrated, the two researchers obtained MCZ Putnam Expedition Grants for both the 2023 and 2024 field seasons, collecting a total of over 2,100 fossils and discovering 60 new species or new occurrences of species to date.

"The Putnam Expedition Grants were enormously appreciated seed funding that proved key to the success of this exploratory stage," says Ortega-Hernández. "Now that we have data to show and a documented source of new spectacularly preserved material, we can propose hypothesis-driven research that is much more competitive for federal funding, which can sustain the project in the longer term."

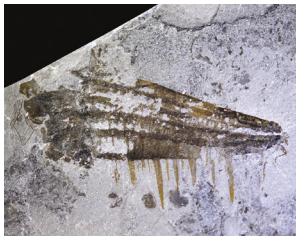
In addition to their contributions to science, the site and the materials hold great educational merit by giving students the opportunity to gain experience in the field and in the lab, which can sometimes produce happy surprises. One of these serendipities occurred when Natalie Morgan, a visiting intern from Smith College, was unpacking fossils in the MCZ. "A slab just broke in her hands," says Lerosey-Aubril, "and there was a fossil so gorgeous that it became a holotype, the reference specimen for a new species."

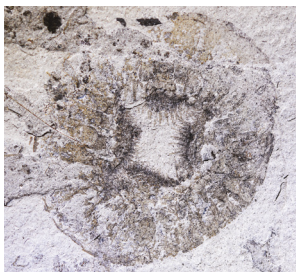
Opening the quarry in 2022

Another time, Lerosey-Aubril split open a slab in the lab to better observe a partially exposed fossil. "Completely exposed, the fossil turned out to be a new arthropod, 15 cm long with three eyes and over 60 body segments, something totally unexpected in beds of that age."

"Every time we return to Utah, we keep finding exciting new organisms," says Ortega-Hernández. "We're still very much in an exponential discovery phase, but in three years the site has yielded so much material that meaningful comparisons with the Burgess Shale and Chengjiang biotas can already be drawn. This is the best Cambrian locality in the United States, hands down." This project has also strengthened collaborations within and beyond Harvard by hosting diverse participants, including Lucas del Mouro (University of São Paulo), Elizabeth Kane (MCZ Faculty Governing Board), Luke Parry (University of Oxford), Shannah Peters (University of Wisconsin), and Randall Irmis and Chad Ostrander (University of Utah).

"It has been instrumental that the MCZ is so committed to the growth of natural history collections," he continues. "There is really a culture within the MCZ that encourages people to go to the field, make discoveries and build collections that will be used by generations of scientists. This is something both of us cherish about this institution."





From top: Appendage (top) and oral cone of a new radiodont; a palaeoscolecid worm (*Arrakiscolex*)

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 in Ornithology
Chair, Department of Organismic & Evolutionary Biology

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*.

Kris Snibbe/Harvard University

Brian D. Farrell

Monique & Philip Lehner Professor for the Study of Latin America
Professor of Organismic & Evolutionary Biology
Curator in 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. He is working on bringing together ways of measuring biophilia for a book project.

Casey Dunn

Gonzalo Giribet

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

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 and exploring techniques to use degraded DNA from old museum specimens in phylogenomics and population genomics. Ongoing research focuses on evolution of a diversity of terrestrial arthropod lineages, including arachnids and myriapods, as well as evolution of molluscs and several marine invertebrates.

Kris Snibbe/Harvard University

Hopi E. Hoekstra

Edgerley Family Dean of the Faculty of Arts & Sciences
C.Y. Chan Professor of Arts & Sciences
Xiaomeng Tong & Yu Chen Professor of Life Sciences
Curator in Mammalogy (on leave)

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.

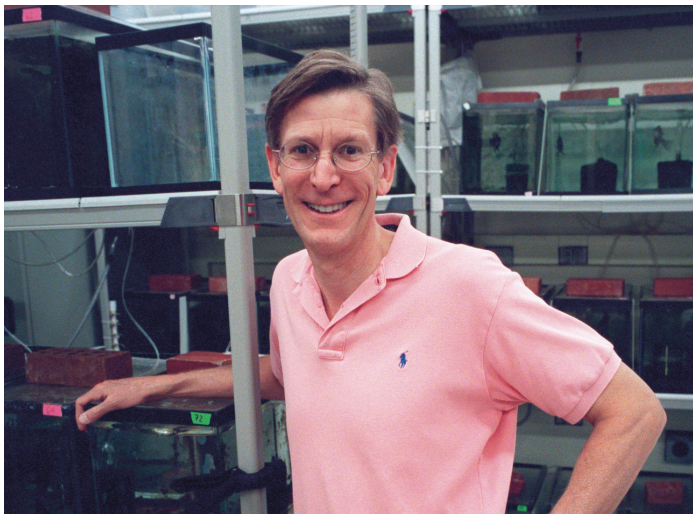
Catherine Weisel

James Hanken

Professor of Biology
Alexander Agassiz Professor of Zoology
Curator in 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
Curator in 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.

Javier Ortega-Hernández

Associate Professor of Organismic & Evolutionary Biology

Curator in Invertebrate Paleontology

Prof. Ortega-Hernández's research focuses on the evolution of metazoans that first appeared and rapidly diversified during the Paleozoic Era (ca. 539 to 251 million years ago). His group specializes in the study of exceptionally preserved Cambrian and Ordovician fossil biotas around the world, with strong interests in the morphology, ecology, phylogeny and development of invertebrate animals. The team brings together experts on the first diverse molting animals, or ecdysozoans, including distant ancestors of modern-day arthropods and velvet worms, with a growing interest in other groups with exceptional preservation such as early deuterostomes, comb jellies and sponges. The lab combines collection and fieldwork-based paleontology with cutting-edge imaging and analytical techniques to obtain new data from key fossil specimens, 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.

Isabella Kirkland

Naomi E. Pierce

Sidney A. & John H. Hessel Professor of Biology

Curator in 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.

Stephanie E. Pierce

Professor of Organismic & Evolutionary Biology

Alexander Agassiz Professor of Zoology

Curator in Vertebrate Paleontology

Acting Curator in Mammalogy

Paul Whatmough

Prof. Pierce's research is focused on major morphological and ecological transitions in vertebrate evolution through an examination of the fossil record. Her work spans almost all vertebrate groups, from the earliest tetrapods to emerge onto land through to modern-day amphibians, reptiles and mammals. Studies tend towards transformation of the musculoskeletal system, including feeding and locomotion, with particular attention on the link between form and function across macroevolutionary timescales.

Mansi Srivastava

Professor of Organismic & Evolutionary Biology

Curator in Invertebrate Zoology

Melissa Aja

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.

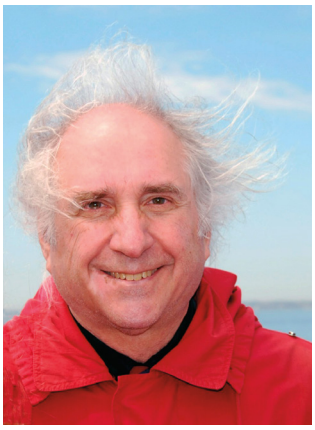
Emeritus Profiles

Justin Ide

A. W. "Fuzz" Crompton

Faculty-Curator Emeritus
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

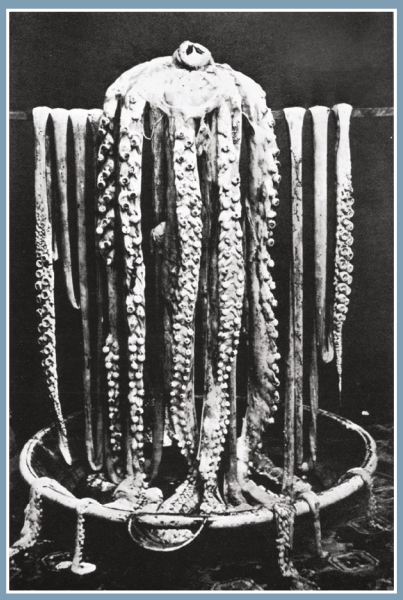
Professor of Biology, Emeritus

Robert M. Woollacott is a professor of biology emeritus. He joined the Harvard faculty in 1972 and retired in 2018. Prof. Woollacott is the founding chairman of the Department of Organismic and Evolutionary Biology. His focus is human impact on life in the sea.

MCZ History

Few sea creatures have inspired as much fascination as the giant squid, one of the most feared and least understood of our extant marine animals. Tales of the giant squid, including the Norse legend of the *Kraken*, have been part of folklore for hundreds of years. These tales were so common among seafarers of yore that giant squids were among the sea monsters that decorated the edges of ancient navigation charts. The giant squid was mentioned by Aristotle and described by Pliny the Elder in his *Natural History* to have a head "as big as a cask," arms 30 feet long, and a carcass weighing 700 pounds. But outside of descriptions and drawings, there was little proof of their existence—that is, until the late 19th century.

In 1873, fishermen in Logy Bay, Newfoundland, Canada, caught something more than fish in their nets. They took the giant squid to Rev. Moses Harvey—known to have an interest in these animals since he had previously inspected tentacle pieces—who recognized the opportunity to document a creature that was otherwise mythical. The fishermen had cut the specimen into two pieces—the body and the arms—and Harvey arranged for a photographic studio to document the giant squid. The body and tentacles were draped over a T-bar, and the photograph went on to make international headlines.



Giant squid from Logy Bay, Newfoundland, Canada (1873)

The fabulous specimen measured about fifteen meters, including the two long feeding tentacles, which are considerably longer than the remaining eight arms. Parts of the animal were sent to museums, including the Yale Peabody Museum and the MCZ. Two specimens, MCZ:Mala:362981 (a tentacle, arm tissue and other body parts) and MCZ:Mala:388029 (the beak), are currently on display in the exhibit *Sea Monsters: Wonders of Nature and Imagination* at the Harvard Museum of Natural History. However, this is not the oldest known specimen of giant squid. The type specimens used by Japetus Steenstrup for the description of *Architeuthis dux* in 1857—collected in Denmark and the U.S. in 1853 and 1855, respectively—are held at the Natural History Museum of Denmark.

Courses Led by Faculty-Curators

Academic Year 2023–2024

OEB 51: Biology & Evolution of Invertebrate Animals

OEB 217R: What Makes a Turtle?

Organismic & Evolutionary Biology

OEB 10: Foundations of Biological Diversity

Brian D. Farrell, Mansi Srivastava (and Elena Kramer, 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 (and Cassandra Extavour)

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. Topics include classical ethology; behavioral endocrinology; behavioral genetics; learning and memory; communication; orientation, migration and biological rhythms; optimal foraging; evolutionary stable strategies; sexual selection; parental investment and mating systems; selfishness, altruism, and reciprocity; and sociality in vertebrates and invertebrates.

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 125: Genome Analysis, Ecology and Evolution
Scott V. Edwards

A survey of theory and applications of DNA technologies to the study of evolutionary, ecological and behavioral processes in natural populations. Topics include the evolution of genes, genomes and proteins; the neutral theory of molecular evolution and molecular clocks; population genomics and phylogenetic principles of speciation and phylogeography; metagenomics of microbial communities; relatedness and behavioral ecology; molecular ecology of infectious disease; and conservation genetics.

OEB 155R: Biology of Insects
Naomi E. Pierce

An introduction to the major groups of insects. The life history, morphology, physiology and ecology of the main taxa are examined. Topics include the phylogeny of terrestrial arthropods, an analysis of abiotic and biotic factors regulating populations, and the use of insects in biological control.

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

An introduction to the biology of birds. Covers the fossil record and theories for avian origins, physiology and anatomy; higher-level systematics and field characters of the ~27 orders; speciation processes, nesting and courtship behavior; vocalizations, mating systems and sexual selection; cooperative breeding; demography; and conservation. Optional field trip during spring break. Laboratories will consist of gross anatomy; bird-watching excursions in the Cambridge area; field techniques and specimen preparation; and systematic study of avian groups using the collections of the Museum of Comparative Zoology.

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

A student-directed course that explores the biology of different focal animals through a mixture of discussions, cadaveric dissection and anatomical observation. Discussion topics will be broad and far reaching, and dependent on the students' interests, but could include such things as evolutionary dynamics, ecomorphology, functional performance, conservation, disease, etc. Alongside in-class discussions, students will participate in dissecting cadaveric material with the aim to build hands-on anatomical skills.

FRSEMR 41U: Museums in the Aftermath of Covid

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.

Freshman Seminar

FRSEMR 22T: Why We Animals Sing
Brian D. Farrell

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

Nadja Drabon

OEB 56: The History & Evolution of Life on Earth

OEB 190: Biology & Diversity of Birds

Nadja Drabon

OEB 56: The History & Evolution of Life on Earth

FRSEMR 41U: Museums in the Aftermath of Covid

James Hanken

The recent Covid-19 pandemic exacted a huge toll on museums, causing great harm but forcing long-overdue changes that capitalize on new opportunities. This seminar will trace the history of museums and consider the role of museums in contemporary society, the objects maintained in museums and their conservation, financial conditions for successful operation, their dual functions of scholarly research and public display, the mechanics and psychology of exhibit design, and legal and ethical issues of collecting and acquisition. The seminar's focus will range from large art, archaeological and natural history museums to smaller and more specialized institutions that feature particular cultural, scientific, artistic and engineering artifacts.

FRSEMR 52L: Life and Death Lessons from the Fossil Record

Javier Ortega-Hernández

Explores the rich world of paleontology and its bearing on human activities, including how cutting-edge scientific research informs our understanding of the main processes that have influenced the evolution of life on Earth for approximately four billion years, including episodes of global warming/cooling and mass extinction events.

Mind, Brain & Behavior

MBB 980AA: Drug Use in Nature

Naomi E. Pierce

Explores the diverse ways that organisms perceive, extract and use drugs in their natural environments. Examines the how and why of drug use in nature through different scientific perspectives, including evolutionary biology, behavioral ecology, molecular biology, chemistry, anthropology and psychology.

Harvard Extension School

MUSE E-153: The Modern Natural History Museum: Theory and Practice

Gonzalo Giribet, Breda Zimkus

Graduate Courses of Reading & Research

OEB 306: Invertebrate Paleobiology and Evolution

Javier Ortega-Hernández

OEB 307: Biomechanics, Physiology and Musculoskeletal Biology

Andrew A. Biewener

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

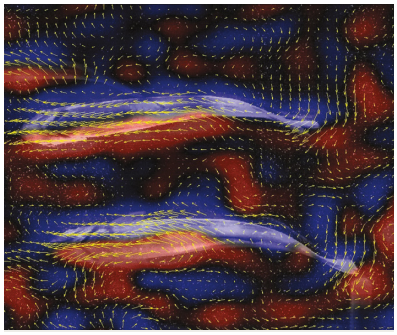
Highlights of Faculty-Curator Grants

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.

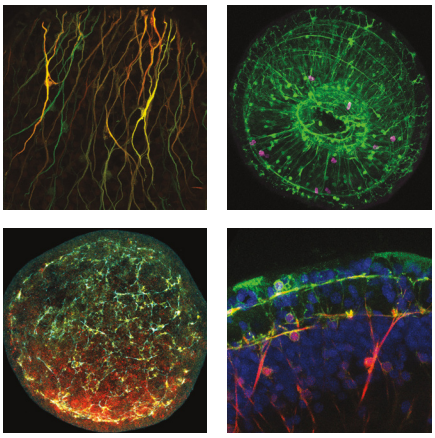
"Faculty-Curator grants constitute the basis for a large component of the research happening in the MCZ," says Director Giribet. "They showcase the cutting-edge nature of the work undertaken by our faculty-curators and their students and postdoctoral fellows. The competitive grants highlighted here are examples of the diverse nature of this research."

George V. Lauder is a Co-Principal Investigator for *The Dynamics of Fish Schools as Robust Decentralized Networks in Turbulent Environments*, a three-year $419,933 research grant from the Office of Naval Research.

Schooling is a fascinating phenomenon observed in numerous fish species, where individuals come together in organized groups, displaying collective behavior and accomplishing many challenging tasks. Even with an observable overall coherence of the school, the fish move constantly within it, which can be important for the school to behave as a robust decentralized network and survive in complex turbulent aquatic environments.



The team of two PIs, with complementary expertise in turbulence and fish locomotion, will investigate whether schooling behavior is a mechanism for a group of fish to efficiently filter hydrodynamic noise and amplify coherent signals. The researchers will use a facility at Johns Hopkins University that can control the mean water flow rate and the characteristics of turbulence separately. A companion facility at Harvard University will conduct measurements of fish schooling behaviors using giant danio (*Devario aequipinnatus*) and rainbow trout (*Oncorhynchus mykiss*) to study the effect of fish size, swimming speed and turbulence level on the energetic cost of swimming. The results will be compared for insights into how fish respond to incoming turbulence.



Mansi Srivastava is the Principal Investigator for *Stem Cell Regulation During Development and Whole-Body Regeneration*, a five-year $2,320,550 research grant from the National Institutes of Health/ National Institute of General Medical Services. Although the early embryos of humans and other vertebrates have pluripotent cells that can differentiate into all cell types, these flexible cells are absent in adults. In contrast, many invertebrate animals harbor adult pluripotent stem cells (aPSCs) that enable whole-body regeneration.

The objective of this research is to identify the molecular and cellular mechanisms that regulate aPSCs called "neoblasts" in the acoel *Hofstenia miamia,* the three-banded panther worm. *Hofstenia* can regenerate any missing cell type and is amenable to high-throughput functional studies of regeneration. It produces manipulable embryos in large numbers, and the research will combine lineage-tracing methods with functional genomics approaches to uncover and characterize critical regulatory control of pluripotent cells.

Transgenesis, a technique recently developed in *Hofstenia* by the PI, will be used to specifically label neoblast subpopulations with fluorescent substances to trace their fates. Live imaging of differentiating neoblast progeny will study morphogenetic processes that assemble newly regenerated tissues. RNA interference or CRISPR-Cas9 gene editing will be used to study gene function.

Research Making Headlines

Opening Museum Collections to Everyone

The openVertebrate (oVert) Thematic Collections Network has been a six-year collaborative project to increase access to, and the impact of, preserved specimens in natural history collections by using 3D imaging to create high-fidelity digital specimens and make them freely available online. **James Hanken** was Principal Investigator (PI) for the National Science Foundation–funded component at Harvard, and the MCZ was one of oVert's six scanning centers located throughout the U.S. Curatorial Assistant **Matt Gage** prepared scans and conducted subsequent data curation and analysis for the effort. David C. Blackburn, a faculty member at the University of Florida and MCZ alumn, was lead PI for the project overall.

The 3D digital specimens were created by preparing high-resolution computed tomography (CT) scans of the skeleton, contrast-enhanced CT scans to reveal internal organs and other soft tissues, surface scanning for large skeletons and photogrammetry to add color to 3D models. As of 2023, oVert had generated 29,000 media files for more than 13,000 specimens, including most living amphibian and reptile genera and more than half of all genera of fishes, birds and mammals. These files have been viewed over a million times via MorphoSource (morphosource.org).

In their paper in *BioScience*, the researchers describe the efforts by the 18 participating U.S. institutions and the impact these data have had on a broad audience of scientists, students, teachers, artists and other non-specialists. Looking forward, the authors identify the need to develop analytical tools for researchers and provide resources and training in data use for teachers as some of the next steps for fully realizing the potential impact of digital 3D specimens.

Blackburn DC and 38 others including Gage MW, Hanken J (2024) Increasing the impact of vertebrate scientific collections through 3D imaging: The openVertebrate (oVert) Thematic Collections Network. *BioScience* 74:169–186 DOI: 10.1093/biosci/biad120

Ancient DNA Comes to Life

Keels and wing structures (or lack thereof) in an ostrich, rhea, little bush moa and tinamou. Illustration by Wren Lu '19

Scientists understand modern birds through their physical form, genetics, behavior and distribution, but for extinct species, scientists have mainly been limited to the study of their fossilized bones. Now, using ancient DNA, extinct species can come back to "life" and shed new light on their biology and natural history.

Using ancient DNA extracted from the toe bone of a museum specimen, **Scott V. Edwards**, former Edwards lab members Maude Baldwin, Alison Cloutie, Phil Grayson and other team members sequenced the genome of the little bush moa, *Anomalopteryx didiformis*, an extinct flightless bird. At about 60 pounds, the little bush moa was the smallest of nine known species of moa, all extinct, that lived in the forests of the North and South Islands of New Zealand. Unlike some flightless and flying birds (such as the moa's closest relative, the tinamou), the moa were completely without a keel.

The researchers used high-throughput sequencing, which allows recovery of short segments of DNA, to characterize the mitochondrial genome and, for the first time, assemble the nuclear genome by mapping little bush moa reads to a high-quality genome of the emu (*Dromaius novaehollandiae*). They found evidence that the eyes of the little bush moa could see ultraviolet light and they had a full set of taste receptors, including bitter and umami. The researchers were also able to estimate a population size of 240,000 prior to the arrival of human settlers that hunted the little bush moa to extinction around 700 years ago. Further study of the moa genome will help reveal more aspects of their biology, such as the development of flightlessness in the moa and other birds.

Edwards SV, Cloutier A, Cockburn G, Driver R, Grayson P, Katch K, Baldwin M, Sackton TB, Baker AJ (2024) A nuclear genome assembly of an extinct flightless bird, the little bush moa. *Sci Adv* 10:eadj6823 DOI:10.1126/sciadv.adj6823

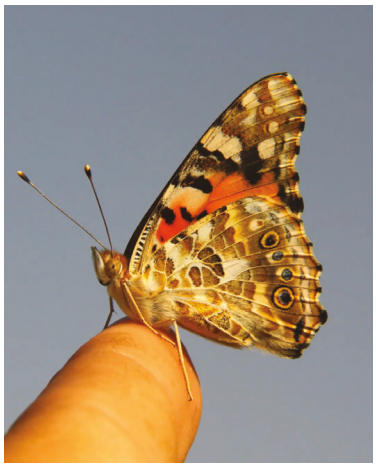
A Long, Strange Trip

In October 2013, a mystery began that took ten years and countless hours of effort to solve. That's when entomologist Gerard Talavera came across a group of butterflies, wings tattered and bodies exhausted, on a beach in French Guiana. They were painted lady butterflies, *Vanessa cardui*, found around the world but not in South America. So where were they from and how did they get there?

Painted lady butterflies are strong migrators, traveling 9,000 miles from Europe to sub-Saharan Africa, and Talavera suspected these may have traveled 2,600 miles across the Atlantic Ocean. Could they have made it with no stop to rest or refuel? In *Nature Communications*, Talavera, **Naomi E. Pierce** and other researchers describe their integrative approach to determine the answer. First they reconstructed wind trajectories and found strong winds that could have swept the butterflies off course and assisted them in crossing the ocean. Second, they analyzed the genome of the butterflies to determine that they were of European-African origin, thus ruling out that they came from North America. Third, they isolated DNA from pollen grains clinging to the butterflies' bodies, finding that it matched shrubs that flower in Africa from August to September. Lastly, they geolocated the natal origin of the butterflies to Western Europe and West Africa.

The team then assessed the feasibility of a five- to eight-day transatlantic crossing by investigating the energetic requirements of different flight strategies. Without wind, the butterflies could only travel about 485 miles without refueling and, with wind, they would only make it about 1180 miles. So they must have been using a strategy of alternating between active flight and lower-effort flight, mostly gliding and flapping only to stay aloft. The combination of methods in this research may be useful in tracking other instances of insect long-distance dispersal.

Suchan T, Bataille CP, Reich MS, Toro-Delgado E, Vila R, Pierce NE, Talavera G (2024) A trans-oceanic flight of over 4,200 km by painted lady butterflies. *Nat Commun* 15:5205 DOI: 10.1038/s41467-024-49079-2



Vanessa cardui

Ongoing Amphibian Decline

Sonali Garg, biodiversity postdoctoral fellow, and **Sathyabhama Das Biju**, MCZ associate, are co-authors of a study that assesses the global status of amphibians. It is an examination and amplification of the 2004 Global Amphibian Assessment (GAA1) and the subsequent 2022 Global Amphibian Assessment (GAA2). The landmark GAA1, published on the IUCN Red List, used data from 1980 to 2004 to determine that amphibians are the most threatened class of vertebrates worldwide, which still held true with GAA2 in 2022.

Since GAA1, information on population trends, ecological requirements, threats and distributional boundaries of amphibians has improved considerably and amphibian systematics have advanced, but this new information can introduce biases in the data. This study used current data from more than 100 scientists to estimate a backcasted Red List category for each species in 1980 and 2004 and examined only genuine status changes. With these data and the GAA2 assessments, they re-examined the global status and trends and presented new insights on threats.

The status of amphibians worldwide continues to deteriorate. Currently 41% of species are globally threatened compared with 38% in 1980 and 39% in 2024. Geographic areas where species are under the greatest pressure were identified; the biggest dangers are habitat degradation and loss, disease and, increasingly, climate change. The study shows that conservation actions like habitat protection can be effective and provides a crucial update that informs the prioritization, planning and monitoring of conservation actions.

Luedtke JA and 96 others including Biju SD, Garg S (2023) Ongoing declines for the world's amphibians in the face of emerging threats. *Nature* 622:308–314 DOI: 10.1038/s41586-023-06578-4

Critically endangered *Mysticellus franki*. Photo by Sathyabhama Das Biju

Discovering a Prehistoric Worm

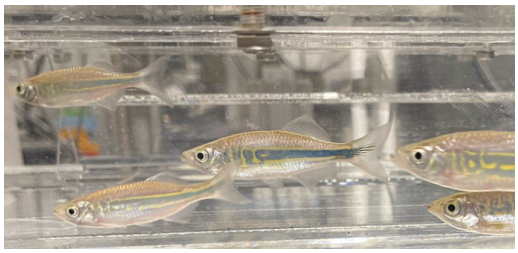
Selkirkia tsering

Scalidophoran worms with circular spines were diverse and common components of early and middle Cambrian Burgess Shale–type fossil biotas, and the worms in the genus *Selkirkia* represent the earliest record of tube dwelling for the group. *Selkirkia* species were found worldwide during the Cambrian. They ranged in size up to three inches long and circlets of pharyngeal teeth indicate their predatory nature. In *Biology Letters*, **Javier Ortega-Hernández** and Postdoctoral Fellow **Karma Nanglu** describe *Selkirkia tsering*, a new species of this type of worm.

The exceptionally preserved fossils from the Fezouata Shale biota of Morocco detail their ringed, secreted tube and their soft bodies and, surprisingly, demonstrate their survival for 25 million years longer than previously thought. The researchers examined fossils from the Invertebrate Paleontology collections of the MCZ and Yale and found that the form of *Selkirkia*'s tube remained basically the same for 40 million years, and its longevity puts it in the realm of "Cambrian survivors" existing alongside Ordovician life forms. Because there is only one living, but much smaller, tube-dwelling worm in the genus *Maccabeus* that makes its shelter out of plant matter, the researchers posit that the hard tube of *Selkirkia* was an effective protective strategy in the Cambrian seas when there weren't many large predators, but it became less effective against the Ordovician ocean's free-swimming predators and was eventually abandoned.

Nanglu K, Ortega-Hernández J (2024) Post-Cambrian survival of the tubicolous scalidophoran *Selkirkia*. *Biol Lett* 20:20240042 DOI: 10.1098/rsbl.2024.0042

Beneficial Schooling



Many creatures move through fluids like air and water in coordinated groups, like birds migrating in a V-shaped formation or fish swimming in schools. While scientists suspect that animals do this for various evolutionary reasons—feeding, mating or protection from predators—measuring the energetic benefits of this behavior has been difficult. In two papers, **George V. Lauder** and Postdoctoral Fellow **Yangfan Zhang** describe their methods for measuring the reduced energy costs of fish moving in schools and demonstrate that collective movement is a shelter from turbulence.

Their experiments use a swim-tunnel respirometer (above), a sealed "aquatic treadmill" in which fish swim against various water flow speeds. The respirometer measures aerobic energy use through oxygen depletion in the water during exercise, while anaerobic (glycolytic) energy expenditure is measured by excess oxygen consumption after exercise. By looking at both aerobic and anaerobic energy use, the researchers were able to develop a complete picture of total energy expenditure. In addition, high-speed video was employed to study the 3D movements of individual and schooling fish in the experiments, in which giant danio (*Devario aequipinnatus*) swam solo and in schools of 8 at 14 different water flow rates. Analysis of the results revealed that, in non-turbulent water, the total energy expenditure of schooling fish was reduced by 56% compared to individual fish; they recovered more quickly after exercise; and the most energy-efficient speed for a school is around one body length per second, the average migratory speed of fish species. When turbulence was added to the water flows, the total energy expenditure of schooling fish swimming at high speeds and turbulence levels was 63% to 79% less than solitary fish. Schooling fish in turbulence grouped together more closely, reducing their volume 41% to 68% to mitigate turbulence.

Zhang Y, Lauder GV (2023) Energy conservation by collective movement in schooling fish. *eLife* 12:RP90352 DOI: 10.7554/eLife.90352

Zhang Y, Ko H, Calicchia MA, Ni R, Lauder GV (2024) Collective movement of schooling fish reduces the costs of locomotion in turbulent conditions. *PLoS Biol* 22:e3002501 DOI: 10.1371/journal.pbio.3002501

Highlights from the Collections

A Significant Global Partnership

SIGNIFY (Singapore in Global Natural History Museums Information Facility) is an initiative of the Lee Kong Chian Natural History Museum at the National University of Singapore. The project's goal is to digitize and document approximately 10,000 historically important specimens collected from Singapore over the last 200 years that are currently housed in museums worldwide, such as the MCZ, with an emphasis on types—the specimens on which scientific names are based. Such specimens are essential to studying and distinguishing species in order to further understand Singapore's natural heritage and its natural environment. Members of the SIGNIFY team—Research Associate and project manager Lydia Gan and Research Assistants Paul Ng and Deon Lee—visited the MCZ for five weeks in spring 2024, spending time among the specimens in the Entomology, Herpetology, Ichthyology, Invertebrate Zoology, Malacology, Mammalogy and Ornithology collections.

Deon Lee, Paul Ng & Lydia Gan

"The SIGNIFY team imaged approximately 45 herpetology specimens, ranging from frogs to pythons, and improved our knowledge of the specimens and their histories with their experience with Singaporean animals and collectors," says **Stevie Kennedy-Gold**, curatorial associate in Herpetology. "For example, they showed us the specific tags that Alfred Russel Wallace frequently used, allowing us to be more aware of the collecting history of the specimens, and informed us that, although the type specimen of *Python brongersmai* was collected from Singapore, the species is no longer present on the island."

In Ichthyology, the SIGNIFY team imaged 150 specimen lots in just a few days. "We're very hopeful that this digitization of fishes will help improve the visibility and increase use of this relatively underutilized part of our collection," says **Andrew Williston**, curatorial associate in Ichthyology. Ichthyology also learned some very promising techniques for specimen photography from the SIGNIFY team.

In Invertebrate Zoology, the SIGNIFY team selected 62 fluid and dry specimen lots for imaging that included crustaceans, scorpions, spiders, corals and echinoderms from among more than 325 cataloged lots collected from Singapore. Of the selected lots, 23 were type specimens.

"While locating the specimens of interest to them, we discovered many more specimen lots from Singapore in our collection that have not yet been cataloged or databased," says **Adam Baldinger**, curatorial associate in Invertebrate Zoology.

The SIGNIFY team also spent two weeks in Entomology, exploring the collection to find uncataloged material from Singapore and then photographing around 160 insect specimens. "Notably, the Entomology collection has a large diversity of Psocodea, or bark lice, including many types from Singapore, from a gift from Charles Fuller Baker," says **Crystal Maier**, curatorial associate in Entomology.

At the conclusion of their visit, the SIGNIFY team presented a seminar to the MCZ community, detailing their work and sharing their advanced imaging techniques. Their images will be shared with the MCZ and will be available in MCZbase, the collections database.

Clockwise from upper left:

Python brongersmai (MCZ:Herp:R-29779); *Tetraponera vivax* (MCZ:ENT:36361); *Rhizoprionodon oligolinx* (MCZ:ICH:S-180); *Mitra cophina* (MCZ:Mala:370539)

Staff Highlight

Jon Woodward started at the MCZ on a type imaging project in the Entomology Department in 2004, later doing the same for Herpetology while also working in Collections Operations on non-imaging projects. "The half-time position with Collections Operations gave me ground-level insight into collection practices and processes throughout the Museum, which led to a full-time position with Collections Operations and a more technology-oriented set of priorities," he says. Now, after 20 years of on-the-job training, he is the MCZ's digitization manager.

The technology in his field has changed drastically since he began. "I remember when a one-megapixel camera sensor was a big deal! The current cutting edges of 3D, interactivity and high-throughput systems are quite distant from the 2D ambitions of 2004." More importantly, though, there's been a shift in attitude in the field. "Digital access to specimen data and media, particularly when aggregated within and among museums, changes the kinds of questions that science can ask. Rather than some facile distinction between the 'real' specimen and its clunky digital sidecar, we talk now about the 'digital extended specimen.' The most exciting projects and progress in the field reflect this change in understanding."

When asked why museum work is important, he says, "Here's where I get kind of grandiose. Museum work is a practical form of memory, banked on behalf of future research, conservation and—most compellingly—forms of activity we can't imagine yet. Our predecessors never imagined the uses to which science is putting the data they worked so hard to preserve. So today, even in the absence of an ongoing climate crisis and its effects on animal life, there would be an urgent need for such work. Digital representation and distribution of animal specimens is a huge part of this memorial effort."

Mammals on the Move

Some specimens, such as skulls with large horns or antlers or shoulder mounts of large animals, do not easily fit in standard-size museum cases, so spaces on the MCZ's fifth floor are being transformed to store these specimens. Initial minor renovations included painting and upgrades to window treatments and air conditioners, which will help regulate temperatures in these spaces. Once these renovations were complete, art racks made of steel mesh were installed on the walls for hanging specimens.

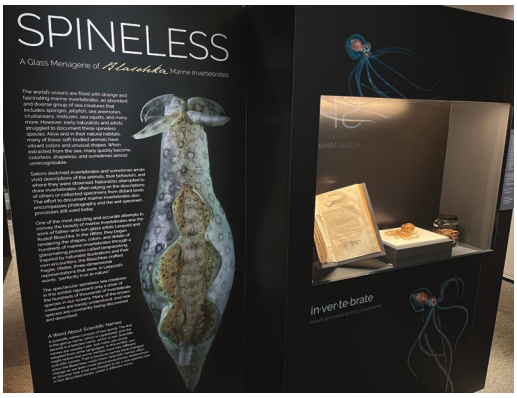
The project began in 2022, and Mammalogy staff are currently moving 533 wall-mounted specimens to the MCZ's fifth floor and 237 wall-mounted specimens to the main collection in the Northwest Building. During this process, the specimens are being treated for pests and curated before being hung in taxonomic order. Additional work in the space will include the installation of shelving for oversized specimens from several departments as well as the renovation of a specific room for large fossils.

Melissa Aja (2)

"Since the main collection was moved to the Northwest Building, larger skulls and other oversized specimens have been housed in temporary storage," says **Mark Omura**, curatorial associate in Mammalogy. "Establishing permanent storage for these specimens is a major step forward to properly curating the collection. The Mammalogy Department staff's dedication to inventory, clean, assess, curate and document these specimens represents a significant effort to improve the collection's storage and accessibility."

Glass Menagerie

The Mystic Seaport Museum in Mystic, Connecticut, is the largest maritime museum in the U.S. In November 2023 they opened *Spineless: A Glass Menagerie of Blaschka Marine Invertebrates*. A rare loan of 41 of the MCZ's stunningly beautiful and scientifically accurate glass models makes up the core of the exhibition, which explores some of the ways that people have tried to represent marine invertebrates—including jellyfish, sea anemones, crustaceans, molluscs like sea slugs and octopuses, sea squirts, sponges and many more—whose delicate bodies are vividly colored in the sea, but fade and lose shape quickly out of the water.



James Hanken

Octopus salutii
(MCZ:SC:382)

Primary among these representations were lifelike glass teaching models, painstakingly fashioned and painted by hand by the father and son team of Leopold and Rudolf Blaschka in Dresden, Germany. The MCZ's glass models were purchased via mail order in the late 19th century. During **James Hanken's** directorship of the MCZ, the collection underwent cleaning and restoration over an eight-year period, culminating in the 2014 Harvard Museum of Natural History's permanent exhibition *Sea Creatures in Glass*, which displays the Museum's collection of 430 invertebrate models on a rotating basis.

Phyllactis praetexta
(MCZ:SC:49)

Breda Zimkus, director of Collections Operations, and **Jon Woodward**, digitization manager, worked with the Mystic Seaport Museum for over a year to select the models for *Spineless* and set them up on display. "The team from Mystic was especially keen to tell a story about invasive species in the Mystic area resulting from global human movement and climate change," says Woodward. "One model, *Clavelina lepadiformis*, became a focal point for this exhibit narrative. The small, unassuming model, made when the species was restricted to European waters, is displayed alongside a wall-sized video by exhibit designer Krystal Rose, showing thousands of individuals swaying in the waters of Mystic Harbor. The models can still serve their original educational purpose." In the exhibition, the Blaschka glass invertebrates are joined by contemporary photography and artworks as well as sailors' journals and rare books containing sketches, watercolors and written descriptions, such as Ward's 1878 *Catalogue of Glass Models of Invertebrate Animals*, loaned by the Ernst Mayr Library. The exhibition will run through early March 2025.

Acquisition from Dr. Willard N. Harman

Melissa Aja (2)

For 56 years, Dr. Willard N. Harman headed up the SUNY Oneonta's Biological Field Station on Otsego Lake in Cooperstown, New York, and he has dedicated much of his 86 years to studying and protecting that lake. In his research, Harmon studied water ecosystems and the effects of water pollution and invasive species, including the reintroduction of native species of fish to control non-native species. In anticipation of his retirement in January 2024, he arranged for his collection of 10,000 specimens (4,000 lots) to be transferred to the MCZ.

This acquisition includes dry and fluid-preserved freshwater mussels, freshwater snails and corresponding sediment samples for a subset of material. The specimens were collected over many decades from New York and other states, and, since many species of mussels are declining, they provide valuable insight into the historical populations. As part of his work on invasive species, the fluid specimens include both native unionid mussels and zebra mussels (*Dreissena polymorpha*), an aquatic invasive species known to affect the native unionid mussels detrimentally. These are some of the earliest records of *Dreissena* mussels from Lake Seneca, New York. "Significant acquisitions, such as this collection from Dr. Harman, focus on species in a specific geographic range over time," says **Jennifer Winifred Trimble**, curatorial associate in Malacology. "Archives of these specimens will allow for future projects to build off of existing datasets."

Projects & Initiatives

Harvard Museums of Science & Culture

Kritsana Hoonsan

Caroline Jean Fernald began her tenure as executive director of Harvard Museums of Science and Culture on January 3, 2024. In her new role, Fernald serves as the public face of HMSC, which is a partnership between six Harvard museums, including the MCZ. Fernald comes to Harvard from the Phoebe A. Hearst Museum at the University of California, Berkeley, where she served as executive director. Before that, she served as executive director of the Millicent Rogers Museum in Taos, New Mexico.

In an interview with the *Harvard Gazette*, Fernald said, "I am looking forward to working closely with the leaders of each of the HMSC museums and the very talented staff team in advancing HMSC's mission, sharing my enthusiasm for museums and each institution's collections with the broader public, and connecting the research and expertise of each museum's faculty and researchers with engaging public programs and exhibits."

A Mini Exhibit for Tiny Beings

Ants and termites are extremely social superorganisms that live in complex societies where colony members work together to survive and reproduce. On March 16, 2024, a new mini exhibit, *Ants and Termites: Nature's Super Organisms*, joined the Harvard Museum of Natural History's popular gallery *Arthropods: Creatures That Rule*.

Ants and termites are master architects and live in resource-efficient nests with ventilation and stable temperature and humidity, which could inspire the design of future eco-friendly and energy-efficient buildings. As "ecosystem engineers," termites alter water and nutrient availability and biodiversity and have great ecological significance.

The MCZ's Entomology collection is among the richest and most historically significant in North America, containing more than 7,500,000 specimens and the primary types of more than 33,000 species. The ant collection alone comprises nearly one million specimens, making it the largest and most important in the world. In *Ants and Termites*, visitors get a window into important parts of this collection. According to **Crystal Maier**, curatorial associate in Entomology, "We lent out specimens for the exhibit, including about 200 pinned ant specimens; a piece of amber with paratypes of *Azteca alpha*, an extinct species of ant; five jars of termites; a termite queen cell; and a cast ant nest created by Walter Tschinkel. Among the pinned ants are some ant-plant mutualists and their Acacia hosts, some of the largest and smallest ants, and even ants that use their heads as doors to their nests!" Maier assisted in selection of the specimens as well as preparation of the specimens in the selected storage, as guided by exhibits staff.

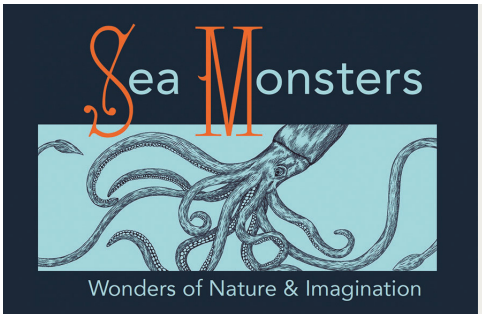
Whale Restoration

Jon Woodward

Since 1882, the MCZ's finback whale skeleton (MCZ:Mamm:59505) has been suspended from the ceiling in the Great Mammal Hall of the Harvard Museum of Natural History. The finback or fin whale (*Balaenoptera physalus*) is a species of baleen whale and the second-largest cetacean after the blue whale, and can grow as large as 85 feet long and weigh around 80 tons. The specimen on display is an adult over 50 feet long that was collected in Provincetown, Massachusetts, in 1879 or 1880.

In October 2023, exhibits staff realized that the skeleton had a cracked vertebra, so the MCZ brought in whale expert and exhibit fabricator Dan DenDanto to make structural repairs. DenDanto's team used conservation techniques that will not cause further damage and are reversible. They also added structural support inside the whale's rib cage to reduce the chance of future breakages. "It is a testament to the preparators' skills that our large whale specimens have been on exhibit for nearly 150 years," says **Mark Omura,** curatorial associate in Mammalogy. "It is our challenge to conserve these specimens with modern techniques to usher them into the future for the next generation to enjoy."

Creatures from the Deep



Sea monsters are a universal phenomenon, appearing in the myths and legends of cultures around the world, and many of these stories originated from real ocean creatures. In the exhibition *Sea Monsters: Wonders of Nature and Imagination*, which opened in June 2024 at the Harvard Museum of Natural History, visitors will discover the existence of these real sea creatures through displays of specimens from the MCZ collections, such as a viperfish, parts of a giant squid and a megalodon tooth.


THE FISHERMEN BATTLE WITH THE GIANT SQUID.

The Malacology collection contributed an octopus along with the beak and a tentacle from a giant squid collected in Logy Bay, Newfoundland, in 1873 (see MCZ History, page 7). "Given the giant squid's rarity, the specimen was photographed and its tissue was sampled for cryopreservation prior to going on exhibit," says **Jennifer Winifred Trimble**, curatorial associate in Malacology.

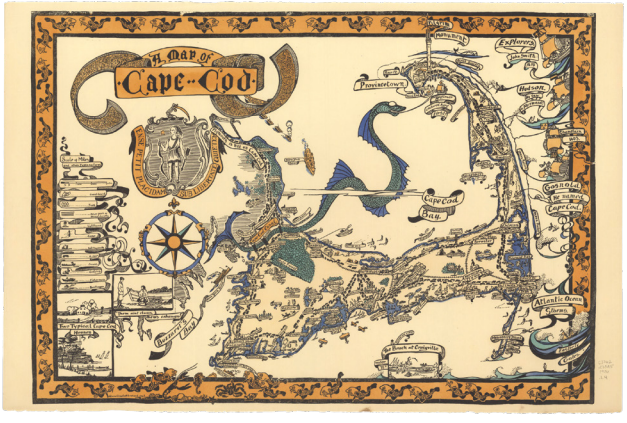
Andrew Williston, curatorial associate in Ichthyology, and **Meaghan Sorce**, curatorial assistant, participated in discussions about potential specimens, eight of which were ultimately included in the exhibit. Their conversation about invasive lionfish led to the exhibit's focus on invasive species.


Melissa Aja


Solvin Zankl

Christina Byrd, curatorial associate in Vertebrate Paleontology, assisted in identifying potential exhibit specimens for the exhibit team's consideration and facilitated the loan of the final selection. "Our specimen of a megalodon tooth is beautifully displayed in the exhibit," she says.

Invertebrate Zoology provided a crown-of-thorns sea star. "This beautifully dry-preserved specimen was collected in October 1913 from the Murray Islands, Australia, and is one of the few specimens in the collection that has the full arrangement of the thorn-like spines covering its body from which the common name is derived," says **Adam Baldinger**, curatorial associate in Invertebrate Zoology.



The exhibition also features historical illustrations of mythical sea monsters and detailed ancient mariners' maps decorated with these creatures. Artifacts like a two-foot Gregorian reflecting telescope made around 1750, decorated with two sea serpents, also appear in the gallery. The exhibition will run through June 2026.

Demystifying Harvard

Michelle Tang

Adam Baldinger mentoring students Damian Gonzalez Rodriguez (above) & Geoffrey Belich (at right)

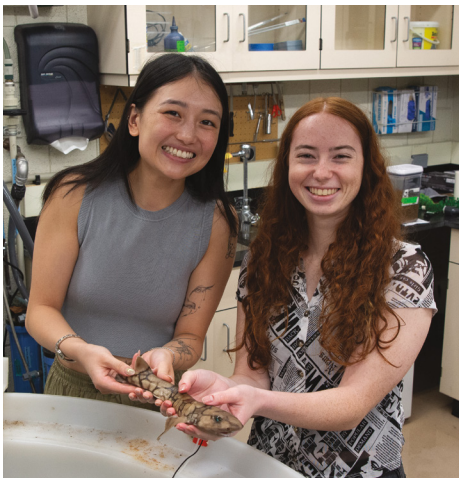
The Emerging Scientists Internship Program is designed to promote interest in and excitement for evolutionary biology and, in effect, demystify Harvard by exposing high school students to the reality of work in research and collections. It's an outgrowth of an informal, multi-year partnership with teachers at the nearby Cambridge Rindge and Latin School.

In October 2023, 80 students from the school participated in Harvard's Evolution Day, hearing talks and visiting labs and collections at the MCZ, among others. Of these students, eight were placed in Emerging Scientist internships in the MCZ and Harvard University Herbaria collections and across labs in OEB and Molecular and Cellular Biology. According to **Julius Tabin**, OEB graduate outreach coordinator, "One of the most important aspects of the program is that it takes place during school hours for class credit, making the experience accessible to students who are otherwise unable to attend after-school and weekend opportunities." This taste of an authentic research experience can lead some students into STEM fields or help clarify the direction of their future studies. And it benefits the mentors, as well.

"I think the mentors really enjoy the energy that young people bring because they're very excited and eager to learn—they just are so curious," says **Ognenka Avramovska**, OEB education and outreach manager, who oversees the program. "I think many of the mentors felt positively challenged with the types of questions these students ask because they see things from a different perspective, which can even help the mentor approach their science in a new way or consider it from a fresh angle. The feedback has been overwhelmingly positive." Support from a Harvard Culture Lab Innovation Fund grant will enable expansion to other local high schools and more internships in 2025 and beyond.

Adam Baldinger

Accessible Sharks



Melissa Aja

Dakota Law & Jade Collins

The Research Experience for Undergraduates program Accessible Sharks, made possible by a National Science Foundation grant, is geared to students with disabilities. The grant has enabled Co-PI **George V. Lauder** to host students in the Lauder lab for the past two summers. For the second and final year of the program, Jade Collins, a biology and computer science major from New Mexico State University, and Dakota Law, a recent engineering graduate from Smith College (who returned for a second year) worked with Postdoctoral Fellow **Molly Gabler-Smith** preparing and analyzing shark denticle samples, the "teeth" on the skin of sharks that help them move so efficiently through the water.

As Lauder explained to the *Harvard Gazette*, "I think lots of us, especially these days, are trying to diversify access to science and the scientific experience. That has many dimensions to it. It has dimensions of race, dimensions of economic accessibility, emotional accessibility, mental health accessibility. We're all trying to diversify science for the future, and this is just a part of that." Lauder and the other PIs hope to expand the program with additional funding.

Awards & Recognition

Scott Edwards with students & assistant professors of Jiangsu Normal University, Xuzhou

Faculty-Curators

Scott Edwards received the 2024 Presidents' Award for Lifetime Achievement from the Society of Systematic Biologists and a supplement to his 2023 Harvard China Fund award for "A Pangenome Approach to Investigating Biodiversity of Birds in China."

Javier Ortega-Hernández was promoted to Associate Professor.

Stephanie E. Pierce and Postdoctoral Fellow **Peter Bishop** were awarded the 2024 Star-Friedman Challenge for Promising Scientific Research for their project, "Biodiversity Collapse and Recovery at the End of the World: Using East Gondwana's Fossil Record to Understand Earth's Greatest Mass Extinction."

Postdoctoral Researchers

Rudy Lerosey-Aubril, in the Ortega-Hernández lab, was appointed a research affiliate of the Natural History Museum of Utah.

Michaël Nicolaï, in the Edwards lab, was awarded the Henri Schouteden Award by the Royal Flemish Academy of Belgium for Science and Arts.

Jon Chase/Harvard University

Stephanie E. Pierce & Peter Bishop

Thalles Lavinscky Pereira, biodiversity postdoctoral fellow in the Farrell lab, was one of five early career scientists to receive a BioOne Ambassador Award.

Kelsey Tyssowski, in the Hoekstra lab, received a Career Transition Award from the National Institutes of Health BRAIN Initiative.

Yangfan Zhang, in the Lauder lab, was featured in the *Journal of Experimental Biology* Spotlight on Researchers and received a Banting Postdoctoral Fellowship.

Zhengyang Wang, in the Naomi E. Pierce lab, was a recipient of National Geographic Society's Wayfinder Awards.

Graduate Students

Sarah Losso was awarded the Winifred Goldring Award by the Association of Women Geoscientists.

Jared Richards was accepted into the Santa Fe Complexity-GAINS International School.

Catie Strong received a Robert A. Chapman Memorial Scholarship for Vertebrate Locomotion from the Harvard Faculty of Arts and Sciences and a postgraduate scholarship from the Natural Sciences and Engineering Research Council of Canada.

Staff

Long-term service anniversaries were celebrated by **Melissa Aja**, administrative manager (15 years); **Tracy Barbaro**, faculty coordinator (15 years); **Anne Everly**, curatorial assistant in Ichthyology (10 years); **Michelle Kennedy**, collections information and database specialist (10 years); and **Mark Renczkowski**, Invertebrate Paleontology (15 years).

The Organismic and Evolutionary Biology **Research Administration Team** received a 2024 Dean's Distinction Award.

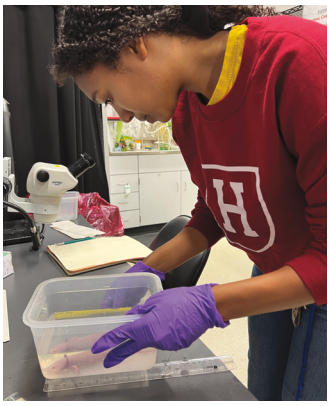
Thalles Lavinscky Pereira

Sarah Losso

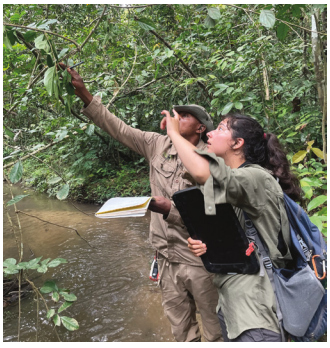
Jared Richards

Summer Smentek

Ella Bradford



Yvonne Burke



Nehir Toklu

Grant Recipients

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
Ella Bradford	OEB/Andrew Davies	Hyenas in the mist: Population ecology of rare rainforest-dwelling spotted hyenas (*Crocuta crocuta*) in the Congo Basin	$1,200
Ella Bradford	OEB/Andrew Davies	Open-ecosystem availability and prey abundance enable persistence of spotted hyena in rainforest	$1,200
Yvonne Burke	OEB/George Lauder	Metabolic cost of regeneration in axolotls	$5,000
Sophia Chen	OEB/Mansi Srivastava	Characterization of pharynx regeneration in *Hofstenia miamia*	$1,200
Connor Coffman	OEB/Brian Farrell	Taxonomic review and distribution of *Wyeomyia smithii* Coquillet (Diptera: Culicidae) in the United States	$1,200
Sawyer Cooper	OEB/George Lauder	Analysis of body stability in manta rays	$4,500
Deshawn Ejiogu	OEB/Hopi Hoekstra	Assessing dexterity and corticospinal tract size in *Peromyscus maniculatus*	$1,200
Eden Fisher	OEB/Benton Taylor	Influence of Siberian alder (*Alnus viridis ssp. fruticosa*) on nutrient cycling in arctic Alaska	$5,000
Eliza Hirsch	OEB/Mansi Srivastava	Spatiotemporal resolution of stem cell specification in the acoel worm *Hofstenia miamia*	$1,200
Olivia Johnson	OEB/Hopi Hoekstra	Parallel evolution of behavioral strategy in skilled climbing in deer mice (spring semester)	$1,200
Olivia Johnson	OEB/Hopi Hoekstra	Parallel evolution of behavioral strategy in skilled climbing in deer mice (fall semester)	$1,200
Elio Kennedy-Yoon	OEB/Gonzalo Giribet	DNA extractions of porcelain crabs	$1,200
Ian Palk	OEB/Benton Taylor	Assessing the impact of climate change on root exudate dynamics and soil carbon sequestration	$5,000
Ananya Salem	OEB/Mansi Srivastava	Molecular organization of a diffuse brain	$5,105
Summer Smentek	OEB/Andrew Davies	Drivers of human-carnivore conflict in northern Laikipia County, Kenya	$1,200
Nehir Toklu	OEB/Andrew Davies	Studying the intermediate disturbance hypothesis in unique bai ecosystems in the Republic of the Congo	$5,590
Samantha Tseng	OEB/Mansi Srivastava	Mating in the simultaneous hermaphrodite *Hofstenia miamia*	$1,200
		Total Awards	**$43,395**

Eden Fisher

Putnam Expedition Grants

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

Recipient	MCZ Department/ Faculty Sponsor	Project Title	Amount
Katherine Angier	Invertebrate Zoology/ Giribet	Characterization of termite-associated arthropod diversity in soil-feeding termites of the Republic of the Congo	$8,783
Gonzalo Giribet	Invertebrate Zoology	Searching for the Egyptian goddess Isis in the Caribbean	$7,662
Javier Ortega-Hernández & Rudy Lerosey-Aubril	Invertebrate Paleontology	The Marjum Burgess-Shale biota II: Exploring the formation of a fossil treasure trove	$10,705
Naomi E. Pierce	Entomology	Juvenile stages of Australian moths and butterflies	$16,900
Stephanie E. Pierce & Peter Bishop	Vertebrate Paleontology	The Australian record of Earth's greatest mass extinction	$7,240
Paulino Siqueira Ribeiro	Entomology/Farrell	Revisiting the project "Mosquitoes of Middle America" to collect and review specimens of Wyeomyians	$13,060
		Total Awards	**$64,350**

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 and others 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 & Sonali Garg	Herpetology/Hanken	Integrative approaches to unravel frog diversity in India	$12,880
		Total Awards	**$12,880**

Paulino Siqueira Ribeiro

Rudy Lerosey-Aubril

Peter Bishop

James Hanken & Sonali Garg

Carlos Perafán

Manuel Barria (right)

Piotr Naskrecki

Norina Vicente

Laura Modesti Donin

Ernst Mayr Travel Grants in Animal Systematics

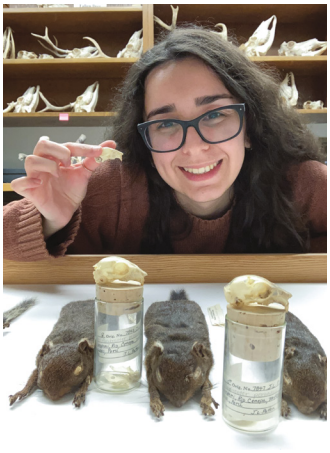
Ernst Mayr Grants support travel for research in animal systematics and are open to the scientific community worldwide. The principal objective of these grants is to stimulate taxonomic work on neglected taxa and/or poorly described species. Ernst Mayr Grants typically facilitate visits to institutional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

Recipient	Institutional Affiliation	Project Title	Amount
Katherine Angier	Museum of Comparative Zoology	Identification of soil-feeding termites from the Republic of the Congo	$2,365
Manuel Barria	University of Panama	Revision of the beetles of the genus *Phyllophaga* Harris (Coleoptera: Scarabaeidae: Rhizotrogini) from Panama deposited in the entomological collection of the Museum of Comparative Zoology	$2,500
Debika Bhunia	University of Kalyani, India	Bringing light into the dark: Closing knowledge gaps in the taxonomy and distribution of Indian Sericini with help of training and knowledge transfer	$2,500
Pricilla Ceja	California State Polytechnic University, Humboldt	Morphological variation and taxonomy of squirrels of the "*Microsciurus*" *flaviventer* group	$2,500
Anshu Chaudhary	Chaudhary Charan Singh University, India	Revisiting the hemiurid digeneans in fishes of India: The first integrated evaluation of the fauna in the South Asia region	$2,500
Sergio Delpiani	National University of Tierra del Fuego, Argentina	Integrative taxonomy of eelpout species (Teleostei: Zoarcidae) in a sub-Antarctic coastal ecosystem	$2,426
Laura Modesti Donin	University of São Paulo, Brazil	Extended phylogenetic analysis, distribution and biogeography of Trichomycteridae (Teleostei: Siluriformes): Temporal and spatial evolution of a taxon of continental relevance	$2,418
Micaela Folino	National University of La Plata, Argentina	Exploring the emblematic and peculiar South American fire beast mammals	$2,000
Sonali Garg	Museum of Comparative Zoology	Integrative approaches to unravel frog diversity in India	$2,500
Julio Gomez-Vasquez	The Southern Border College, Mexico	Revision of the genera *Apionsoma* and *Phascolosoma* (Sipuncula: Phascolosomatidae)	$2,300
Roberta Graboski	Tel Aviv University, Israel	Systematic and taxonomic survey of Israel's land reptile biodiversity	$2,100
Panagiotis Kontos	University of Greifswald, Germany	Crawling into the unknown: A revision of the Sironidae (Opiliones: Cyphophthalmi) of Greece	$2,500
Maria Melo	National University of La Plata, Argentina	The type specimens of South American species of Reduviidae (Hemiptera, Heteroptera)	$2,500
Adriana Andrade Mota	University of Panama	Morphological evolution associated with maternal care in Mesomphaliini and taxonomic revision of *Paraselenis* Spaeth, 1913 (Chrysomelidae: Cassidinae)	$2,500

Aswan Punnath

Richard Robbins

Debika Bhunia



Pricilla Ceja

Recipient	Institutional Affiliation	Project Title	Amount
Yeshwanth Murthy	University of Agricultural Sciences, Bangalore	Study of Miridae (Hemiptera) at the National Museum of Natural History, Smithsonian	$2,500
Carlos Perafán	University of the Republic, Uruguay	Taxonomic revision of Neotropical Theraphosidae (Araneae: Mygalomorphae)	$2,500
Piyatida Pimvichai	Mahasarakham University, Thailand	Taxonomy and phylogeny of Southeast Asian millipedes	$2,500
Aswan Punnath	University of Florida	Systematic revision of the Asian and Australasian *Nylanderia* (Hymenoptera: Formicidae: Formicinae) encompassing collections held at the MCZ	$2,500
Richard Robbins	Walter Reed Biological Unit	Survey, image and catalog the tick types in the MCZ	$2,500
Julián Rojas-Morales	University of Caldas, Colombia	Integrative systematics and biogeography of the poorly known ground snakes of the genus *Urotheca* (*Rhadinaea lateristriga* group Myers, 1974) (Squamata: Serpentes: Colubridae) in the northern Andes	$1,350
Luanna Santos	University of São Paulo, Brazil	Systematics of Mythicomyiidae (Diptera) using morphological characters	$2,500
Norina Vicente	San Francisco State University	A taxonomic revision of the Ponerinae ant genus *Mesoponera* (Hymenoptera: Formicidae) from the Afrotropical and Malagasy regions	$2,500
		Total Awards	**$52,459**

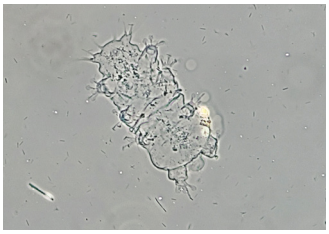
Sergio Delpiani

Piyatida Pimvichai

Farish A. Jenkins Jr. Grants

The Farish A. Jenkins Jr. Fund supports student fieldwork in comparative zoology. It honors the memory of Professor Jenkins, whose research, fieldwork and teaching in the fields of paleontology and evolutionary biology served as great inspiration for generations of students. These grants are made possible by the gift of the family and friends of Farish Jenkins.

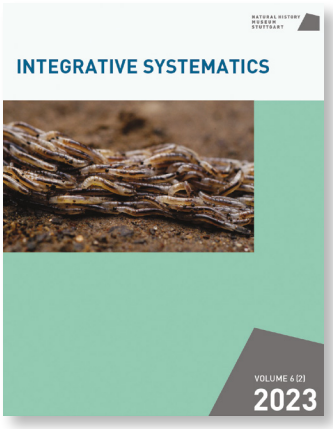
Recipient	MCZ Department/ Faculty Sponsor	Project Title	Amount
Marc Mapalo	Invertebrate Paleontology/Ortega-Hernández	Collection of marine tardigrades in the East Philippines	$4,850
		Total Awards	**$4,850**

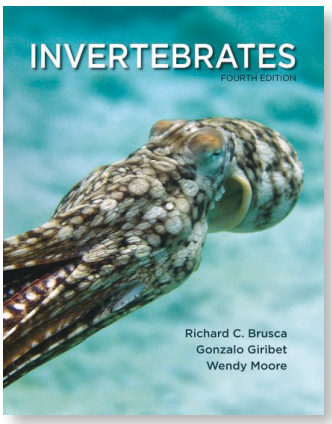


Marc Mapalo

Batillipes sp.

Publications in 2023





• Almeida JC, Hoshino AT, **Pereira TPL**, Pasini A (2023) Parasitismo de *Atta sexdens* Forel, 1908 (Hymenoptera: Formicidae) por forídeos (Diptera: Phoridae) em Londrina-PR. *Semin Cienc Agrar* 44:1603–1620 DOI: 10.5433/1679-0359.2023v44n5p1603

• Amarasinghe AAT and 21 others including **Kennedy-Gold SR** (2023) Integrative approach resolves the systematics of barred wolf snakes in the *Lycodon striatus* complex (Reptilia, Colubridae). *Zool Scr* 52:370–393 DOI: 10.1111/zsc.12587

• **Baldinger AM**, Kelley KA, Wagner D (2023) Providing a foundation for follow-on investigations: Sample archives at the Museum of Comparative Zoology and the Marine Geological Samples Laboratory. In: *New Frontiers in Ocean Exploration: The E/V Nautilus 2022 Field Season* (ed. Wagner D). *Oceanography* 36 DOI: 10.5670/oceanog.2023.s2

• Barord GJ, **Combosch DJ**, **Giribet G**, Landman N, **Lemer S**, Veloso J, Ward PD (2023) Three new species of *Nautilus* Linnaeus, 1758 (Mollusca, Cephalopoda) from the Coral Sea and South Pacific. *ZooKeys* 1143:51–69 DOI: 10.3897/zookeys.1143.84427

• Bartel C, Dunlop JA, **Giribet G** (2023) An unexpected diversity of Cyphophthalmi (Arachnida: Opiliones) in Upper Cretaceous Burmese amber. *Zootaxa* 5296:421–445 DOI: 10.11646/zootaxa.5296.3.6

• **Benavides LR**, Edgecombe GD, **Giribet G** (2023) Re-evaluating and dating myriapod diversification with phylotranscriptomics under a regime of dense taxon sampling. *Mol Phylogenet Evol* 178:107621 DOI: 10.1016/j.ympev.2022.107621

• **Bishop PJ**, **Brocklehurst RJ**, **Pierce SE** (2023) 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

• **Bishop PJ**, Norton LA, Jirah S, Day MO, Rubidge BS, **Pierce SE** (2023) Enigmatic humerus from the mid-Permian of South Africa bridges the anatomical gap between "pelycosaurs" and therapsids. *J Vertebr Paleontol* 42:e2170805 DOI: 10.1080/02724634.2023.2170805

• **Bishop PJ**, **Pierce SE** (2023) The fossil record of appendicular muscle evolution in Synapsida on the line to mammals: Part I—Forelimb. *Anat Rec* 307:1764–1825 DOI: 10.1002/ar.25312

• **Bishop PJ**, **Pierce SE** (2023) The fossil record of appendicular muscle evolution in Synapsida on the line to mammals: Part II—Hindlimb. *Anat Rec* 307:1826–1896 DOI: 10.1002/ar.25310

• Bittleston LS, Wolock CJ, Maeda J, Infante V, Ané JM, **Pierce NE**, Pringle A (2023) Carnivorous *Nepenthes* pitchers with less acidic fluid house nitrogen-fixing bacteria. *Appl Environ Microbiol* 89:e00812-23 DOI: 10.1128/aem.00812-23

• **Boyle JH**, Espeland M, Sáfián S, Ducarme R, Gardiner AJ, **Coleman JW**, Heath A, Fisher S, Collins SC, **Martins DJ**, Aduse-Poku K, Libert M, **Dankowicz E**, Kawahara AY, Lohman DJ, **Pierce NE** (2023) Phylogeny of the Poritiinae (Lepidoptera: Lycaenidae), butterflies with ant associations and unusual lichenivorous diets. *Syst Entomol* 48:422–433 DOI: 10.1111/syen.12585

• Brusca RC, **Giribet G**, Moore W (2023) *Invertebrates*, 4th edition. Sinauer Associates and Oxford University Press: Oxford.

• **Burley JT**, **Orzechowski SCM**, **Sin SYW**, **Edwards SV** (2023) Whole-genome phylogeography of the blue-faced honeyeater (*Entomyzon cyanotis*) and discovery and characterization of a neo-Z chromosome. *Mol Ecol* 32:1248–1270 DOI: 10.1111/mec.16604

• **Card DC**, W. Jennings B, **Edwards SV** (2023) Genome evolution and the future of phylogenomics of non-avian reptiles. *Animals* 13:471 DOI: 10.3390/ani13030471

• Chernyshev AV and 21 others including **Giribet G** (2023) Raymond Gibson (1938–2023): In memoriam. *Zootaxa* 5311:596–599 DOI: 10.11646/zootaxa.5311.4.7

• **Childers RAR**, and 12 others including **Cornwall M**, **Lim MLM**, **Pierce NE** (2023) A hypothesis for robust polarization vision: An example from the Australian imperial blue butterfly, *Jalmenus evagoras*. *J Exp Biol* 226:jeb244515 DOI: 10.1242/jeb.244515

• Costa Santos MA, **Paes Neto VD**, Schultz CL, Cisneros J, **Pierce SE**, Pinheiro FL (2023) Cranial osteology of the Brazilian dinocephalian *Pampaphoneus biccai* (Anteosauridae: Syodontinae). *Zool J Linnean Soc* 199:1034–1058 DOI: 10.1093/zoolinnean/zlad071

• **Cunha TJ**, **de Medeiros BAS**, **Lord A**, Sørensen MV, **Giribet G** (2023) Rampant loss of universal metazoan genes revealed by a chromosome-level genome assembly of the parasitic Nematomorpha. *Curr Biol* 33:3514–3521 DOI: 10.1016/j.cub.2023.07.003

• **Cunha TJ**, Fernández-Simón J, **Petrula M**, **Giribet G**, **Moles J** (2023) Photographic checklist, DNA barcoding, and new species of sea slugs and snails from the Faafu Atoll, Maldives (Gastropoda: Heterobranchia and Vetigastropoda). *Diversity* 15:219 DOI: 10.3390/d15020219

• **Del Mouro L**, Becker-Kerber B, Janasi VA, de Araújo Carvalho M, Waichel BL, Lima EF, Rossetti LMM, Cruz V, Souza Silva M, Famelli N, **Ortega-Hernández J** (2023) Organic walled microfossils in wet peperites from the early Cretaceous Paraná-Etendeka volcanism of Brazil. *Sci Rep* 13:15362 DOI: 10.1038/s41598-023-42483-6

• **Derkarabetian S**, **Lord A**, **Angier K**, **Frigyik E**, **Giribet G** (2023) An Opiliones-specific ultraconserved element probe set with a near-complete family-level phylogeny. *Mol Phylogenet Evol* 187:107887 DOI: 10.1016/j.ympev.2023.107887

• **DiGiacomo AA**, Cloutier A, Grayson P, Sackton T, **Edwards SV** (2023) Chapter 11—The unfinished synthesis of comparative genomics and phylogenetics: Examples from flightless birds. In: *Species Tree Inference: A Guide to Methods and Applications* (eds. Kubatko LS, Knowles LL). Princeton University Press: Princeton

• **Edwards SV**, **Tonini JFR**, Mcinerney N, Welch C, Beerli P (2023) Multilocus phylogeography, population genetics and niche evolution of Australian brown and black-tailed treecreepers (Aves: *Climacteris*). *Biol J Linnean Soc* 138:249–273 DOI: 10.1093/biolinnean/blac144

• **Espeland M** and 28 others including **Kaliszewska ZA**, **Baker CCM**, **Pierce NE** (2023) Rapid radiation of ant parasitic butterflies during the Miocene aridification of Africa. *Ecol Evol* 13:e10046 DOI: 10.1002/ece3.10046

• Figueira TJ, **Kennedy-Gold S**, Piantoni C, Screen RM, Wright AN (2023) Head shape predicts isotopic diet in anoles and day geckos. *Funct Ecol* 37:1553–1566 DOI: 10.1111/1365-2435.14331

• García-Berro A, Talla V, Vila R, Wai HK, Shipilina D, Chan KG, **Pierce NE**, Backström N, **Talavera G** (2023) Migratory behaviour is positively associated with genetic diversity in butterflies. *Mol Ecol* 32:560–574 DOI: 10.1111/mec.16770

• Giles S, Feilich K, Warnock RCM, **Pierce SE**, Friedman M (2023) A Late Devonian actinopterygian suggests high lineage survivorship across the end-Devonian mass extinction. *Nat Ecol Evol* 7:10–19 DOI: 10.1038/s41559-022-01919-4

• **Giribet G** (2023) Non-insect terrestrial arthropods. In: *The Living Planet: The State of the World's Wildlife* (ed. Maclean N). Cambridge University Press DOI: 10.1017/9781108758826.015

• **Giribet G** (2023) Terrestrial invertebrates other than arthropods and molluscs. In: *The Living Planet: The State of the World's Wildlife* (ed. Maclean N). Cambridge University Press DOI: 10.1017/9781108758826.015

• **Giribet G**, Wangensteen OS, Garcés-Pastor S, Møller PR, Worsaae K (2023) Using eDNA to find Micrognathozoa. *Curr Biol* 33:756–757 DOI: 10.1016/j.cub.2023.04.075

• Gopika C, **Garg S**, Sivaperuman C, Gokulakrishnan G, **Biju SD** (2023) Larval morphology and natural history in two *Minervarya* species from Andaman Islands, with comments on a new phytotelmonous larval morphotype for the genus. *Zootaxa* 5366:567–581 DOI: 10.11646/zootaxa.5353.6.4

• **Gorring PS**, **Farrell BD** (2023) Evaluating species boundaries using coalescent delimitation in pine-killing *Monochamus* (Coleoptera: Cerambycidae) sawyer beetles. *Mol Phylogenet Evol* 184:107777 DOI: 10.1016/j.ympev.2023.107777

• **Gozashti L**, Feschotte C, **Hoekstra HE** (2023) Transposable element interactions shape the ecology of the deer mouse genome. *Mol Biol Evol* 40:msad069 DOI: 10.1093/molbev/msad069

• Guo J, Han P, Zhang W, Wang J, **Lauder GV**, Di Santo V, Dong H (2023) Vortex dynamics and fin-fin interactions resulting in performance enhancement in fish-like propulsion. *Phys Rev Fluids* 8:073101 DOI: 10.1103/PhysRevFluids.8.073101

• Gutiérrez-García K, **Whitaker MRL**, Bustos-Díaz ED, **Salzman S**, Ramos-Aboites HE, Reitz ZL, **Pierce NE**, Cibrián-Jaramillo A, Barona-Gómez F (2023) Gut microbiomes of cycad-feeding insects tolerant to ß-methylamino-L-alanine (BMAA) are rich in siderophore biosynthesis. *ISME Commun* 3:122 DOI: 10.1038/s43705-023-00323-8

• Hall BK, **Hanken J** (2023) Modularity, homology, heterochrony: Gavin de Beer's legacy to the mammalian skull. *Phil Trans R Soc B* 378:20220078 DOI: 10.1098/rstb.2022.0078

• Hill P, Dickman CR, Dinnage R, Duncan RP, **Edwards SV**, Greenville A, Sarre SD, Stringer EJ, Wardle GM, Gruber B (2023) Episodic population fragmentation and gene flow reveal a trade-off between heterozygosity and allelic richness. *Mol Ecol* 32:6766–6776 DOI: 10.1111/mec.17174

• Hormiga G, Kulkarni S, Arnedo M, Dimitrov D, **Giribet G**, Kallal RJ, Scharff N (2023) Genitalic morphology and phylogenomic placement of the Australian spider *Paraplectanoides crassipes* Keyserling, 1886 (Araneae, Araneidae) with a discussion on the classification of the family Araneidae. *Invertebr Syst* 37:797–818 DOI: 10.1071/IS23050

• **Hulett RE**, **Kimura JO**, **Bolaños DM**, **Luo Y-J**, **Rivera-López C**, **Ricci L**, **Srivastava M** (2023) Acoel single-cell atlas reveals expression dynamics and heterogeneity of adult pluripotent stem cells. *Nat Commun* 14:2612 DOI: 10.1038/s41467-023-38016-4

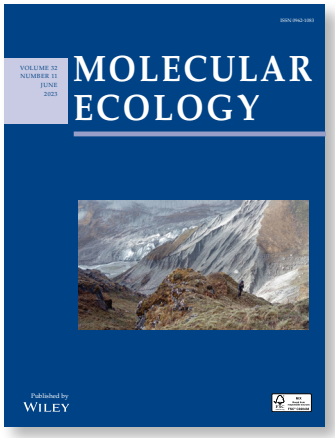
• Huynh S, **Cloutier A**, Chen G, Chan DTC, Lam DK, Huyvaert KP, Sato F, **Edwards SV**, **Sin SYW** (2023) Whole-genome analyses reveal past population fluctuations and low genetic diversities of the North Pacific albatrosses. *Mol Biol Evol* 40:msad155 DOI: 10.1093/molbev/msad155

• Jenny LA, Shapiro LR, Davis CC, Davies TJ, **Pierce NE** (2023) Herbarium specimens reveal herbivory patterns across the genus *Cucurbita*. *Am J Bot* 110:e16126 DOI: 10.1002/ajb2.16126

• Johnson KR, Owens IFP and The Global Collections Group which includes **Giribet G** and **Hanken J** (2023) A global approach for natural history museum collections. *Science* 379:1192–1194 DOI: 10.1126/science.adf6434

• **Jourjine N**, **Woolfolk ML**, **Sanguinetti-Scheck JI**, **Sabatini JE**, **McFadden S,** Lindholm AK, **Hoekstra HE** (2023) Two pup vocalization types are genetically and functionally separable in deer mice. *Curr Biol* 33:1237–1248.e4 DOI: 10.1016/j.cub.2023.02.045

• Kawahara AY and 88 authors including **Cai L**, **Valencia-Montoya WA**, **Chan W-P**, **Childers RAR**, **Dankowicz E**, **Eastwood R**, **Hawkins Sipe RL**, **Heath A**, **Maier CA**, **Maunsell SC**, **Talavera G**, **Pierce NE** (2023) A global phylogeny of butterflies reveals their evolutionary history, ancestral hosts and biogeographic origins. *Nat Ecol Evol* 7:903–913 DOI: 10.1038/s41559-023-02041-9



• Khalil S, Enbody ED, Frankl-Vilches C, Welklin JF, Koch RE, Toomey MB, **Sin SYW**, **Edwards SV**, Gahr M, Schwabl H, Webster MS, Karubian, J (2023) Testosterone coordinates gene expression across different tissues to produce carotenoid-based red ornamentation. *Mol Biol Evol* 40:msad056 DOI: 10.1093/molbev/msad056

• **Knecht RJ**, **Swain A**, Benner JS, Emma SL, **Pierce NE**, Labandeira CC (2023) Endophytic ancestors of modern leaf miners may have evolved in the Late Carboniferous. *New Phytol* 240:2050–2057 DOI: 10.1111/nph.19266

• Ko H, **Lauder G**, Nagpal R (2023) The role of hydrodynamics in collective motions of fish schools and bioinspired underwater robots. *J R Soc Interface* 20:20230357 DOI: 10.1098/rsif.2023.0357

• Köhler J, **Gage M**, Janssen H, Rauhaus A, Ziegler T (2023) Longevity in salamandrid newts—a rule, not an exception? Verified cases of Japanese Fire-bellied Newts (*Cynops pyrrhogaster*) reaching a lifespan of more than 40 years. *Rev suisse Zool* 130:121–124 DOI: 10.35929/RSZ.0093

• Li Z, Linard B, Vogler A, Yu D, **Wang Z** (2023) Phylogenetic diversity only weakly mitigates climate-change-driven biodiversity loss in insect communities. *Mol Ecol* 32:6147–6160 DOI: 10.1111/mec.16747

• Liu L, Liu Y, Wu S, Arnold J, Whalen C, Davis C, **Edwards SV** (2023) Short branch attraction in phylogenomic inference under the multispecies coalescent. *Front Ecol Evol* 11:1134764 DOI: 10.3389/fevo.2023.1134764

• **Lord A**, **Cunha TJ**, **de Medeiros BAS**, **Sato S**, Khost DE, Sackton TB, **Giribet G** (2023) Expanding on our knowledge of ecdysozoan genomes: A contiguous assembly of the meiofaunal priapulan *Tubiluchus corallicola*. *Genome Biol Evol* 15:evad103 DOI: 10.1093/gbe/evad103

• Lorente-Martinez H, Agorreta A, Irisarri I, Zardoya R, **Edwards SV**, San Mauro D (2023) Multiple instances of adaptive evolution in aquaporins of amphibious fishes. *Biology* 12:846 DOI: 10.3390/biology12060846

• **Losso SR**, **Affatato P**, **Nanglu K**, **Ortega-Hernández J** (2023) Convergent evolution of ventral adaptations for enrolment in trilobites and extant euarthropods. *Proc R Soc B* 290:20232212 DOI: 10.1098/rspb.2023.2212

• **Losso SR**, Thines JE, **Ortega-Hernández J** (2023) Taphonomy of non-biomineralized trilobite tissues preserved as calcite casts from the Ordovician Walcott-Rust Quarry, USA. *Commun Earth Environ* 4:330 DOI: 10.1038/s43247-023-00981-5

• Luedtke JA and 96 others including **Biju SD**, **Garg S** (2023) Ongoing declines for the world's amphibians in the face of emerging threats. *Nature* 622:308–314 DOI: 10.1038/s41586-023-06578-4

• Mann A, Henrici AC, Sues HD, **Pierce SE** (2023) A new Carboniferous edaphosaurid and the origin of herbivory in mammal forerunners. *Sci Rep* 13:4459 DOI: 10.1038/s41598-023-30626-8

• **Matthews DG**, Dial TR, **Lauder GV** (2023) Genes, morphology, performance, and fitness: Quantifying organismal performance to understand adaptive evolution. *Integr Comp Biol* 63:843–859 DOI: 10.1093/icb/icad096

• **Matthews DG**, Maciejewski MF, **Wong GA**, **Lauder GV**, Bolnick DI (2023) Locomotor effects of a fibrosis-based immune response in stickleback fish. *J Exp Biol* 226:jeb246684 DOI: 10.1242/jeb.246684

• Melim LA, Mure-Ravaud SR, Hegna TA, Bellott BJ, **Lerosey-Aubril R** (2023) Silicification of trilobites and biofilm from the Cambrian Weeks Formation, Utah: Evidence for microbial mediation of silicification. *Geology* 51:80–84 DOI: 10.1130/G51561Y.1 and REPLY *Geology* 51:e567 DOI: 10.1130/G51561Y.1

• Minias P, **Edwards SV**, Babik W (2023) Ancient duplication, coevolution, and selection at the MHC class IIA and IIB genes of birds. *Front Immunol* 14:1250824 DOI: 10.3389/fimmu.2023.1250824

• Moreno-Martínez L, San Martín G, Riesgo A, **Giribet G**, **Álvarez-Campos P** (2023) Molecular analysis of Indo-Pacific Syllinae annelids with the description of five new species from the Philippine Islands. *Syst Biodivers* 21:1 DOI: 10.1080/14772000.2023.2227630

• Nachman MW and 119 others including **Edwards SV**, **Hanken J** (2023) Specimen collection is essential for modern science. *PLoS Biol* 21:e3002318 DOI: 10.1371/journal.pbio.3002318

• **Nanglu K**, **Lerosey-Aubril R**, Weaver JC, **Ortega-Hernández J** (2023) A mid-Cambrian tunicate and the deep origin of the ascidiacean body plan. *Nat Commun* 14:3832 DOI: 10.1038/s41467-023-39012-4

• **Nicolaï MPJ**, Vanisterbecq R, Shawkey MD, D'Alba L (2023) Back in black: Melanin-rich skin colour associated with increased net diversification rates in birds. *Biol Lett* 19:20230304 DOI: 10.1098/rsbl.2023.0304

• Öztürk B, **Recevik M** (2023) First record of alien gastropods *Epitonium aranea* Bonfitto, 2018 and *Stosicia annulata* Dunker, 1860 (Mollusca) from the Mediterranean Sea. *EgeJFAS* 40:298–303 DOI: 10.12714/egejfas.40.4.09

• Palmieri L, **Giribet G**, Sharma PP (2023) Too early for the ferry: The biogeographic history of the Assamiidae of southeast Asia (Chelicerata: Opiliones, Laniatores). *Mol Phylogenet Evol* 178:107647 DOI: 0.1016/j.ympev.2022.107647

• **Pereira TPL** (2023) Chris Thompson's contributions to the study of Alaskan Diptera and the University of Alaska Museum Insect Collection. *Stud Dipterol* Supplement 23:69–76

• **Pereira TPL**, Heller K, Sutou M, Sikes DS (2023) Discovery of snakeworm gnats in Alaska: A new species of *Sciara* Meigen (Diptera: Sciaridae) based on morphological, molecular, and citizen science data. *Integr Syst* 6:91–111 DOI: 10.18476/2023.673937

• Recuero E, **Rodríguez-Flores PC** (2023) The bristle millipedes (Diplopoda, Penicillata, Polyxenida) of the Iberian Peninsula, Balearic and Canary Islands with new records and data on their distribution. *Graellsia* 79:e198 **DOI: 10.3989/graellsia.2023.v79.385**

• Rinaldo C, Rielinger D, **Deveer J**, Castronovo D (2023) Connecting libraries, archives, and museums: Collections in support of natural history science. *J Comput Cult Herit* 16:1–24 **DOI: 10.1145/3570905**

• **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**

• Sadanandan KR, Ko M-C, Low GW, Gahr M, **Edwards SV**, Hiller M, Sackton TB, Rheindt FE, Sin SYW, Baldwin MW (2023) Dynamics of mitochondrial DNA evolution in animals: Amplification and sequencing with conserved primers. *Proc Natl Acad Sci USA* 120:e2307340120 **DOI: 10.1073/pnas.2307340120**

• Salcedo MK, Jun BH, Socha JJ, **Pierce NE**, Vlachos PP, Combes SA (2023) Complex hemolymph circulation patterns in grasshopper wings. *Commun Biol* 6:313 **DOI: 10.1038/s42003-023-04651-2**

• **Sato S**, **Cunha TJ**, **de Medeiros BAS**, Khost DE, Sackton TB, **Giribet G** (2023) Sizing up the onychophoran genome: Repeats, introns, and gene family expansion contribute to genome gigantism in *Epiperipatus broadwayi*. *Genome Biol Evol* 15:evad021 **DOI: 10.1093/gbe/evad021**

• Schwaner MJ, Gordon JC, **Biewener AA**, MA Daley (2023) Muscle force–length dynamics during walking over obstacles indicates delayed recovery and a shift towards more "strut-like" function in birds with proprioceptive deficit. *J Exp Biol* 226:jeb245199 **DOI: 10.1242/jeb.245199**

• Sierra-Botero L, Calonje M, Robbins RK, Rosser N, **Pierce NE**, López-Gallego C, **Valencia-Montoya WA** (2023) Cycad phylogeny predicts host plant use of *Eumaeus* butterflies. *Ecol Evol* 13:e9978 **DOI: 10.1002/ece3.9978**

• **Simões TR**, Greifer N, Barido-Sottani J, **Pierce SE** (2023) EvoPhylo: An r package for pre- and postprocessing of morphological data from relaxed clock Bayesian phylogenetics. *Methods Ecol Evol* 14:1981–1993 **DOI: 10.1111/2041-210X.14128**

• Souza JRD, **Ferrão M**, Kaefer IL, Cunha-Machado AS, Melo-Sampaio PR, **Hanken J**, Lima AP (2023) A new pale-ventered nurse frog (Aromobatidae: *Allobates*) from southwestern Brazilian Amazonia. *Vertebr Zool* 73:647–675 **DOI: 10.3897/vz.73.e103534**

• **Talavera G** and 22 others including **Pierce NE** (2023) The Afrotropical breeding grounds of the Palearctic-African migratory painted lady butterflies (*Vanessa cardui*). *Proc Natl Acad Sci USA* 120:e2218280120 **DOI: 10.1073/pnas.2218280120**

• **Thandiackal R**, **Lauder GV** (2023) In-line swimming dynamics revealed by fish interacting with a robotic mechanism. *eLife* 12:e81392 **DOI: 10.7554/eLife.81392**

• **Vaz DFB**, **Avery TM**, **Gabler-Smith MK**, **Lauder GV** (2023) The denticle multiverse: Morphological diversity of placoid scales across ontogeny in the Portuguese Dogfish, *Centroscymnus coelolepis*, and its systematic implications. *Diversity* 15:1105 **DOI: 10.3390/d15111105**

• **Wang Z**, **Chan WP**, Pham NT, Zeng J, **Pierce NE**, Lohman DJ, Meng W (2023) One in five butterfly species sold online across borders. *Biol Conserv* 283:110092 **DOI: 10.1016/j.biocon.2023.110092**

• **Wang Z**, **Pierce NE** (2023) 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**

• **Wang Z**, Zeng J, Ran H, Meng W, Zhou S, Davies AB, **Liu C** (2023) Monitoring the online ant trade reveals high biological invasion risk. *Biol Conserv* 282:110038 **DOI: 10.1016/j.biocon.2023.110038**

• Weil SS, Gallien L, **Nicolaï MPJ**, Lavergne S, Börger L, Allen WL (2023) Body size and life history shape the historical biogeography of tetrapods. *Nat Ecol Evol* 7:1467–1479 **DOI: 10.1038/s41559-023-02150-5**

• Wu MY, Forcina G, Low GW, Sadanandan KR, Gwee CY, van Grouw H, Wu S, **Edwards SV**, Baldwin MW, Rheindt FE (2023) Historic samples reveal loss of wild genotype through domestic chicken introgression during the Anthropocene. *PLoS Genet* 19:e1010551 **DOI: 10.1371/journal.pgen.1010551**

• Yan H, Hu Z, Thomas GWC, **Edwards SV**, Sackton TB, Liu JS (2023) PhyloAcc-GT: A Bayesian method for inferring patterns of substitution rate shifts on targeted lineages accounting for gene tree discordance. *Mol Biol Evol* 40:msad195 **DOI: 10.1093/molbev/msad195**

• Zhang C, Liu Y, **Ortega-Hernández J**, **Wolfe JM**, Jin C, Mai H, Hou X, Guo J, Zhai D (2023) Three-dimensional morphology of the biramous appendages in *Isoxys* from the early Cambrian of South China, and its implications for early euarthropod evolution. *Proc R Soc B* 290:20230335 **DOI: 10.1098/rspb.2023.0335**

• Zhang W, Pan Y, Wang J, Di Santo V, **Lauder GV**, Dong H (2023) An efficient tree-topological local mesh refinement on Cartesian grids for multiple moving objects in incompressible flow. *J Comput Phys* 479:111983 **DOI: 10.1016/j.jcp.2023.111983**

• **Zhang Y**, **Lauder GV** (2023) Energetics of collective movement in vertebrates. *J Exp Biol* 226:jeb245617 **DOI: 10.1242/jeb.245617**

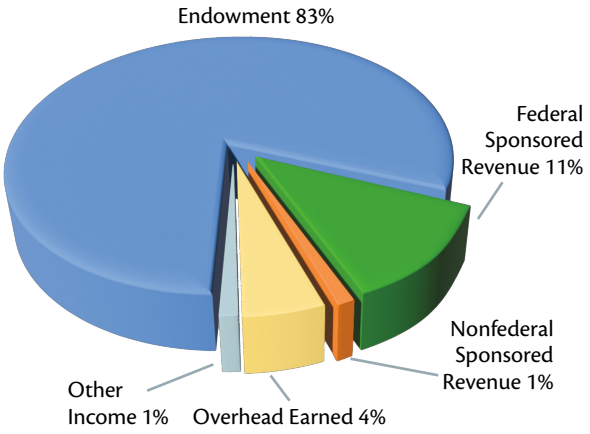
• **Zhang Y** and seven others (2023) Respiratory plasticity during acclimation to hypoxia and following a recovery in normoxia. *Can J Zool* 101:794-806 **DOI: 10.1139/cjz-2022-0158**

Financial Data

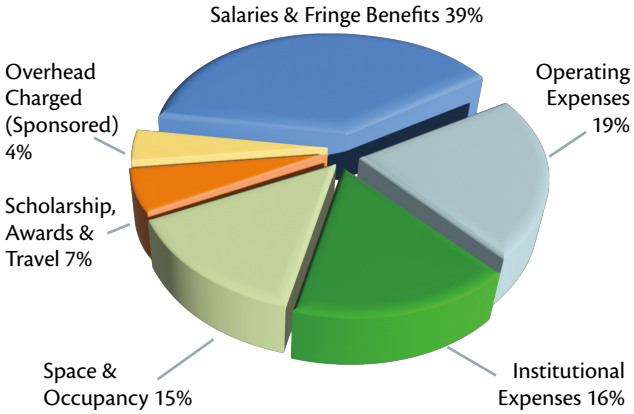
These charts describe the income and expenses of the Museum of Comparative Zoology in fiscal year 2023.

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; 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. **Draw on Restricted Reserves** indicates restricted fund balances utilized to fund operations. Building expenses such as maintenance, facility improvements and utilities are captured in the **Space and 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 and 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	$19,581,267
Federal Sponsored Revenue	$2,610,996
Overhead Earned	$866,520
Nonfederal Sponsored Revenue	$329,723
Other Income	$298,412
Draw on Restricted Reserves	$52,743
Gifts	$13,600
Accumulation of Unrestricted Reserves	($2,203,627)
Total	**$21,549,634**

Expenses

Salaries & Fringe Benefits	$8,299,866
Operating Expenses	$4,136,109
Institutional Expenses	$3,444,833
Space & Occupancy	$3,332,427
Overhead Charged (Sponsored)	$1,469,879
Scholarships, Awards & Travel	$866,520
Total	**$21,549,634**

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 in Ornithology; Chair, Department of Organismic & Evolutionary Biology

Brian D. Farrell
Monique & Philip Lehner Professor for the Study of Latin America; Professor of Organismic & Evolutionary Biology; Curator in Entomology

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

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

Hopi E. Hoekstra
Edgerley Family Dean of the Faculty of Arts & Sciences; C.Y. Chan Professor of Arts & Sciences; Xiaomeng Tong & Yu Chen Professor of Life Sciences; Curator in Mammalogy (on leave)

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

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

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

Stephanie E. Pierce
Professor of Organismic & Evolutionary Biology; Alexander Agassiz Professor of Zoology; Curator in Vertebrate Paleontology; Acting Curator in Mammalogy

Mansi Srivastava
Professor of Organismic & Evolutionary Biology; Curator in 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

Aylin Alegre Barroso
Invertebrate Zoology, Giribet Lab

Alan Batistao
Invertebrate Zoology, Giribet Lab

Chawalida Benjangkaprasert
Vertebrate Paleontology, S. Pierce Lab

Peter Bishop
Vertebrate Paleontology, S. Pierce Lab

D. Marcela Bolaños
Invertebrate Zoology, Srivastava Lab

Robert Boria
Ornithology, Edwards Lab

Solene Bourdas
Invertebrate Paleontology, Ortega-Hernández 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

Shahan Derkarabetian
Invertebrate Zoology, Giribet Lab

Niklas Dreyer
Invertebrate Zoology, Giribet Lab

Bohao Fang
Ornithology, Edwards Lab

Ella Frigyik
Invertebrate Zoology, Giribet Lab

Sonali Garg
Herpetology, Hanken Lab

Patrick Gemmell
Ornithology, Edwards Lab

Amandine Gillet
Vertebrate Paleontology, S. Pierce Lab

Elsa Goerig
Ichthyology, Lauder Lab

Yuki Haba
Mammalogy, Hoekstra Lab

Shuonan He
Mammalogy, Hoekstra Lab

Caroline Hu
Mammalogy, Hoekstra Lab

Eloise Hunt
Vertebrate Paleontology, S. Pierce Lab

Nicholas Jourjine
Mammalogy, Hoekstra Lab

Allison Kann
Invertebrate Zoology, Srivastava Lab

Andreas Kautt
Mammalogy, Hoekstra Lab

Dongyoung Kim
Invertebrate Zoology, Giribet Lab

Gunnar Kramer
Ornithology, Edwards Lab

Leo Laborieux
Invertebrate Paleontology, Ortega-Hernández Lab

Thalles Lavinscky Pereira
Entomology, Farrell Lab

Rudy Lerosey-Aubril
Invertebrate Paleontology, Ortega-Hernández Lab

Thais Marinho
Invertebrate Zoology, Giribet 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

Leticia de Oliveira
Vertebrate Paleontology, S. Pierce Lab

Daniel Paluh
Herpetology, Hanken Lab

Yu Pan
Ichthyology, Lauder Lab

Tiago Rodrigues Simões
Vertebrate Paleontology, S. Pierce Lab

Paula Rodríguez Flores
Invertebrate Zoology, Giribet Lab

Dylan Ryals
Entomology, Farrell Lab

Nacho Sanguinetti-Scheck
Mammalogy, Hoekstra Lab

Hevana Santana de Lima
Ornithology, Edwards Lab

Shoyo Sato
Invertebrate Zoology, Giribet Lab

Jonathan Schmitt
Ornithology, Edwards Lab

Trey Scott
Entomology, N. Pierce Lab

Subir Shakya
Ornithology, Edwards Lab

Paulino Siqueira Ribeiro
Entomology, Farrell Lab

Molly Gabler Smith
Ichthyology, Lauder Lab

Anshuman Swain
Invertebrate Paleontology, Ortega-Hernández Lab

Sofia Ten
Invertebrate Zoology, Giribet Lab

Flavia Termignoni Garcia
Ornithology, Edwards Lab

Robin Thandiackal
Ichthyology, Lauder Lab

Kelsey Tyssowski
Mammalogy, Hoekstra Lab

Joanna Wolfe
Invertebrate Paleontology, Ortega-Hernández Lab

Yangfan Zhang
Ichthyology, Lauder Lab

Graduate Students

Katherine Angier
Invertebrate Zoology, Giribet Lab

Jennifer Austiff
Herpetology, Hanken Lab

Gaurav Bhardwaj
Invertebrate Zoology, Srivastava Lab

Catriona Breen
Invertebrate Zoology, Srivastava Lab

Kaylin Chong
Entomology, Farrell Lab

Juli Cosgrove
Invertebrate Zoology, Giribet Lab

Alexandria DiGiacomo
Ornithology, Edwards Lab

Landen Gozashti
Mammalogy, Hoekstra Lab

Evan Hoki
Entomology, N. Pierce Lab

Jordan Johnson
Entomology, Farrell Lab

Breanna Jordan
Invertebrate Zoology, Giribet Lab

Richard Knecht
Entomology, N. Pierce Lab

Duyi Kuang
Vertebrate Paleontology, S. 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

Edna Rodriguez Sanchez
Invertebrate Paleontology, Ortega-Hernández Lab

Lily Shapiro
Invertebrate Zoology, Giribet Lab

PERSONNEL

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

Maya Woolfolk
Mammalogy, Hoekstra Lab

Mark Wright
Vertebrate Paleontology, S. Pierce Lab

Associates

Bruce Archibald
Associate of Entomology
University of British Columbia

Aaron Bauer
Associate of Herpetology
Villanova University

Reinier Beeuwkes III
Associate of the Concord Field Station
Independent Researcher

Sathyabhama Das Biju
Associate of Herpetology
University of Delhi

James Blake
Associate of Invertebrate Zoology
Independent Researcher

Elizabeth Brainerd
Associate of Ichthyology
Brown University

Gustavo Bravo
Associate of Ornithology
Humboldt Institute

Janet Collett
Associate of Entomology
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

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 Invertebrate Zoology
Pacific Biosciences Research Center

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
Independent Researcher

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

Cong Liu
Associate of Entomology
University of Massachusetts Boston

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
Gorongosa Restoration Project

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

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

Neil Rosser
Associate of Entomology
Princeton University

Jessica Rykken
Associate of Entomology
Denali National Park & Preserve

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 (CSIRO)

Scott R. Shaw
Associate of Entomology
University of Wyoming

James Traniello
Associate of Entomology
Boston University

Marvalee 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
Smithsonian Marine Station

Staff

Melissa Aja
Administrative Manager

Sarah Arnold
Research Assistant, Srivastava Lab

Sorcha Ashe
Greenhouse Assistant

Adam Baldinger
Curatorial Associate, Invertebrate Zoology

Tracy Barbaro
Faculty Coordinator, S. Pierce Lab

Ligia Benavides Silva
Curatorial Assistant, Invertebrate Zoology

Eva Biedron
Curatorial Assistant, Vertebrate & Invertebrate Paleontology

Nina Black
Curatorial Assistant, Collections Operations, Mammalogy & Ornithology

Emily Blank
Curatorial Assistant, Collections Operations

Christian Burns
Laboratory Technician, Edwards Lab

Ronnie Broadfoot
Coordinator of Access Services, Ernst Mayr Library

Christina Byrd
Curatorial Associate, Vertebrate Paleontology

April Collins
Acquisitions & Technology Specialist, Ernst Mayr Library

Paul Cervantes
Curatorial Assistant, Collections Operations

Jessica Cundiff
Curatorial Associate, Invertebrate Paleontology

Even Dankowicz
Curatorial Assistant, Entomology

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

Katherine Eldridge
Curatorial Assistant, Ornithology

Anne Everly
Curatorial Assistant, Ichthyology

Charles Farnum
Curatorial Assistant, Entomology

Ayman Fayad
Greenhouse Coordinator for Plant Sciences

Giuliana Fillion
Research Assistant, Srivastava Lab

Zoe Flores
Curatorial Assistant, Entomology

Ella Frigyik
Researcher, Giribet Lab

Patricia Fuentes-Cross
Faculty Coordinator, Srivastava Lab

Matt Gage
Curatorial Assistant, Collections Operations & Herpetology

Cyrus Green
Invertebrate Paleontology Technician & Preparator

Cory Hahn
Plant Technologist & Animal Technician, Lauder Lab

Brendan Haley
Senior Database Manager

Robert Higgins
Research Assistant, Vertebrate Paleontology

Andra Hollis
Staff Assistant, Concord Field Station

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

Christopher Kirby
Research Assistant, Hoekstra Lab

Jeremy Kisala
Curatorial Assistant, Collections Operations

Adam Kowalczyk
Curatorial Assistant, Vertebrate Paleontology

Lisa Litchfield
Coordinator, Concord Field Station

Crystal Maier
Curatorial Associate, Entomology

Nicole Mejia
Laboratory Technician, Ornithology

Melissa Merkel
Curatorial Assistant, Malacology & Invertebrate Zoology

John Mewherter
Curatorial Assistant, Collections Operations

Paul J. Morris
Biodiversity Informatics Manager

Madeleine Mullon
Curatorial Assistant, Mammalogy

Catherine Musinsky
Faculty Assistant, Mammalogy

Mark Omura
Curatorial Associate, Mammalogy

Melinda Peterson
Research Lab Coordinator, Edwards Lab

Bridget Power
Faculty Coordinator, Herpetology & Invertebrate Zoology

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, Invertebrate Zoology

Isobel Smith
Laboratory Technician, Hoekstra Lab

Mary Sears
Head of Public Services, Ernst Mayr Library

Meaghan Sorce
Curatorial Assistant, Ichthyology

Margaret Starvish
Faculty Assistant, Entomology & Ichthyology

Tsuyoshi Takahashi
Curatorial Assistant, Collections Operations & Herpetology

Michelle Tang
Curatorial Assistant, Invertebrate Zoology & Malacology

Jennifer Thomson
Lab Administrator, Invertebrate Zoology

Jennifer Winifred Trimble
Curatorial Associate, Malacology

Jeremiah Trimble
Curatorial Associate, Ornithology

Diana Turmenne
Curatorial Assistant, Collections Operations

Cynthia Wang-Claypool
Manager of Genetic Resources

Kenneth Wilcox
Building Superintendent

Andrew Williston
Curatorial Associate, Ichthyology

Jon Woodward
Digitization Manager

Robert Young
Special Collections Librarian, Ernst Mayr Library

Breda Zimkus
Director, Collections Operations

Temporary Staff

Aylin Alegre Barroso
Invertebrate Zoology

Matthew Baldinger
Malacology

Laura Borrelli
Mammalogy

William Brister
Malacology

Alexa Bryan
Entomology

Michael Budner
Invertebrate Paleontology

Hlib Burtsev
Entomology

Júlia Chaumel Cerda
MCZ Seminars

Theo Dewar
Mammalogy

Giuliana Fillion
Invertebrate Zoology

Chloe Gilligan
Invertebrate Zoology

Aiden Houlihan
Invertebrate Zoology

Amelia Lawson
Malacology

Laura Leibensperger
Invertebrate Zoology

Joseph Martinez
Herpetology

Joseph McDonald
Collections Operations

Orlando Moreno
Concord Field Station

Dylan Morse
Entomology

Janet Sherwood
Greenhouse

Andrew Tan
Entomology

Gary Taylor
Concord Field Station

Dillon Wheeler
Entomology

Zixuan Zhang
Concord Field Station

Administration for the Department of Organismic & Evolutionary Biology

Ognenka Avramovska
Education & Outreach Manager

Janelle Batista
Financial Analyst

Tiara Borneman
HR Coordinator

Lydia Carmosino
Senior Academics 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

Tarah Johnson
Senior Research Administrator

Jasmine Khlieng
Financial Associate

Julie Knippa Colby
Associate Director of Finance & Research Administration

Jenna Legault
Senior Research Administrator

Megan McHugh
Assistant Director of Human Resources

Kristin Pennarun
Assistant Director of Research Administration

Christopher Preheim
Senior Academic Appointments Administrator

Emily Reynolds
Research Administration Manager

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 2023–2024 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 Claudine Gay (July–January), Alan M. Garber (January–present)

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