About The MCZ

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

Contents

Feature: Javier Ortega-Hernández 2
Faculty-Curator Profiles 3
Emeritus Profiles 6
Courses Led by Faculty-Curators 7
Research Making Headlines 11
Highlights from the Collections 14
Projects & Initiatives 17
Awards & Recognition 20
Grant Recipients 22
Publications in 2018 26
Financial Data 29
Personnel 30
The past year saw significant accomplishments by the MCZ in our core areas of research, teaching and collections stewardship.

These activities are made all the more urgent by recent authoritative reports that document impending threats to biodiversity worldwide. Perhaps the most chilling is the claim that “around one million species already face extinction, many within decades, unless action is taken to reduce the intensity of drivers of biodiversity loss.”1 MCZ and other natural history institutions can play a unique and essential role in documenting the full extent of life on Earth and in helping to craft strategies to conserve it, and we take this obligation seriously.

MCZ’s success is a function of our ability to attract talented and creative people to work and study with us, and we scored big this year on two fronts. First, in January we welcomed Prof. Javier Ortega-Hernández as our new curator of Invertebrate Paleontology, and you can learn more about Javier’s background and research plans in the feature story. Second, the inaugural class of Edward O. Wilson Biodiversity Postdoctoral Fellows was selected, and they arrived in time for the start of the 2019–2020 academic year. With support from additional donors, we are able to fund four researchers who will discover, formally describe and name new animal species.

On the curatorial front, we acquired several valuable collections that will enhance our holdings in both vertebrate and invertebrate zoology, and we received another digitization grant from the National Science Foundation that will facilitate free, online access to MCZ specimen data. Looking ahead, negotiations are underway for the acquisition of an important fossil collection as early as next summer.

Following a great multiyear run as executive director of the Harvard Museums of Science & Culture, which includes the Harvard Museum of Natural History, Jane Pickering accepted a new appointment at Harvard as director of the Peabody Museum of Archaeology & Ethnology. One of HMSC’s many highlights this year is a grant from the Institute of Museum and Library Services to use 3D-scanning technology to develop teaching aids derived from MCZ’s specimen collections.

I am saddened to report that a member of the MCZ Faculty passed away this year. George Putnam Jr. was a longtime friend and supporter of the MCZ. In addition to serving on the Museum’s governing board, George, together with his wife Nancy, was the founding donor of the Putnam Expeditionary Grants program, which supports field-based research by MCZ graduate students, postdoctoral fellows and faculty-curators. He served with the U.S. Army Air Corps in World War II and was an alumnus of Harvard College and Harvard Business School. George’s kindness, wise counsel and advocacy on behalf of the MCZ will be sorely missed.

1 Summary for policymakers of the global assessment report on biodiversity and ecosystem services of the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services
The MCZ is pleased to welcome Dr. Javier Ortega-Hernández as curator of Invertebrate Paleontology and assistant professor in the Department of Organismic and Evolutionary Biology.

Dr. Ortega-Hernández joined the MCZ in January 2019 after his postdoctoral stint as a Herchel Smith Fellow in Biological Sciences at the University of Cambridge. “Javier brings to Harvard a wealth of expertise regarding a group of animals that are fundamental to our understanding of the evolution of life on Earth,” says MCZ Director James Hanken.

As a paleobiologist, Dr. Ortega-Hernández explores the origin and early evolution of invertebrate animals during the “Cambrian Explosion” more than 500 million years ago, when animal fossils first appeared, relatively suddenly, all around the world. He has spent most of his career studying extinct arthropods and their modern descendants, including arachnids, millipedes, centipedes, crustaceans and insects.

“Arthropods and their relatives represent one of the most successful animal groups in the history of life on Earth,” says Dr. Ortega-Hernández. As such, arthropods are an excellent group for addressing the origin of animals during the Cambrian Explosion and investigating how evolution has produced one of the most versatile and adaptable body plans known.

“By combining available information on the embryonic development and segmentation of extant species, it has been possible to better understand how the Cambrian organisms—with their often strange body plans—are related to living groups and learn something about their early evolution that would be otherwise impossible to realize if we only study organisms alive today.”

Dr. Ortega-Hernández’s research utilizes exceptionally preserved fossils that, due to unusual circumstances during the process of fossilization, contain information about the soft tissues such as the legs, eyes and brains. He has helped pioneer the use of X-ray computed tomography to investigate the 3D-preserved morphology in pyritized fossils from the Cambrian in South China, making it possible to study features that are normally concealed within the rock.

The Ortega-Hernández lab will bring together traditional paleontology and fieldwork, developmental biology of extant organisms, state-of-the-art imaging and other analytical techniques to study the evolutionary history of arthropods and their close relatives. “We are expanding our access to numerous exceptional fossil discoveries around the world, providing material to better understand the extinct biodiversity of Cambrian and Ordovician ecosystems,” he says, “and we are implementing high-end imaging techniques to obtain as much morphological data as possible from the material.”

According to Dr. Ortega-Hernández, “The MCZ, brimming with invaluable collections of great scientific significance, has been a powerhouse for invertebrate paleontology. It houses an extremely supportive staff that is as excited about these resources as I am.”
**Faculty-Curator Profiles**

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

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

**Brian D. Farrell**
*Monique & Philip Lehner Professor for the Study of Latin America*
*Professor of Organismic & Evolutionary Biology*
*Curator of Entomology*
*Director, David Rockefeller Center for Latin American Studies*
*Facuity Dean, Leverett House*

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

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

**Scott V. Edwards**
*Professor of Biology*
*Alexander Agassiz Professor of Zoology*
*Curator of Ornithology*

Prof. Edwards’ research focuses on the evolutionary biology of birds and related species, combining field, museum and genomics approaches to understand the basis of avian diversity, evolution and behavior. Current projects use genomics technologies to study comparative genomics and the evolution of flightlessness and other traits in birds; phylogeography and speciation in Neotropical and Australasian birds; and the genomics of host–parasite coevolution between house finches and a recently acquired bacterial pathogen, *Mycoplasma*.

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

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

Prof. Hanken utilizes laboratory-based analyses and field surveys to examine morphological evolution, developmental biology and systematics. Current areas of research include the evolution of craniofacial patterning, the developmental basis of morphological novelty and life-history evolution, biodiversity informatics, and systematics and evolution of neotropical salamanders.

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

Prof. Hoekstra combines field and laboratory work to understand the evolution of mammalian diversity. 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.

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

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

His current studies focus on the 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.

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

Prof. McCarthy’s research focuses on factors that regulate the processes of primary production and nutrient supply in the ocean. Using field studies and modeling, Prof. McCarthy and his group examine the effects of seasonal or interannual climate change on marine life from plankton to whales.
Naomi E. Pierce  
Sidney A. & John Hessel Professor of Biology  
Curator of Lepidoptera

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

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

Prof. Srivastava’s research focuses on understanding the evolution of animal development and regeneration. Her group utilizes the three-banded panther worm, Hofstenia miamia, which she has developed as a new acoel model system. Acoels represent the sister-group to all animals with bilateral symmetry, which allows the study of genetic mechanisms that span 550 million years of animal evolution.

Current projects in the lab range from identifying gene regulatory networks for regeneration to determining the embryonic origins of pluripotent stem cells to understanding the origins of bilateral nervous systems.

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

Prof. Ortega-Hernández’s research focuses on the evolution of metazoans that first appeared and rapidly diversified during the Paleozoic Era (ca. 541 to 251 million years ago). His group specializes in the study of exceptionally preserved Cambrian and Ordovician fossil biotas around the world, with a strong interest in the morphology, phylogeny and development of panarthropods and their relatives. The lab combines traditional paleontology with cutting-edge techniques to investigate exceptional fossils, test macroevolutionary hypotheses through deep time, and better understand the origin of the major animal groups that have shaped the biosphere for more than 500 million years.

Stephanie E. Pierce  
Thomas D. Cabot Associate Professor of Organismic & Evolutionary Biology  
Curator of Vertebrate Paleontology

Prof. Pierce’s research is focused on major morphological and ecological transitions in vertebrate evolution through an examination of the fossil record. Her work tends toward 3D modeling and experimentation of the musculoskeletal system, with particular attention to the link between form and function. Current projects include the fin-to-limb transition, the “reptile”-to-mammal transition and the evolution of the horse.
Emeritus Profiles

A. W. “Fuzz” Crompton
Faculty-Curator, Emeritus
Fisher Professor of Natural History, Emeritus

Prof. Crompton, former curator of Mammalogy, was the director of the MCZ from 1970 to 1982, having served as director of both the Peabody Museum of Natural History at Yale University and the South African Museum in Cape Town.

His primary research interests include the origin and evolution of mammals, functional anatomy, and neural control and evolution of feeding in recent and fossil vertebrates. Prof. Crompton received two Guggenheim fellowships for his research on vertebrate paleontology and functional morphology, and in 2011 received the Romer-Simpson Medal from the Society of Vertebrate Paleontology.

Edward O. Wilson
Honorary Curator in Entomology
Pellegrino University
Professor, Emeritus

Prof. Wilson is considered the founder of sociobiology and has developed the basis of modern biodiversity conservation. He has received many of the world’s leading prizes in recognition of his research, creative literature and environmental activism. Prof. Wilson was awarded two Pulitzer Prizes for his books The Ants (1990, with Bert Hölldobler) and On Human Nature (1978). He received the TED Prize in 2007, where he articulated the concept of the Encyclopedia of Life, and the Hubbard Medal in 2013, the rarely given highest award of the National Geographic Society.

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

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

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

Robert M. Woollacott
Professor of Biology Emeritus

Prof. Woollacott joined the faculty in 1972 and retired in 2018. His teaching and research focus is on the reproduction of marine invertebrates, especially larval biology, as well as human impacts on life in the sea.
Organismic and Evolutionary Biology

**OEB 11: Introduction to Tropical Biology**  
Gonzalo Giribet (and David Haig)  
Introduction to concepts of tropical biology and tropical biodiversity with a focus on the ecology, physiology and diversity of rainforest and tropical coral reef ecosystems.

**OEB 51: Biology and Evolution of Invertebrate Animals**  
Gonzalo Giribet (and Cassandra Extavour)  
Introduction to invertebrate diversity, covering the development, adult anatomy, biology and evolutionary relationships of the main animal phyla, including sponges, mollusks, annelids and arthropods, among others.

**OEB 57: Animal Behavior**  
Naomi E. Pierce (and Bence P. Olveczky)  
A review of the behavior of animals under natural conditions, with emphasis on both mechanistic and evolutionary approaches.

**OEB 58: How to Build an Animal**  
Stephanie E. Pierce, Mansi Srivastava  
Introduction to animal biology, evolution and development and how these processes combine to shape the diversity of life on Earth.

**OEB 115: The Developmental Basis for Evolutionary Change**  
Mansi Srivastava (and Matthew Harris, Clifford Tabin)  
Introduction to evolutionary developmental biology, focusing on the molecular and cellular bases of how embryos generate adult body plans in order to understand how form, physiology and life history strategies are modulated over the course of evolution.

**OEB 125: Molecular 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.
OEB 58: How to Build an Animal

OEB 155r: Biology of Insects
Naomi E. Pierce
Introduction to the major groups of insects—life history, morphology, physiology and ecology—through a combination of lecture, lab and field exercises.

OEB 207: The Fishy Aspects of the Human Body
Stephanie E. Pierce
Exploration of how the human body evolved through an analysis of the nonfiction book *Your Inner Fish: A Journey into the 3.5-Billion-Year History of the Human Body* by evolutionary biologist Neil Shubin.

Freshman Seminar

FRSEMR 21R: The Evolutionary Transition from Dinosaurs to Birds: Fossils, Genomes and Behavior
Scott V. Edwards
Exploration of the dinosaurian origins of modern birds through examination of Harvard’s excellent collections of dinosaur fossils, skeletons and specimens of extant birds, and focused readings and discussions.

FRSEMR 50H: The Biology of Movement
Andrew A. Biewener
Explores why and how organisms move, providing an overview of the biological motors animals and microbes use to power movement and the mechanisms plants use for growth and geotaxis and phototaxis, as well as the aesthetics and health benefits of movement.

Mind, Brain and Behavior

MBB 980Q: Of Mice and Microbes: How Microbes Shape Animal Behavior
Naomi E. Pierce (and Chris Baker)
Exploration of a variety of animal–microbe symbioses through the lens of animal behavioral ecology.
Life Sciences

LIFESCI 1B: An Integrated Introduction to the Life Sciences: Genetics, Genomics and Evolution
Hopi E. Hoekstra (and Andrew Berry, Pardis Sabeti)
An integrated approach showing how genetics and evolution are intimately related, together explaining the patterns of genetic variation we see in nature, and how genomics can be used to analyze variation.

LIFESCI 2: Evolutionary Human Physiology and Anatomy
Andrew A. Biewener, George V. Lauder (and Daniel E. Lieberman)
Explores human anatomy and physiology from an integrated framework, combining functional, comparative and evolutionary perspectives on how organisms work.

Graduate Courses of Reading and 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 345/E-PSCI 337: Biological Oceanography
James J. McCarthy

OEB 355: Evolutionary Developmental Biology
James Hanken

OEB 362: Research in Molecular Evolution
Scott V. Edwards

OEB 370: Mammalian Evolutionary Genetics
Hopi E. Hoekstra
Introduction to Tropical Biology in Australia

OEB11: Introduction to Tropical Biology exposes students to concepts of tropical biology and biodiversity. A pre-semester three-week field trip for the course took place in January 2019 in Australia. Students did fieldwork in the rainforest and tropical coral reefs and focused on the ecology, physiology and diversity of these ecosystems. Experts on tropical ecology, including rainforests and marine environments, and taxonomic experts were involved. Taught by Gonzalo Giribet, professor of Organismic and Evolutionary Biology and curator of Invertebrate Zoology, and David Haig, George Putnam Professor of Biology in Organismic and Evolutionary Biology at Harvard, along with faculty of the University of Sydney, the ten Harvard students on the trip partnered with ten students from the University of Sydney. The students experienced the local biodiversity and the research related to aspects of diversity, ecology and evolution, while interacting with their Australian counterparts and learning about the local culture. This was the first time the field course was offered and it was a great success.
Research Making Headlines

Just Breathe

With 478 species, plethodontid salamanders are the largest group of salamanders in the world. They can also survive on land without lungs. Loss of lungs is a major evolutionary change that might be expected to limit body size and thermal tolerance, and therefore location, of a species. However, these lungless salamanders are up to 27 centimeters long and thrive in a variety of environments throughout the Western Hemisphere, South Korea and Italy, so they must have adapted successfully to obtain adequate oxygen.

For decades, scientists have assumed that lungless salamanders “breathe” through their skin and the lining of their mouth, but have not explored exactly how the process works. James Hanken, Zachary Lewis and Jorge Dorantes examined the lungless dusky salamander (Desmognathus fuscus) and found that while it has the genes to form lungs—which develop initially but then stop—it instead forms enriched blood vessels to the skin and mouth rather than lungs. They also discovered that a gene which produces a key protein for lung function, surfactant protein C, is expressed in their skin and mouths, possibly helping facilitate absorption of oxygen, and that the dusky salamander has two copies of this gene. Gene duplication is important in evolution because the first gene can continue functioning normally while the second is deployed in some other way to enable the evolution of novel traits. In this case, the second copy turns on in the skin in larvae, but once the salamander comes on land and the skin begins to harden, this expression moves to the mouth. The research was published in Proceedings of the Royal Society B.


Solving the Segmented Spine

Much of the agility of mammals—climbing, running, flying and digging—is made possible by highly specialized regions of their backbones. To examine how the mammal spine and its distinctive regions evolved, a team led by Stephanie E. Pierce and postdoctoral researcher and lead author Katrina Jones looked to the fossil record of mammalian ancestors, the nonmammalian synapsids, which diverged from reptiles like lizards and dinosaurs more than 320 million years ago. However, finding extinct animals with all 25-plus vertebrae in place is extremely rare, so the researchers searched museum collections from around the world to CT-scan and measure dozens of fossil spines and more than 1,000 vertebrae from living mammals, reptiles and amphibians. The analysis of the spinal regions showed that, contrary to common assumptions based on living animals, the mammalian spine gained new regions during its deep-time evolution. Around 250 million years ago a new region evolved near the shoulders as the forelimbs lengthened and moved under the body, changing how these animals walked and ran. Later, another region developed near the pelvis forming the ribless lumbar region, an area that is very important for locomotion and adapting to new environments. Formation of the lumbar region is also linked to changes in Hox gene expression, the genetic scheme for determining the layout of the spine in early development. Together, these evolutionary changes laid the foundation for a highly adaptable mammalian body plan, enabling mammals to diversify into the myriad forms we see today.

A Mouse of a Different Color

In the faraway Sand Hills of Nebraska, steel enclosures and a population of deer mice (Peromyscus maniculatus) have been instrumental in an unprecedented, multiyear experiment conducted in the laboratory of Hopi E. Hoekstra. Fieldwork led by former postdoctoral researcher Rowan Barrett combined with lab experiments led by former postdoctoral researcher Ricardo Mallarino, among others, illuminated the full process of evolution by natural selection.

The Sand Hills region contains areas of distinctively dark and light soils, with deer mice of corresponding dark and light fur. It was long hypothesized that the light mice would be better camouflaged from predators on light soil, and dark ones better on dark soil. To test this, researchers built 80-foot-square steel enclosures on both types of soil and placed approximately 100 deer mice with different coat colors into each of six pens open to avian predators. After only three months they already found that coat color strongly predicted the likelihood of survival, with higher survival of mice that matched the soil color, clearly demonstrating how physical attributes can interact with environmental conditions to affect fitness. But that was just the beginning.

In the lab, researchers examined the gene Agouti that controls the production of yellow pigment. The darker mice had a functioning copy of the gene, producing dark coats, but the lighter mice were discovered to have a single three-DNA base-pair mutation in the Agouti protein, which affected the protein’s binding leading to lighter pigmentation. For the first time in a single study, researchers were able to demonstrate how physical traits impact survival in the wild, determine the gene and mutation that contribute to these physical traits, and establish how that mutation operates.


Flight Delays

It is understandable that early evolutionary biologists assumed that flightless birds descended from a common ancestor. After all, they have similar body types, with small to no forelimbs or wings, an absence of a “keel” in the breastbone for wing muscle attachments, and larger hind limbs. However, recent genomics analysis has shown that since there was no recent common ancestor, flightlessness evolved independently in multiple lineages. But how?

Led by Scott V. Edwards and Timothy Sackton, director of informatics for FAS Research Computing, the multi-disciplinary team of ornithologists, developmental biologists, morphologists, statisticians and population geneticists included Harvard members Phil Grayson, Alison Cloutier, Zhirui Hu, Jun S. Liu, and Michele Clamp, among others. The team assembled and annotated 11 new genomes, including 8 flightless birds like the emu, kiwi and extinct moa, and 3 tinamous, which can fly. These genomes were then analyzed together with the published genomes of 33 bird species, both flightless and flying. The team found that even though the species show wide functional divergences in the protein-coding portions of their genomes, they have very similar regions that regulate these proteins. These shared developmental pathways are employed to alter limb development, stunting or stopping development of the forelimb/wing. Because of their key role in the body- and limb-scaling changes that accompany loss of flight, the study suggests that these developmental pathways have been employed multiple times across the various flightless lineages.

**RESEARCH**

**Protecting Pollinators**

Bees and insects everywhere are in decline. They help maintain biodiversity and ecosystem function and are critical for the pollination of about a third of the world’s agricultural crops. New research has shown that neonicotinoids, the most commonly used class of pesticide around the globe, have profound impacts on a variety of social behaviors to the detriment of the colony’s vitality, even in nonlethal doses.

While earlier research showed pesticide exposure decreased foraging activities, new techniques were required to look inside the nest. To observe the bees’ interior world, a team of Harvard researchers, including lead author postdoctoral fellow James Crall, Naomi Pierce, Stacey Combes and Benjamin de Bivort developed a robotic platform to study colonies under field conditions. By placing a QR code on each bumblebee (Bombus impatiens), the behavior of individuals in multiple colonies could be monitored with a mobile camera array and computer vision.

A team led by Prof. Srivastava is using the three-banded panther worm (Hofstenia miamia) as a model organism for its ability to regenerate its entire body and its phylogenetic position as the likely sister group to all other organisms with symmetrical body plans, or bilaterians. Then she developed molecular techniques to study how the worm is able to regenerate.

Colonies were then exposed to ecologically relevant levels of imidacloprid, a neonicotinoid pesticide. The researchers found exposure impaired queen and worker behaviors within the nest, with even more marked effects at night. The bees were not as efficient at regulating nest temperature and were less likely to build an insulating wax canopy around the brood, an important adaptation to cold.

These results, published in *Science*, illustrate the potential for this high throughput monitoring system to analyze effects of agrochemicals for sublethal impacts on pollinators.


**A Model Worm**

Like salamanders, some animals are capable of regrowing a missing limb. Others, such as jellyfish, can regenerate their bodies after being cut in half. To study the genetics of regeneration, Mansi Srivastava developed the three-banded panther worm (Hofstenia miamia) as a model organism for its ability to regenerate its entire body and its phylogenetic position as the likely sister group to all other organisms with symmetrical body plans, or bilaterians. Then she developed molecular techniques to study how the worm is able to regenerate.

A team led by Prof. Srivastava is using the three-banded panther worm to uncover the regulatory logic that orchestrates regeneration. Prof. Srivastava and Andrew Gehrke, a postdoctoral fellow in the Srivastava lab, and others began by sequencing the genome of Hofstenia miamia, the first from this phylum. They used the genome to map functional binding sites and construct a gene regulatory network initiating whole-body regeneration. In the process, they uncovered a regulatory mechanism—the protein encoded by the gene early growth response, or EGR, gets activated right after amputation and binds to noncoding DNA near other regeneration genes to activate them, acting like a master switch. EGR and its target genes together represent a network or circuit of regulatory interactions that launches the process of regeneration in Hofstenia.

EGR and other genes found in the regeneration circuit of three-banded panther worms are also present in other species. The researchers want to determine what the connections are and how they are wired in other animals, including humans and vertebrates that only do limited regeneration.

With support from a Putnam Expeditionary Grant, members of the Edwards lab and the MCZ Ornithology Department collected specimens in southern Mongolia from June 23 to July 27, 2018. The first goal was to collect high-quality tissues from common species distributed along a north-south gradient of aridity and temperature for eventual gene expression studies. The second goal was to increase the global genomic resources for Mongolian birds through general collecting. MCZ participants included Scott V. Edwards, curator of Ornithology, Jeremiah Trimble, curatorial associate in Ornithology, and graduate student Jonathan Schmitt. The expedition was led by Sundev Gombobaatar, professor of biology at the National University of Mongolia.

“Expedition highlights came not through acquisition of impressively plumaged birds, although that occasionally happened, but through collecting in series, which means obtaining a number of members of single species that can document geographic variation,” says Prof. Edwards. Specimens collected in series included willow tits (Parus montanus), great tits (Parus major), wrynecks (Jynx torquatus)—the most basal lineage of woodpeckers—Daurian redstarts (Phoenicurus auroreus), black redstarts (Phoenicurus ochruros), lesser whitethroats (Sylvia curruca), Godlewski’s buntings (Emberiza godlewskii) and common rosefinches (Carpodacus erythrinus). Several birds were new to the MCZ Ornithology collection, either as species or tissues. Two Saxaul sparrows (Passer ammodendri) collected are among only around 100 specimens of this species worldwide and the best represented in terms of high-quality tissues.

“An expedition innovation was the pre-labeling of cryotubes in the MCZ,” says Trimble, “which expedited the accession of the Mongolia specimens into the Ornithology collection and made them quickly available on MCZbase.” Another innovation was the rapid freezing and high diversity of most of the tissues, since multifaceted tissue preservation is still unique for ornithology.
New Histological Collections at MCZ

Northcutt Collection
The R. Glenn Northcutt Collection of Comparative Vertebrate Neuroanatomy and Embryology consists of an estimated 40,000 histology slides showing the minute structure of animal tissues discernible by microscope.

The collection was amassed over Dr. Northcutt’s career from 1963 to 2014 and generously gifted to the MCZ by him and his friend and colleague, Cornell University professor Dr. William E. Bemis.

Almost 250 unique genera from all living vertebrate groups are represented, including species that are rarely found as histological preparations in museum collections, such as the South American hoatzin, or stinkbird. Most specimens are serially sectioned whole or partial brains. Entire heads and hundreds of serially sectioned embryos are also included. The collection, with incredibly fine histological preparation, is well suited for slide digitization and has provided anatomical voucher material for more than 240 publications in neuroanatomy and development.

Since the collection represents taxa from multiple curatorial departments, it is being cataloged in MCZ’s Special Collections. According to Linda S. Ford, director of collections operations, “The collection has remarkable representation among the vertebrates and is a wonderful complement to the Minot Harvard Embryological Collection, which is also cataloged and housed in Special Collections.”

Wilder Collection
The Wilder Collection was built by anatomist and zoologist Harris Hawthorne Wilder (1864–1928). “The collection contains around 2,600 slides of various vertebrate skulls and developmental series, and numerous salamander histological sections,” says José Rosado, curatorial associate in Herpetology.

A member of the Smith College faculty, Wilder lived with his wife in Northampton in a house situated on the campus. When she passed, the contents were stored away and the house used for offices. At some later time, the contents were reviewed by Smith College, which gave the slides to Dr. Stephen Tilley, a herpetologist in the Department of Biology. He, in turn, donated the collection to the MCZ.
Land snails are a major component of terrestrial ecosystems. There are more than 25,000 species of land snails worldwide with more than 6,000 species occurring on the Pacific Islands. Unfortunately, Pacific Island land snails account for 40% of all documented recent animal extinctions (IUCN 2016).

MCZ is a member of a consortium of five of the largest natural history collections in the U.S. that has been awarded a National Science Foundation grant to establish the Pacific Island Land Snail Biodiversity Repository (PILSBRY). “When complete, this resource will document the biodiversity of land snails that occur now, or once lived, on many of the Pacific Islands,” says Principal Investigator James J. McCarthy, acting curator of Malacology. “It will allow researchers to assess species distributions, population variation, morphological variation, species invasions, and other ecological and evolutionary relevant questions.”

“From various Pacific Islands, MCZ has over 11,407 lots—around 104,000 specimens—representing 2,840 different species of land snails, and more than half of them are from Hawaii,” says Adam J. Baldinger, curatorial associate in Malacology. MCZ’s primary role will be to ensure the accuracy of these records and enrich them with habitat data, collectors’ observational notes, genetic data and georeferences. MCZ staff will digitally capture data for uncatalogued specimens as well as create digital images of all primary types—516 specimens in all—from the Pacific Islands.

Caribbean Millipedes

The Department of Invertebrate Zoology recently acquired a large and valuable collection of Caribbean millipedes from well-known Cuban zoologist Antonio Pérez-Asso. The Pérez-Asso Collection was amassed during a lifetime of dedication to myriapodology and includes his major taxonomic interest, juliform millipedes of Hispaniola.

“Juliform millipedes are often poorly preserved in collections due to their tendency to curl during initial fixation, and many specimens are fragile and can break when in contact with other specimens or container walls,” says Gonzalo Giribet, curator of Invertebrate Zoology. To prevent this damage, Pérez-Asso carefully placed each specimen in a straight plastic tube—often a piece of straw—and stored them in these tubes in jars, so all specimens are beautifully preserved.

The collection includes about 5,650 specimens collected between 1993 and 2008 in the Dominican Republic and Haiti; 24 are holotypes—specimens used to formally describe a species—and 595 are paratypes, additional specimens of a type series. This extensive collection also comprises numerous topotypes—specimens collected at the same location as the original holotype—of most of the species from the Dominican Republic, plus a few from Haiti, that were described by Loomis and Chamberlin between the 1910s and 1940s.

Malacology Receives NSF Digitization Grant

Land snails are a major component of terrestrial ecosystems. There are more than 25,000 species of land snails worldwide with more than 6,000 species occurring on the Pacific Islands. Unfortunately, Pacific Island land snails account for 40% of all documented recent animal extinctions (IUCN 2016).
Projects & Initiatives

Encyclopedia of Life Learning + Education Group

The Encyclopedia of Life (eol.org) is an open-science project that aggregates biodiversity content and data from partners such as MCZbase, the Smithsonian Institution, the Global Biodiversity Information Facility and iNaturalist. EOL is also used in formal and informal education settings and for citizen-science activities. All resources, data, tools and applications are freely available.

Due to EOL’s shift to ecological modelers and scientists as its primary audiences, the EOL Learning + Education Group, hosted at the MCZ, disbanded in June 2019.

Educational Resources

The EOL Learning + Education website (education.eol.org) continues to offer podcasts, lesson plans and biodiversity cards, all aligned with the U.S. Next Generation Science Standards. The EOL Biodiversity Card Maker allows anyone to access, download and make biodiversity cards for classroom learning and to support biodiversity-related citizen science projects.

City Nature Challenge

In 2019, the City Nature Challenge took place April 26 to April 30 in 159 cities and 29 countries, engaging 35,126 observers and logging 963,773 observations. All 351,671 research-grade images flowed from the iNaturalist biodiversity observation platform to EOL, including observations of 1,100 rare, endangered and threatened species globally. EOL led the effort to create the CNC Education Toolkit and helped organize the Boston event.

Teaching with Specimens and Digital Images

Through a 2018 grant from the Institute of Museum and Library Services, the Harvard Museums of Science & Culture will improve the ability of middle school teachers to teach with museum collections-based digital resources. With teachers as advisors, the museum will create four classroom activities and associated teacher professional development programs. The project, which will run through 2021, will provide schools with classroom-ready resources that support student learning.

The activity The Natural History of Frogs uses 3D-printed frogs created from the MCZ Herpetology collection. The museum worked with graduate student Mara Laslo in the Hanken lab to identify a dozen frog species that show a variety of strategies for survival, and students will use these lifelike replicas to observe physical traits that allow survival in a particular habitat.

For Is it a snake? Not all legless reptiles are snakes!, students will investigate morphological traits of limbless specimens through digital images from the Herpetology collection to determine which ones are snakes and which ones are not, and to explore convergent evolution that led many disparate lineages to adopt similar morphologies.

Teeth, Toes and Temperature: Climate Change and Horse Evolution utilizes 3D-printed fossil horse teeth to illustrate the changing food source, and hence changing environments, of horse ancestors during the Cenozoic. Graduate student Brianna McHorse of Stephanie Pierce's lab and Jessica Cundiff, curatorial associate in Vertebrate Paleontology, assisted in selecting fossil horse teeth.
Ernst Mayr Library

Biodiversity Heritage Library
EML staff has enriched BHL’s online content while focusing on MCZ’s unique collections, such as adding digital versions of more than 500 books held by MCZ in just the last year. EML content in BHL is viewed by an average of 7,191 users per month, with 22,296 total views per month.

William Brewster Collections Digitized
This year volunteers transcribed more than 900 pages of William Brewster’s journals and diaries. To date, 41 volumes have been transcribed and validated for a total of 8,009 pages. Since the November 2018 soft launch of BHL’s transcription functionality, EML has added eight transcribed volumes—1,547 pages—of his journal entries, which are full-text searchable in BHL.

Jacques Burkhardt Fish Illustrations Published
The 2019 book *Brazilian Fishes: Watercolors by Jacques Burkhardt (1865–1866)* features nearly 1,000 paintings made during the Louis Agassiz–led Thayer Expedition to Brazil. A grant in 2000 enabled digitization of these paintings and associated Thayer Expedition materials. The Jacques Burkhardt Scientific Drawings collection is available on Harvard Library’s CURIOSity Spotlight digital collections platform.

Digitizing MCZ Collection Documents
More than 1,000 pages of field notes, ledgers and ancillary materials from several MCZ departments have been scanned, including 196 sponge photographs and cards from Invertebrate Zoology, 314 ledger sheets from Malacology (*Thaanum Catalogue of Hawaiian Land Shells*) and 515 data cards from Mammalogy (*Asiatic Primate Expedition 1937*). They are archived in the Harvard Digital Repository Service and will be linked to MCZbase specimen records.

MCZ History
Swiss-born Jacques Burkhardt was among the finest natural history illustrators of the 19th century, and for most of his life he worked for the MCZ’s founding director, Louis Agassiz. His greatest artistic legacy may be a collection of more than 400 watercolor and pencil drawings of Amazonian fishes from the Thayer Expedition to Brazil, 1865–1866. Each haul of the ship’s nets would deposit piles of fishes on deck, with Agassiz quickly identifying new species while Burkhardt furiously sketched outlines of select specimens and made color notes to complete the drawings later.

Widespread appreciation of Burkhardt’s watercolors has come only recently. In 2004, the Ernst Mayr Library began offering digital scans of the drawings, which have been viewed thousands of times, and in 2019 many were reproduced in a lavish volume by Heraldo Britski and José Lima de Figueirado of the University of São Paulo Museum of Zoology. But not everyone recognized their value. In 1940, MCZ Director Thomas Barbour shipped the drawings to Stanford, telling ichthyologist George Myers: “They are a gift, pure and simple, and I hope that you may . . . perhaps find some use for them. If not, I suppose even in California you occasionally have a fire in the grate.” Thankfully, Myers didn’t take Barbour’s advice, and the paintings were eventually returned to the MCZ.
Harvard Museums of Science & Culture

In July 2019, Jane Pickering became the director of Harvard’s Peabody Museum of Archaeology & Ethnology. Pickering will oversee the curation, care and conservation, and programming of one of the oldest and largest collections of cultural objects in the Western Hemisphere. Founded in 1866, the Peabody Museum houses more than 1.2 million objects.

Pickering had been executive director of the Harvard Museums of Science & Culture since 2013, directing public programming for a consortium of six partner museums: the Museum of Comparative Zoology, the Harvard University Herbaria, and the Mineralogical & Geological Museum, which contribute to the Harvard Museum of Natural History; the Semitic Museum; the Peabody Museum of Archaeology & Ethnology; and the Collection of Historical Scientific Instruments.

During the consortium’s first five years, museum attendance increased by 34 percent to almost 300,000 annual visitors. Pickering worked to expand the reach of HSMC programming in collaboration with other Harvard communities, and in 2017, more than 150 Harvard faculty members participated in HMSC curation, presentations and program advising.

HMSC Highlights
During the academic year, HMSC opened several new exhibitions. The multimedia Climate Change at the Harvard Museum of Natural History is a complete gallery renovation that features Harvard research about the warming climate, its global and local consequences, and how to reduce fossil fuel emissions and prepare for its effects. The Rockefeller Beetles, an exhibition of hundreds of specimens from David Rockefeller’s recently donated collection, debuted in October. Two new photographic exhibitions were shown at the Peabody Museum—Caspian: Chloe Dewe Mathews and Kalahari Perspectives: Anthropology, Photography and the Marshall Family.

In celebration of the 10th anniversary of the Evolution Matters lecture series, a special event was held with authors David Quammen and Carl Zimmer. Later in the semester, Frontiers in Evolution featured lightning talks by four Harvard graduate students, an experimental format that was very successful.

More than 6,000 people enjoyed HMSC’s evening programs, with the live streams watched by viewers around the world. Special evening programs were hosted for Harvard students at both ends of their college experience. A new program at the Peabody, Native American Poetry Playlist: Poems in the Gallery, enabled visitors to listen to contemporary poems by Native American authors while exploring the first-floor galleries.
Awards & Recognition

Faculty-Curators

Scott V. Edwards was awarded the 2019 Molecular Ecology Prize. Along with several other colleagues, he was awarded a National Science Foundation grant in Dimensions of Biodiversity, a new program that supports projects that yield a better understanding of Earth’s biodiversity.

Two new species of invertebrates were named after Gonzalo Giribet: the sponge Leucetta giribeti and the annelid worm Pterocirrus giribeti.

George V. Lauder received the Joseph S. Nelson Lifetime Achievement Award in Ichthyology from the American Society of Ichthyologists and Herpetologists.

Javier Ortega-Hernández was granted the distinction of National Researcher Level 1 by the National System of Researchers of the Government of Mexico.

Mansi Srivastava received a National Institutes of Health Maximizing Investigators’ Research Award for Early Stage Investigators for the project Using a new regenerative model system to elucidate mechanisms for stem cell regulation.

Staff

Jason Fleming, senior research administrator, and Nikki Hughes, faculty assistant, each received a Dean’s Distinction Award from the Faculty of Arts and Sciences.

Karsten E. Hartel, former curatorial associate of Ichthyology, was honored by the American Society of Ichthyologists and Herpetologists with the Spiritus Award for his excellence in service and support of natural history collections.

Breda Zimkus, cryogenics collections manager for genetic resources, received a Certificate of Teaching Excellence for Lecturers from the Derek Bok Center.

Postdoctoral Researchers

Ligia Benavides Silva received a Certificate of Distinction in Teaching from the Derek Bok Center.

Valentina Di Santo received the She Made a Difference award from the European Women’s Management Development International Network.
Graduate Students

Caitlin Baker received first place for best student talk in Evolution, Systematics and Biogeography at the 21st International Congress of Arachnology.


Jasmin Camacho was awarded an American Association of University Women 2018 American Fellowship for her project Developmental, cellular and genetic mechanisms underlying striking cranio-facial variation in New World leaf-nosed bats.

Olivia Meyerson received the Lewontin Research Award from the Society for the Study of Evolution and a National Science Foundation Graduate Research Fellowship.

Sofia Prado-Irwin was awarded a Society of Systematic Biologists Graduate Student Research Award.

Shayla Salzman and Dylan Wainwright were each awarded a National Science Foundation Postdoctoral Research Fellowship in Biology.

Anole by Sofia Prado-Irwin

Kadeem Gilbert was awarded a National Institute of Food and Agriculture Postdoctoral Fellowship from the United States Department of Agriculture.

Phil Grayson won Best Student Talk in the Division of Evolutionary Developmental Biology at the Society for Integrative and Comparative Biology annual meeting.

Richard Knecht was awarded a National Science Foundation Graduate Research Fellowship and a Crustacean Society Fellowship in Graduate Studies.

Undergraduate Students

Sophie Westbrook received the Freund Prize for the highest academic standing in Harvard College.

Brendan Dean Zhi Min received a Hoopes Prize for his thesis project Burning questions: Responses to fire by partners in a complex ant–plant symbiosis.
Grants-in-Aid of Undergraduate Research

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

<table>
<thead>
<tr>
<th>Recipient</th>
<th>Academic Dept./Faculty Sponsor</th>
<th>Project Title</th>
<th>Amount</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chloé-Rose Colombero</td>
<td>OEB/George Lauder</td>
<td>Dermal denticle replacement in sharks: A comparative analysis across species</td>
<td>$5,000</td>
</tr>
<tr>
<td>Emmanuel D’Agostino</td>
<td>OEB/James Hanken</td>
<td>Estimating behavioral, morphological and genomic divergence in precopulatory isolation of <em>Anolis sagrei</em></td>
<td>$500</td>
</tr>
<tr>
<td>Camille DeSisto</td>
<td>HUH/Charles Davis</td>
<td>The spread and consequences of the invasive strawberry guava in Madagascar</td>
<td>$4,797</td>
</tr>
<tr>
<td>Elizabeth D’haiti</td>
<td>OEB/Mansi Srivastava</td>
<td>Determining the timeline of development of adult pluripotent stem cells in <em>Hofstenia miamia</em></td>
<td>$4,000</td>
</tr>
<tr>
<td>Sonja K. Eliason</td>
<td>HEB/Bridget Alex</td>
<td>Investigating the genetic coevolution of humans and <em>Yersinia pestis</em></td>
<td>$500</td>
</tr>
<tr>
<td>Skye Fenton</td>
<td>OEB/Paul Moorcroft</td>
<td>Senior thesis research: Mechanistic modeling of reintroduced roe deer movement and resource use</td>
<td>$4,000</td>
</tr>
<tr>
<td>Laura Jenny</td>
<td>OEB/Naomi Pierce</td>
<td>Analyzing changes to the microbiota of cucurbit plants during infection with <em>Erwinia tracheiphila</em></td>
<td>$2,311</td>
</tr>
<tr>
<td>Anne Kennedy-Yoon</td>
<td>OEB/Naomi Pierce</td>
<td>The effect of ant species on tree growth and morphology in African whistling thorn acacias</td>
<td>$2,750</td>
</tr>
<tr>
<td>Eli Martin</td>
<td>OEB/Gonzalo Giribet</td>
<td>Investigation of pteropod diversity and distribution in Panama using numerical and genetic methods</td>
<td>$3,100</td>
</tr>
<tr>
<td>Elena Moncada</td>
<td>OEB/Gonzalo Giribet</td>
<td>Phylogenetic analysis of the family Donacidae (coquina or bean clams)</td>
<td>$1,750</td>
</tr>
<tr>
<td>Deirdre Potter</td>
<td>OEB/Mansi Srivastava</td>
<td>Neural regeneration in <em>Hofstenia miamia</em>: Investigating expression of genes in adult neurogenesis</td>
<td>$4,000</td>
</tr>
<tr>
<td>Jaelithe Virgin-Downey</td>
<td>Kennedy School of Government/Sheila Jasanoff</td>
<td>The science and politics of Florida’s red tide (harmful algal blooms)</td>
<td>$2,600</td>
</tr>
<tr>
<td>Brendan Dean Zhi Min</td>
<td>OEB/Naomi Pierce</td>
<td>A song of time and fire: Symbiosis maintenance in a complex Kenyan ant–acacia system</td>
<td>$2,500</td>
</tr>
<tr>
<td>Brendan Dean Zhi Min</td>
<td>OEB/Naomi Pierce</td>
<td>Burning questions: Responses to fire by partners in a complex ant–plant symbiosis</td>
<td>$3,740</td>
</tr>
</tbody>
</table>

**Total Awards**                                                                 $41,548
**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.

<table>
<thead>
<tr>
<th>Recipient</th>
<th>MCZ Department/ Faculty Sponsor</th>
<th>Project Title</th>
<th>Amount</th>
</tr>
</thead>
<tbody>
<tr>
<td>Richard Childers</td>
<td>Entomology/Naomi Pierce</td>
<td>Ants and associated myrmecophiles of East African acacias</td>
<td>$8,699</td>
</tr>
<tr>
<td>Shahan Derkarabetian</td>
<td>Invertebrate Zoology/ Gonzalo Giribet</td>
<td>Genomics of phenotypic convergence: Evolution of limb loss in squamates</td>
<td>$7,030</td>
</tr>
<tr>
<td>Scott Edwards</td>
<td>Ornithology</td>
<td>Chromosomal evolution in Australian honeyeaters (Aves: Meliphagidae)</td>
<td>$6,105</td>
</tr>
<tr>
<td>Sang Il Kim</td>
<td>Entomology/Brian Farrell</td>
<td>Systematics of <em>Anoplophora</em> longhorn beetles (Coleoptera: Cerambycidae) and their genomic basis of adaptation to the temperate zone</td>
<td>$9,000</td>
</tr>
<tr>
<td>Juan Moles</td>
<td>Invertebrate Zoology/ Gonzalo Giribet</td>
<td>Exploring Maldives sea slug diversity</td>
<td>$9,240</td>
</tr>
<tr>
<td>Javier Ortega-Hernández</td>
<td>Invertebrate Paleontology</td>
<td>A new early Cambrian Burgess Shale–type fossil biota from shallow marine waters</td>
<td>$10,860</td>
</tr>
<tr>
<td>Flavia Termignoni Garcia</td>
<td>Ornithology/Scott Edwards</td>
<td>Genomics and neurobiology of cooperative breeding in birds</td>
<td>$5,508</td>
</tr>
<tr>
<td>Zhengyang Wang</td>
<td>Entomology/Naomi Pierce</td>
<td>Co-diversification of entomophagous fungi and their lepidopteran hosts: Surveying “mummified caterpillars” of the Himalayan and Hengdian mountains</td>
<td>$9,570</td>
</tr>
</tbody>
</table>

**Total Awards**

$66,012
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.

<table>
<thead>
<tr>
<th>Recipient</th>
<th>Institutional Affiliation</th>
<th>Project Title</th>
<th>Amount</th>
</tr>
</thead>
<tbody>
<tr>
<td>Federico Alejandro Agrain</td>
<td>CCT-CONICET, Argentina</td>
<td>Study of type specimens of Cryptocephalinae: Aiding current systematics and phylogenetic works (Coleoptera: Chrysomelidae)</td>
<td>$1,380</td>
</tr>
<tr>
<td>Jeffry A. Ardila-Camacho</td>
<td>Universidad Nacional Autónoma de México</td>
<td>Systematics of the mantidfly subfamily Symphrasinae (Neuroptera: Mantispidae)</td>
<td>$1,500</td>
</tr>
<tr>
<td>Nelson Buainain Neto</td>
<td>Instituto Nacional de Pesquisas da Amazônia</td>
<td>Phylogenomics and species limits in two Oscine (Aves: Passeri) genera</td>
<td>$1,500</td>
</tr>
<tr>
<td>Alexandre Casadei Ferreira</td>
<td>Universidade Federal do Paraná, Brazil</td>
<td>Taxonomy of the hyperdiverse ant genus Pheidole (Hymenoptera: Formicidae: Myrmicinae) in the Brazilian Atlantic Forest</td>
<td>$1,500</td>
</tr>
<tr>
<td>Julissa Melissa Churata Salcedo</td>
<td>Universidade Federal do Paraná, Brazil</td>
<td>Phylogeny of Chnoodini Mulsant, 1850 (Coleoptera, Coccinellidae, Coccinellinae)</td>
<td>$1,500</td>
</tr>
<tr>
<td>Victor Manuel Conde Vela</td>
<td>El Colegio de la Frontera Sur, Unidad Chetumal</td>
<td>Revision of type and non-type materials of the polychaete family Nereididae (Annelida: Polychaeta)</td>
<td>$1,500</td>
</tr>
<tr>
<td>Mario J. Cupello</td>
<td>Universidade Federal do Paraná, Brazil</td>
<td>Unreveling the megadiversity of an adaptive radiation: Systematics of the New World dung beetle genus Ateuchus Weber, 1801 (Coleoptera: Scarabaeidae: Scarabaeinae: Ateuchini)</td>
<td>$1,500</td>
</tr>
<tr>
<td>Hayden R. Davis</td>
<td>Villanova University</td>
<td>Uncovering the hidden diversity of Borneo in the gecko genus Cyrtodactylus</td>
<td>$1,385</td>
</tr>
<tr>
<td>Valeria Gabbanelli</td>
<td>Instituto de Investigaciones Marinas y Costeras, CONICET</td>
<td>Taxonomy of Southwest Atlantic longnose skates</td>
<td>$1,000</td>
</tr>
<tr>
<td>Nayeli Gutierrez Trejo</td>
<td>American Museum of Natural History</td>
<td>Revision of the genus Tetraopus Dalman in Schoenherr (Coleoptera, Cerambycidae)</td>
<td>$1,000</td>
</tr>
<tr>
<td>Nicolas A. Hazi</td>
<td>The George Washington University</td>
<td>Taxonomic revision and distribution of wandering spiders (Araneae: Ctenidae) in Costa Rica</td>
<td>$1,400</td>
</tr>
<tr>
<td>Richard A. B. Leschen</td>
<td>Landcare Research</td>
<td>Australasian Elmidae</td>
<td>$1,500</td>
</tr>
<tr>
<td>Carlos Alberto Martinez Muñoz</td>
<td>University of Turku, Finland</td>
<td>Revision of Hispaniolan Scolopendromorpha</td>
<td>$1,200</td>
</tr>
<tr>
<td>David B. Muniz</td>
<td>Universidade Federal do Paraná, Brazil</td>
<td>Review of Trypoxylon (Trypargiulium) species occurring in Brazil (Hymenoptera, Crabronidae, Crabroninae)</td>
<td>$1,500</td>
</tr>
<tr>
<td>Jill T. Oberski</td>
<td>University of California, Davis</td>
<td>New World ants of the genus Dorymyrmex: A systematic revision</td>
<td>$1,250</td>
</tr>
</tbody>
</table>
### GRANTS

<table>
<thead>
<tr>
<th>Recipient</th>
<th>Institutional Affiliation</th>
<th>Project Title</th>
<th>Amount</th>
</tr>
</thead>
<tbody>
<tr>
<td>Janakiraman Poorani</td>
<td>ICAR–National Research Centre for Banana</td>
<td>Examination and imaging of Coccinellidae types</td>
<td>$1,500</td>
</tr>
<tr>
<td>Tania Pineda Enríquez</td>
<td>University of Florida</td>
<td>Diversity and evolution of brittle stars across the world ocean: Revisionary systematics of ophiiolepidids</td>
<td>$1,500</td>
</tr>
<tr>
<td>Tiago R. Simões</td>
<td>MCZ</td>
<td>Taxonomy, ontogeny and phylogeny of early rhynchocoephalians</td>
<td>$1,500</td>
</tr>
<tr>
<td>Alexandra Tokareva</td>
<td>Saint Petersburg University</td>
<td>Taxonomy of the neglected mycophagous rove beetle subfamily Oxyporinae Ericson, 1839 (Coleoptera: Staphylinidae)</td>
<td>$1,500</td>
</tr>
<tr>
<td>Omar Valencia-Méndez</td>
<td>Universidad Autónoma Metropolitana, Mexico City</td>
<td>Marine and coastal gobies (Teleostei: Gobiidae) from Eastern Tropical Pacific: A systematic revision</td>
<td>$1,500</td>
</tr>
<tr>
<td>Dagmara Żyła</td>
<td>Iowa State University and University of Gdańsk</td>
<td>Generic revision of Lathrobiini (Paederinae) and Xantholinini (Staphylininae) rove beetles</td>
<td>$1,500</td>
</tr>
<tr>
<td></td>
<td></td>
<td><strong>Total Awards</strong></td>
<td><strong>$31,115</strong></td>
</tr>
</tbody>
</table>

**Robert G. Goelet Research Awards**

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

<table>
<thead>
<tr>
<th>Recipient</th>
<th>Department/ Faculty Sponsor</th>
<th>Project Title</th>
<th>Amount</th>
</tr>
</thead>
<tbody>
<tr>
<td>Jennifer Austiff</td>
<td>Herpetology/James Hanken</td>
<td>Embryology: Concepts and techniques in modern developmental biology</td>
<td>$3,000</td>
</tr>
<tr>
<td>Gustavo Bravo</td>
<td>Ornithology/Scott Edwards</td>
<td>Gordon Research seminar on ecological and evolutionary genomics</td>
<td>$240</td>
</tr>
<tr>
<td>Daren Card</td>
<td>Ornithology/Scott Edwards</td>
<td>Gordon Research seminar on ecological and evolutionary genomics</td>
<td>$240</td>
</tr>
<tr>
<td>Nathaniel Edelman</td>
<td>OEB/James Mallet</td>
<td>Gordon Research seminar on ecological and evolutionary genomics</td>
<td>$240</td>
</tr>
<tr>
<td>Sangeet Lamichhaney</td>
<td>Ornithology/Scott Edwards</td>
<td>Gordon Research seminar on ecological and evolutionary genomics</td>
<td>$240</td>
</tr>
<tr>
<td>Sofia Prado-Irwin</td>
<td>Ornithology/Scott Edwards</td>
<td>Gordon Research seminar on ecological and evolutionary genomics</td>
<td>$240</td>
</tr>
<tr>
<td>Samantha Royle</td>
<td>Herpetology/James Hanken</td>
<td>Cell and developmental biology of <em>Xenopus</em>: Gene discovery and disease</td>
<td>$2,460</td>
</tr>
<tr>
<td>Tianzhu Xiong</td>
<td>OEB/James Mallet</td>
<td>Deciphering the divergence-with-gene-flow pattern in several swallowtail butterflies from the Hengduan Mountains (SW China)</td>
<td>$1,825</td>
</tr>
<tr>
<td>Guillem Ylla Nou</td>
<td>OEB/Cassandra Extavour</td>
<td>Gordon Research seminar on ecological and evolutionary genomics</td>
<td>$240</td>
</tr>
<tr>
<td></td>
<td></td>
<td><strong>Total Awards</strong></td>
<td><strong>$8,725</strong></td>
</tr>
</tbody>
</table>
The cover story highlighted research on early limb patterning in the direct-developing salamander *Plethodon cinereus* by James Hanken and colleagues.

**PUBLICATIONS IN 2018**

- **Ahn AN, Konow N, Tijc C, Biewener AA** (2018) Different segments within vertebrate muscles can operate on different regions of their force-length relationships. *Int Comp Biol* 58:2:19-231
- **Chavarría-Arellano ML, Simões TR, Montellano-Ballesteros M** (2018) New data on the Late Cretaceous lizard *Dicothodon bajasensis* (Squamata, Borioteiioidea) from Baja California, Mexico, reveals an unusual tooth replacement pattern in squamates. *An Acad Bras Cienc* 90:2781-2795

---

James Hanken was consulting editor for *Animal: Exploring the Zoological World.*

Research by Tiago R. Simões and colleagues on the origin of squamates was featured on the cover of *Nature.*

• Hautier L, Oliver JD, Pierce SE (2018) An overview of Xenarthran developmental studies with a focus on the development of the Xenarthrous vertebrae. J Mammal Evol 25:507-523


• Giribet G (2018) Phylogenomics resolves the evolutionary chronicle of our squirming closest relatives. BMC Biol 16:49


MCZ PUBLICATIONS

These charts describe the income and expenses of the Museum of Comparative Zoology in fiscal year 2019.

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

Accumulation of Restricted Reserves indicates net growth of balances in highly restricted gifts and endowments. Building expenses such as maintenance, facility improvements and utilities are captured in the Space & Occupancy category. Operating Expenses consist of equipment purchases, supplies, and consultant and conference fees, as well as annual subventions to the Department of Organismic and Evolutionary Biology (OEB) for administrative services and MCZ support for faculty-curator research. Support for MCZ-affiliated graduate students in OEB is included in Scholarships, Awards & Travel. Institutional Expenses are support for other University activities outside the MCZ, including FAS and University initiatives and general operating support to the Harvard Museums of Science & Culture.

**INCOME**

- Endowment: 83%
- Gifts: 1.5%
- Transfers: 2%
- Federal Sponsored Revenue: 7%
- Overhead Earned: 2%
- Overhead Charged: 2%
- Draw on Unrestricted Reserves: 3%
- Nonfederal Sponsored Revenue: 1%
- Accumulation of Restricted Reserves: 3%

**EXPENSES & NON-OPERATING FUNDS**

- Salaries & Fringe Benefits: 39%
- Operating Expenses: 22%
- Scholarships, Awards & Travel: 4%
- Space & Occupancy: 16%
- Institutional Expenses: 17%
- Overhead Charged: 2%
- Capitalized Balances: <1%

**Income**

<table>
<thead>
<tr>
<th>Source</th>
<th>Amount</th>
</tr>
</thead>
<tbody>
<tr>
<td>Endowment</td>
<td>$16,565,294</td>
</tr>
<tr>
<td>Federal Sponsored Revenue</td>
<td>$1,314,674</td>
</tr>
<tr>
<td>Draw on Unrestricted Reserves</td>
<td>$679,739</td>
</tr>
<tr>
<td>Overhead Earned</td>
<td>$456,280</td>
</tr>
<tr>
<td>Transfers</td>
<td>$383,183</td>
</tr>
<tr>
<td>Gifts</td>
<td>$294,699</td>
</tr>
<tr>
<td>Nonfederal Sponsored Revenue</td>
<td>$171,292</td>
</tr>
<tr>
<td>Other Income</td>
<td>$168,732</td>
</tr>
<tr>
<td>Accumulation of Restricted Reserves</td>
<td>($606,938)</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>$19,426,955</strong></td>
</tr>
</tbody>
</table>

**Expenses**

<table>
<thead>
<tr>
<th>Category</th>
<th>Amount</th>
</tr>
</thead>
<tbody>
<tr>
<td>Salaries &amp; Fringe Benefits</td>
<td>$7,658,953</td>
</tr>
<tr>
<td>Operating Expenses</td>
<td>$4,207,614</td>
</tr>
<tr>
<td>Institutional Expenses</td>
<td>$3,245,348</td>
</tr>
<tr>
<td>Space &amp; Occupancy</td>
<td>$3,088,728</td>
</tr>
<tr>
<td>Scholarships, Awards &amp; Travel</td>
<td>$744,760</td>
</tr>
<tr>
<td>Overhead Charged</td>
<td>$456,280</td>
</tr>
<tr>
<td>Capitalized Balances</td>
<td>$25,272</td>
</tr>
<tr>
<td>Capital Projects</td>
<td>—</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>$19,426,955</strong></td>
</tr>
</tbody>
</table>
PERSONNEL

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

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

Brian D. Farrell
Professor of Organismic & Evolutionary Biology; Monique & Philip Lehner Professor for the Study of Latin America; Curator of Entomology; Director, David Rockefeller Center for Latin American Studies; Faculty Dean, Leverett House

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

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

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

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

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

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

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

Robert M. Woollacott
Professor of Biology, Emeritus

Postdoctoral Fellows, Research Associates & Visiting Scholars
Simon Baeckens
Herpetology, Losos Lab

Christopher Baker
Entomology, N. Pierce Lab

Leandro Becker
Ornithology, Edwards Lab

Lidia Benavides Silva
Invertebrate Zoology, Giribet Lab

Dan Bock
Herpetology, Losos Lab

D. Marcela Bolaños
Invertebrate Zoology, Srivastava Lab

Gustavo Bravo
Ornithology, Edwards Lab

Daren Card
Ornithology, Edwards Lab

Marina Cheng
Invertebrate Zoology, Giribet Lab

Shahan Derkarabetian
Invertebrate Zoology, Srivastava Lab

Valentina Di Santo
Ichthyology, Lauder Lab

Terry Dial
Ichthyology, Lauder Lab

Lu Dong
Ornithology, Edwards Lab

Colin Donihue
Herpetology, Losos Lab

Stacy Farina
Ichthyology, Lauder Lab

Molly Gabler
Ichthyology, Lauder Lab

Andrew Gehrike
Invertebrate Zoology, Srivastava Lab

Anthony Geneva
Herpetology, Losos Lab

Elsa Goering
Ichthyology, Lauder Lab

Carlos Guerra Schrago
Ornithology, Edwards Lab

Aaron Hartmann
Hrdy Fellow, Giribet Lab

Brandon Hedrick
Vertebrate Paleontology, S. Pierce Lab

Caroline Hu
Mammalogy, Hoekstra Lab

Charlotte Jandér
Entomology, N. Pierce Lab

Katrina Jones
Vertebrate Paleontology, S. Pierce Lab

Nicholas Jourjine
Mammalogy, Hoekstra Lab

Robert Kambic
Vertebrate Paleontology, S. Pierce Lab

Albert Kao
Entomology, N. Pierce Lab

Andreas Kautt
Mammalogy, Hoekstra Lab

Melissa Kemp
Herpetology, Losos Lab

Sangeet Lamichhane
Ornithology, Edwards Lab

Oriol Lapedra Gonzalez
Herpetology, Losos Lab

Rudy Lerosey
Invertebrate Paleontology, Ortega-Hernández Lab

Yuanheng Li
Entomology, N. Pierce Lab

Gang Liu
Ornithology, Edwards Lab

Yi-lyn Luo
Invertebrate Zoology, Srivastava Lab

Pierre-Jean Malé
Entomology, N. Pierce Lab

Rafael Marcondes
Ornithology, Edwards Lab

Sarah Maunsell
Entomology, N. Pierce Lab

Bruno Souza de Medeiros
Entomology, Farrell Lab

Juan Moles
Entomology, Giribet Lab

Renata Moretti
Herpetology, Losos Lab

Andres Moya Simarro
Invertebrate Zoology, Giribet Lab

Luciano Naka
Ornithology, Edwards Lab

Kathrin Napflin
Ornithology, Edwards Lab

Altai Carlos Pavon Paneque
Invertebrate Zoology, Giribet Lab

Sophie Pryal Regnault
Vertebrate Paleontology, S. Pierce Lab

Lorenzo Ricci
Invertebrate Zoology, Srivastava Lab

Melhi Saadat
Ichthyology, Lauder Lab

Elizabeth Sibert
Ichthyology, Lauder Lab

James Sikes
Invertebrate Zoology, Srivastava Lab

Tiago R. Simões
Vertebrate Paleontology, S. Pierce Lab

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

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

<table>
<thead>
<tr>
<th>Name</th>
<th>Department</th>
<th>Lab</th>
</tr>
</thead>
<tbody>
<tr>
<td>Jacob Gable</td>
<td>Vertebrate Paleontology</td>
<td>S. Pierce Lab</td>
</tr>
<tr>
<td>Alexandria DiGiacomo</td>
<td>Vertebrate Paleontology</td>
<td></td>
</tr>
<tr>
<td>Vertebrae Paleontology, S. Pierce Lab</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Richard Childers</td>
<td>Entomology</td>
<td>N. Pierce Lab</td>
</tr>
<tr>
<td>Wei-Ping Wang</td>
<td>Mammalogy</td>
<td>Hoekstra Lab</td>
</tr>
<tr>
<td>Patrick Gorrin</td>
<td>Entomology</td>
<td></td>
</tr>
<tr>
<td>Phillip Grayson</td>
<td>Ornithology</td>
<td>Edwards Lab</td>
</tr>
<tr>
<td>Emily Hager</td>
<td>Mammalogy</td>
<td>Hoekstra Lab</td>
</tr>
<tr>
<td>Michael Brent Hawkins</td>
<td>Herpetology</td>
<td>Hanken Lab</td>
</tr>
<tr>
<td>Alyssa Hernandez</td>
<td>Entomology</td>
<td>Farrell Lab</td>
</tr>
<tr>
<td>Eva Hoffman</td>
<td>Vertebrate Paleontology</td>
<td>S. Pierce Lab</td>
</tr>
<tr>
<td>Evan Hoki</td>
<td>Entomology</td>
<td>N. Pierce Lab</td>
</tr>
<tr>
<td>Ryan Hulett</td>
<td>Vertebrate Zoology, Srivastava Lab</td>
<td></td>
</tr>
<tr>
<td>Sang Il Kim</td>
<td>Entomology</td>
<td>Farrell Lab</td>
</tr>
<tr>
<td>Julian Kimura</td>
<td>Vertebrate Zoology, Srivastava Lab</td>
<td></td>
</tr>
<tr>
<td>Richard Knecht</td>
<td>Vertebrate Paleontology, Ortega-Hernández Lab</td>
<td></td>
</tr>
<tr>
<td>Vanessa Knutson</td>
<td>Vertebrate Zoology, Giribet Lab</td>
<td></td>
</tr>
<tr>
<td>Philip Lai</td>
<td>Concord Field Station, Biewener Lab &amp; Vertebrate Paleontology, S. Pierce Lab</td>
<td></td>
</tr>
<tr>
<td>Mara Laslo</td>
<td>Herpetology</td>
<td>Hanken Lab</td>
</tr>
<tr>
<td>Caitlin Lewarch</td>
<td>Mammalogy</td>
<td>Hoekstra Lab</td>
</tr>
<tr>
<td>Sarah Losso</td>
<td>Invertebrate Paleontology, Ortega-Hernández Lab</td>
<td></td>
</tr>
<tr>
<td>Inbar Maayan</td>
<td>Herpetology</td>
<td>Losos Lab</td>
</tr>
<tr>
<td>David Matthews</td>
<td>Ichthyology</td>
<td>Lauder Lab</td>
</tr>
<tr>
<td>Brianna McHorse</td>
<td>Concord Field Station, Biewener Lab &amp; Vertebrate Paleontology, S. Pierce Lab</td>
<td></td>
</tr>
<tr>
<td>Bruno Souza de Medeiros</td>
<td>Entomology</td>
<td>Farrell Lab</td>
</tr>
<tr>
<td>Olivia Meyerson</td>
<td>Mammalogy</td>
<td>Hoekstra Lab</td>
</tr>
<tr>
<td>Zachary Morris</td>
<td>Vertebrate Paleontology</td>
<td>S. Pierce Lab</td>
</tr>
<tr>
<td>Pavitra Muralidhar</td>
<td>Herpetology</td>
<td>Losos Lab</td>
</tr>
<tr>
<td>Sofia Prado-Irwin</td>
<td>Ornithology</td>
<td>Edwards Lab</td>
</tr>
<tr>
<td>Samantha Royle</td>
<td>Herpetology</td>
<td>Hanken Lab</td>
</tr>
<tr>
<td>Shaya Salzman</td>
<td>Entomology</td>
<td>N. Pierce Lab</td>
</tr>
<tr>
<td>Shoyo Sato</td>
<td>Vertebrate Zoology, Giribet Lab</td>
<td></td>
</tr>
<tr>
<td>Carl Jonathan Schmitz</td>
<td>Ornithology</td>
<td>Edwards Lab</td>
</tr>
<tr>
<td>Kari Taylor-Burt</td>
<td>Concord Field Station, Biewener Lab</td>
<td></td>
</tr>
<tr>
<td>Kira Treibergs</td>
<td>Invertebrate Zoology, Woollacott Lab</td>
<td></td>
</tr>
<tr>
<td>Dylan Wainwright</td>
<td>Ichthyology</td>
<td>Lauder Lab</td>
</tr>
<tr>
<td>Zhengyang Wang</td>
<td>Entomology</td>
<td>N. Pierce Lab</td>
</tr>
<tr>
<td>Rebecca Zane Wolf</td>
<td>Ichthyology</td>
<td>Lauder Lab</td>
</tr>
<tr>
<td>Tyler Brock Wooldridge</td>
<td>Mammalogy</td>
<td>Hoekstra Lab</td>
</tr>
<tr>
<td>Xuemei Zhai</td>
<td>Biological Oceanography</td>
<td>McCarthy Lab</td>
</tr>
<tr>
<td>Philip DeVries</td>
<td>Associate of Entomology</td>
<td>University of New Orleans</td>
</tr>
<tr>
<td>Gregory D. Edgecombe</td>
<td>Associate of Vertebrate Zoology</td>
<td>Natural History Museum, England</td>
</tr>
<tr>
<td>Ben Evans</td>
<td>Associate of Herpetology</td>
<td>McMaster University</td>
</tr>
<tr>
<td>Brooke E. Flammang</td>
<td>Associate of Ichthyology</td>
<td>New Jersey Institute of Technology</td>
</tr>
<tr>
<td>Michael Hadfield</td>
<td>Associate of Marine Biology</td>
<td>University of Hawaii</td>
</tr>
<tr>
<td>Berthold Hölldobler</td>
<td>Associate of Entomology</td>
<td>Arizona State University</td>
</tr>
<tr>
<td>Gustavo Hormiga</td>
<td>Associate of Vertebrate Zoology</td>
<td>The George Washington University</td>
</tr>
<tr>
<td>Michael Huben</td>
<td>Associate of Entomology</td>
<td>Independent Researcher</td>
</tr>
<tr>
<td>Samuel Jaffe</td>
<td>Associate of Entomology</td>
<td>Independent Researcher</td>
</tr>
<tr>
<td>Alan Kabat</td>
<td>Associate of Malacology</td>
<td>Attorney, Bernabei &amp; Wachtel</td>
</tr>
<tr>
<td>Leslie S. Kaufman</td>
<td>Associate of Ichthyology</td>
<td>Boston University</td>
</tr>
<tr>
<td>Anthony E. Kisiewski</td>
<td>Associate of Entomology</td>
<td>Bentley University</td>
</tr>
<tr>
<td>Nicolai Konow</td>
<td>Associate of Entomology</td>
<td>University of Massachusetts, Lowell</td>
</tr>
<tr>
<td>Timothy Laman</td>
<td>Associate of Ornithology</td>
<td>National Geographic</td>
</tr>
<tr>
<td>Phillip Lobel</td>
<td>Associate of Ichthyology</td>
<td>Boston University</td>
</tr>
<tr>
<td>David Lohman</td>
<td>Associate of Entomology</td>
<td>The City College of New York</td>
</tr>
<tr>
<td>Vladimir A. Lukhtanov</td>
<td>Associate of Entomology</td>
<td>Russian Academy of Sciences</td>
</tr>
<tr>
<td>D. Luke Mahler</td>
<td>Associate of Herpetology</td>
<td>University of Toronto</td>
</tr>
<tr>
<td>James Mallet</td>
<td>Associate of Population Genetics</td>
<td>Harvard University</td>
</tr>
<tr>
<td>Andrew Berry</td>
<td>Associate of Ichthyology</td>
<td>Brown University</td>
</tr>
<tr>
<td>Elizabeth Brainerd</td>
<td>Associate of Ichthyology</td>
<td>University of Sussex</td>
</tr>
<tr>
<td>Jae Choe</td>
<td>Associate of Entomology</td>
<td>Ewha Womans University</td>
</tr>
<tr>
<td>Janet Collett</td>
<td>Associate of Population Genetics</td>
<td>University of Sussex</td>
</tr>
<tr>
<td>Bruce Collette</td>
<td>Associate of Ichthyology</td>
<td>National Marine Fisheries Service</td>
</tr>
<tr>
<td>James Costa</td>
<td>Associate of Entomology</td>
<td>Western Carolina University</td>
</tr>
<tr>
<td>Catherine Craig</td>
<td>Associate of Vertebrate Zoology</td>
<td>Berry College</td>
</tr>
<tr>
<td>D. Luke Mahler</td>
<td>Associate of Herpetology</td>
<td>University of Toronto</td>
</tr>
<tr>
<td>James Mallet</td>
<td>Associate of Population Genetics</td>
<td>Harvard University</td>
</tr>
<tr>
<td>Piotr Naskrecki</td>
<td>Associate of Entomology</td>
<td>Conservation International</td>
</tr>
</tbody>
</table>

## Graduate Students

<table>
<thead>
<tr>
<th>Name</th>
<th>Department</th>
<th>Lab</th>
</tr>
</thead>
<tbody>
<tr>
<td>Jennifer Austiff</td>
<td>Herpetology</td>
<td>Hanken Lab</td>
</tr>
<tr>
<td>Felix Baier</td>
<td>Mammalogy</td>
<td>Hoekstra Lab</td>
</tr>
<tr>
<td>Caitlin Baker</td>
<td>Invertebrate Zoology, Giribet Lab</td>
<td></td>
</tr>
<tr>
<td>Nicole Bedford</td>
<td>Mammalogy</td>
<td>Hoekstra Lab</td>
</tr>
<tr>
<td>Jasmin Camacho</td>
<td>Mammalogy</td>
<td>Hoekstra Lab</td>
</tr>
<tr>
<td>Wei-Ping Chan</td>
<td>Entomology</td>
<td>N. Pierce Lab</td>
</tr>
<tr>
<td>Richard Childers</td>
<td>Entomology</td>
<td>N. Pierce Lab</td>
</tr>
<tr>
<td>Tausana Cunha</td>
<td>Invertebrate Zoology, Giribet Lab</td>
<td></td>
</tr>
<tr>
<td>Blake Dickson</td>
<td>Vertebrate Paleontology</td>
<td>S. Pierce Lab</td>
</tr>
<tr>
<td>Alexandra DiGiacomo</td>
<td>Ornithology</td>
<td></td>
</tr>
<tr>
<td>Jacob Gable</td>
<td>Mammalogy</td>
<td>Hoekstra Lab</td>
</tr>
<tr>
<td>Kadeem Gilbert</td>
<td>Entomology</td>
<td>N. Pierce Lab</td>
</tr>
<tr>
<td>Patrick Gorrin</td>
<td>Entomology</td>
<td>Farrell Lab</td>
</tr>
<tr>
<td>Philip Grayson</td>
<td>Ornithology</td>
<td>Edwards Lab</td>
</tr>
<tr>
<td>Emily Hager</td>
<td>Mammalogy</td>
<td>Hoekstra Lab</td>
</tr>
<tr>
<td>Michael Brent Hawkins</td>
<td>Herpetology</td>
<td>Hanken Lab</td>
</tr>
<tr>
<td>Alyssa Hernandez</td>
<td>Entomology</td>
<td>Farrell Lab</td>
</tr>
<tr>
<td>Eva Hoffman</td>
<td>Vertebrate Paleontology</td>
<td>S. Pierce Lab</td>
</tr>
<tr>
<td>Evan Hoki</td>
<td>Entomology</td>
<td>N. Pierce Lab</td>
</tr>
<tr>
<td>Ryan Hulett</td>
<td>Vertebrate Zoology, Srivastava Lab</td>
<td></td>
</tr>
<tr>
<td>Sang Il Kim</td>
<td>Entomology</td>
<td>Farrell Lab</td>
</tr>
<tr>
<td>Julian Kimura</td>
<td>Vertebrate Zoology, Srivastava Lab</td>
<td></td>
</tr>
<tr>
<td>Richard Knecht</td>
<td>Vertebrate Paleontology, Ortega-Hernández Lab</td>
<td></td>
</tr>
<tr>
<td>Vanessa Knutson</td>
<td>Vertebrate Zoology, Giribet Lab</td>
<td></td>
</tr>
<tr>
<td>Philip Lai</td>
<td>Concord Field Station, Biewener Lab &amp; Vertebrate Paleontology, S. Pierce Lab</td>
<td></td>
</tr>
<tr>
<td>Mara Laslo</td>
<td>Herpetology</td>
<td>Hanken Lab</td>
</tr>
<tr>
<td>Caitlin Lewarch</td>
<td>Mammalogy</td>
<td>Hoekstra Lab</td>
</tr>
<tr>
<td>Sarah Losso</td>
<td>Invertebrate Paleontology, Ortega-Hernández Lab</td>
<td></td>
</tr>
<tr>
<td>Inbar Maayan</td>
<td>Herpetology</td>
<td>Losos Lab</td>
</tr>
<tr>
<td>David Matthews</td>
<td>Ichthyology</td>
<td>Lauder Lab</td>
</tr>
<tr>
<td>Brianna McHorse</td>
<td>Concord Field Station, Biewener Lab &amp; Vertebrate Paleontology, S. Pierce Lab</td>
<td></td>
</tr>
<tr>
<td>Bruno Souza de Medeiros</td>
<td>Entomology</td>
<td>Farrell Lab</td>
</tr>
<tr>
<td>Olivia Meyerson</td>
<td>Mammalogy</td>
<td>Hoekstra Lab</td>
</tr>
<tr>
<td>Zachary Morris</td>
<td>Vertebrate Paleontology</td>
<td>S. Pierce Lab</td>
</tr>
<tr>
<td>Pavitra Muralidhar</td>
<td>Herpetology</td>
<td>Losos Lab</td>
</tr>
<tr>
<td>Sofia Prado-Irwin</td>
<td>Ornithology</td>
<td>Edwards Lab</td>
</tr>
<tr>
<td>Samantha Royle</td>
<td>Herpetology</td>
<td>Hanken Lab</td>
</tr>
<tr>
<td>Shaya Salzman</td>
<td>Entomology</td>
<td>N. Pierce Lab</td>
</tr>
<tr>
<td>Shoyo Sato</td>
<td>Vertebrate Zoology, Giribet Lab</td>
<td></td>
</tr>
<tr>
<td>Carl Jonathan Schmitz</td>
<td>Ornithology</td>
<td>Edwards Lab</td>
</tr>
<tr>
<td>Kari Taylor-Burt</td>
<td>Concord Field Station, Biewener Lab</td>
<td></td>
</tr>
<tr>
<td>Kira Treibergs</td>
<td>Invertebrate Zoology, Woollacott Lab</td>
<td></td>
</tr>
<tr>
<td>Dylan Wainwright</td>
<td>Ichthyology</td>
<td>Lauder Lab</td>
</tr>
<tr>
<td>Zhengyang Wang</td>
<td>Entomology</td>
<td>N. Pierce Lab</td>
</tr>
<tr>
<td>Rebecca Zane Wolf</td>
<td>Ichthyology</td>
<td>Lauder Lab</td>
</tr>
<tr>
<td>Tyler Brock Wooldridge</td>
<td>Mammalogy</td>
<td>Hoekstra Lab</td>
</tr>
<tr>
<td>Xuemei Zhai</td>
<td>Biological Oceanography</td>
<td>McCarthy Lab</td>
</tr>
<tr>
<td>Philip DeVries</td>
<td>Associate of Entomology</td>
<td>University of New Orleans</td>
</tr>
<tr>
<td>Gregory D. Edgecombe</td>
<td>Associate of Vertebrate Zoology</td>
<td>Natural History Museum, England</td>
</tr>
<tr>
<td>Ben Evans</td>
<td>Associate of Herpetology</td>
<td>McMaster University</td>
</tr>
<tr>
<td>Brooke E. Flammang</td>
<td>Associate of Ichthyology</td>
<td>New Jersey Institute of Technology</td>
</tr>
<tr>
<td>Michael Hadfield</td>
<td>Associate of Marine Biology</td>
<td>University of Hawaii</td>
</tr>
<tr>
<td>Berthold Hölldobler</td>
<td>Associate of Entomology</td>
<td>Arizona State University</td>
</tr>
<tr>
<td>Gustavo Hormiga</td>
<td>Associate of Vertebrate Zoology</td>
<td>The George Washington University</td>
</tr>
<tr>
<td>Michael Huben</td>
<td>Associate of Entomology</td>
<td>Independent Researcher</td>
</tr>
<tr>
<td>Samuel Jaffe</td>
<td>Associate of Entomology</td>
<td>Independent Researcher</td>
</tr>
<tr>
<td>Alan Kabat</td>
<td>Associate of Malacology</td>
<td>Attorney, Bernabei &amp; Wachtel</td>
</tr>
<tr>
<td>Leslie S. Kaufman</td>
<td>Associate of Ichthyology</td>
<td>Boston University</td>
</tr>
<tr>
<td>Anthony E. Kisiewski</td>
<td>Associate of Entomology</td>
<td>Bentley University</td>
</tr>
<tr>
<td>Nicolai Konow</td>
<td>Associate of Entomology</td>
<td>University of Massachusetts, Lowell</td>
</tr>
<tr>
<td>Timothy Laman</td>
<td>Associate of Ornithology</td>
<td>National Geographic</td>
</tr>
<tr>
<td>Phillip Lobel</td>
<td>Associate of Ichthyology</td>
<td>Boston University</td>
</tr>
<tr>
<td>David Lohman</td>
<td>Associate of Entomology</td>
<td>The City College of New York</td>
</tr>
<tr>
<td>Vladimir A. Lukhtanov</td>
<td>Associate of Entomology</td>
<td>Russian Academy of Sciences</td>
</tr>
<tr>
<td>D. Luke Mahler</td>
<td>Associate of Herpetology</td>
<td>University of Toronto</td>
</tr>
<tr>
<td>James Mallet</td>
<td>Associate of Population Genetics</td>
<td>Harvard University</td>
</tr>
<tr>
<td>Andrew Berry</td>
<td>Associate of Ichthyology</td>
<td>National Marine Fisheries Service</td>
</tr>
<tr>
<td>Elizabeth Brainerd</td>
<td>Associate of Ichthyology</td>
<td>Berry College</td>
</tr>
<tr>
<td>Jae Choe</td>
<td>Associate of Entomology</td>
<td>Ewha Womans University</td>
</tr>
<tr>
<td>Janet Collett</td>
<td>Associate of Population Genetics</td>
<td>University of Sussex</td>
</tr>
<tr>
<td>Bruce Collette</td>
<td>Associate of Ichthyology</td>
<td>National Marine Fisheries Service</td>
</tr>
<tr>
<td>James Costa</td>
<td>Associate of Entomology</td>
<td>Western Carolina University</td>
</tr>
<tr>
<td>Catherine Craig</td>
<td>Associate of Vertebrate Zoology</td>
<td>Berry College</td>
</tr>
<tr>
<td>D. Luke Mahler</td>
<td>Associate of Herpetology</td>
<td>University of Toronto</td>
</tr>
<tr>
<td>James Mallet</td>
<td>Associate of Population Genetics</td>
<td>Harvard University</td>
</tr>
<tr>
<td>Piotr Naskrecki</td>
<td>Associate of Entomology</td>
<td>Conservation International</td>
</tr>
</tbody>
</table>
Diane B. Paul  
Associate of Population Genetics  
Harvard University

David L. Pawson  
Associate of Marine Biology  
Smithsonian National Museum of Natural History

Paulo Petry  
Associate of Ichthyology  
The Nature Conservancy

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

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

Michael Rex  
Associate of Malacology  
University of Massachusetts, Boston

Jessica Rykken  
Associate of Entomology  
Harvard University

Carl Schmitt  
Associate of Ornithology  
Independent Researcher

Donna Schmitt  
Associate of Ornithology  
Independent Researcher

Çağan H. Şekercioğlu  
Associate of Ornithology  
Harvard University

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

Cheryl Wilga  
Associate of Ichthyology  
University of Rhode Island

Judith Winston  
Associate of Marine Biology  
Virginia Museum of Natural History

Staff  
Melissa Aja  
Museum Projects Coordinator & Interim Managing Editor

Adam Baldinger  
Curatorial Associate, Invertebrate Zoology & Malacology

Penny Benson  
Curatorial Assistant, Malacology

Eva Biedron  
Curatorial Assistant, Vertebrate Paleontology

Ronnie Broadfoot  
Coordinator of Access Services, Ernst Mayr Library

Christopher Capobianco  
Technician & Preparator, Vertebrate Paleontology

April Collins  
Acquisitions & Technology Specialist, Ernst Mayr Library

Stefan Cover  
Curatorial Assistant, Entomology

Jessica Cundiff  
Curatorial Associate, Invertebrate & Vertebrate Paleontology

Joseph deVeer  
Head of Technical Services, Ernst Mayr Library

Katherine Eldridge  
Curatorial Assistant, Ornithology

Charles Farnum  
Curatorial Assistant, Entomology

Helene Ferranti  
Faculty/Collection Assistant, Biological Oceanography & Marine Biology

Dana Fisher  
Assistant to the Librarian/Special Collections, Ernst Mayr Library

Linda S. Ford  
Director, Collections Operations

Matthew Gage  
Curatorial Assistant & Lab Manager, Hanken Lab

Emily Graham  
Curatorial Assistant, Collections Operations

Cyrus Green  
Curatorial Assistant, Vertebrate Paleontology

Cory Hahn  
Animal Technician, Herpetology

Brendan Haley  
Senior Database Manager

Rachel Hawkins  
Curatorial Assistant, Entomology

Andra Hollis  
Staff Assistant, Concord Field Station

Kathleen Horton  
Assistant with Professor Wilson, Entomology

Jared Hughes  
Faculty/Collection Assistant, Herpetology, Invertebrate & Vertebrate Paleontology

Nikki Hughes  
Faculty/Collection Assistant, Mammalogy

Amie Jones  
Faculty/Collection Assistant, Entomology

Marcia Kazmierczak  
Staff Assistant, Collections Operations

Michelle Kennedy  
Collections Information & Database Specialist

Christopher Kirby  
Research Assistant, Hoekstra Lab

Jeremy Kisala  
Curatorial Assistant, Collections Operations

Laura Leibensperger  
Curatorial Assistant, Invertebrate Zoology

Lisa Litchfield  
Administrator, Concord Field Station

Maggie Lopes  
Manager of Administrative Operations

David Lubertazzi  
Research Scientist, Entomology

Crystal Maier  
Curatorial Associate, Entomology

Maddie Marino  
Faculty/Collection Assistant, Ornithology

Joseph Martinez  
Curatorial Assistant, Herpetology

Patrick McCormack  
Curatorial Assistant, Entomology

John Mewherter  
Curatorial Assistant, Collections Operations

Elizabeth Meyer  
Project Assistant, Ernst Mayr Library

Paul J. Morris  
Biodiversity Informatics Manager

Madeleine Mullon  
Curatorial Associate, Mammalogy

Catherine Musinsky  
Faculty/Collection Assistant, Mammalogy

Mark Omura  
Curatorial Associate, Mammalogy

Melinda Peterson  
Research Lab Coordinator, Edwards Lab

Vanessa Poirier  
Laboratory Technician, Invertebrate Zoology

Bridget Power  
Faculty/Collection Assistant, Invertebrate Zoology

Pedro Ramirez  
Research Assistant, Concord Field Station

Rona Razon  
Archivist, Ernst Mayr Library

Murat Recevik  
Curatorial Assistant, Malacology

Mark Renczowski  
Curatorial Assistant, Invertebrate Paleontology

Constance Rinaldo  
Librarian, Ernst Mayr Library

Alana Rivera  
Curatorial Assistant, Collections Operations

José Rosado  
Curatorial Associate, Herpetology

Mary Sears  
Head of Public Services, Ernst Mayr Library

Kaitlin Sheridan  
Laboratory Assistant, Invertebrate Zoology

Nina Sokolov  
Research Assistant, Mammalogy

Meaghan Sorce  
Curatorial Assistant, Collections Operations

Margaret Starvish  
Faculty/Collection Assistant, Entomology & Ichthyology

Tsunoshi Takahashi  
Curatorial Assistant, Herpetology & Collections Operations

Jennifer Thomson  
Faculty/Collection Assistant, Population Genetics & Srivastava Lab

Jennifer Trimble  
Curatorial Assistant, Invertebrate Zoology

Jeremiah Trimble  
Curatorial Associate, Ornithology

Diana Turmenne  
Curatorial Assistant, Collections Operations

Kenneth Wilcox  
Building Services Coordinator

Andrew Williston  
Curatorial Associate, Ichthyology

Jonathan Woodward  
Curatorial Assistant, Collections Operations

Mark Wright  
Research Lab Assistant, Vertebrate Paleontology
PERSONNEL

Robert Young
Special Collections Librarian, Ernst Mayr Library

Clayton Ziemke
Curatorial Assistant, Entomology

Breda Zimkus
Cryogenics Collections Manager for Genetic Resources

Temporary Staff
Eliza Alston
Ernst Mayr Library

Griffin Andres
Ichthyology

Lila Ardor Belucci
Invertebrate Zoology

Adham Bedir
Ernst Mayr Library

Portia Berry-Kilby
Ernst Mayr Library

Emily Blank
Cryogenics Collections

Jeffrey Breeze
Herpetology

Jonathan Clark
Ornithology

William Clark
Ernst Mayr Library

Alexandra Collias
Concord Field Station

Chloe-Rose Colombero
Ichthyology

Brendan Cramphorn
Entomology

Sheridan Cunningham
Ernst Mayr Library

Walker Darling
Entomology

Gino Domel
Ichthyology

Anne Everly
Ichthyology

Cleo Falvey
Herpetology

Caroline Fleming
Invertebrate Zoology

Jose Flores
Ichthyology

Andrea Garza Erdmann
Ernst Mayr Library

Martha Gavula
Ernst Mayr Library

Jennifer Goldstein
Invertebrate Zoology

Sarah Gonzalez
Invertebrate Paleontology

Jane Harrison
Ornithology

Jyhjong Hwang
Collections Operations

Kalvin Janik
Ernst Mayr Library

Jackson Kehoe
Entomology

Adam Kowalczyk
Collections Operations

Anthony Long
Cryogenics Collections

Francisco Matos
Entomology

Patrick McCormack
Collections Operations & Entomology

Vic Moore
Vertebrate Paleontology

Madeleine Muilun
Mammalogy

John Neivins
Biological Oceanography

Uzochi Nwoko
Ernst Mayr Library

Christian Perez
Entomology

Erin Polka
Malacology

Emile Radyte
Ernst Mayr Library

Carolina Sepulveda
Ernst Mayr Library

Lauren Shear
Collections Operations

Kaitlin Sheridan
Invertebrate Zoology

Daniel Stevens
Collections Operations

Dexter Summers
Ichthyology

Gary Taylor
Concord Field Station

Chidambaram Thillairajah
Ornithology

Thao Vu
Ichthyology

Jalen Winstanley
Entomology

Mark Wright
Vertebrate Paleontology

Amy Wu
Entomology

Clayton Ziemke
Entomology

Encyclopedia of Life
Learning + Education Group

Zoe Foster
Intern

Amy Lorenz
Project Coordinator

Carly Sanker
Designer

Marie M. Studer
Learning + Education Director

Michael Vitale
Developer

Administration for the Department of Organismic & Evolutionary Biology

Lydia Carmosino
Senior Academics Programs Administrator

Rebecca Chetham
Executive Director

Paul Dwyer
Mailroom Staff Assistant

Jason Fleming
Senior Research Administrator

Christian Flynn
Administrative Coordinator

Donna Gadbois
Financial Associate

Diana Gjino
Senior Research Administrator

Jason Green
Financial Associate

Wendy Heywood
Communications & Events Coordinator

Julie Knippa Colby
Associate Director of Finance and Research Administration

Megan McHugh
Human Resources Coordinator

Jeremiah (JJ) O’Connor
Temporary Financial Analyst

Kristin Pennarun
Assistant Director of Research Administration

Christopher Preheim
Temporary Academic Program Coordinator

Keleigh Quinn
Senior Research Administrator

Emily Reynolds
Senior Research Administrator

Peg Richards
Financial Assistant

Damari Rosado
Associate Director of Administration

Anna Salvato
Manager of Financial Operations

The MCZ deeply appreciates the additional support and contributions of numerous interns and undergraduate students during the 2018–2019 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.

Mr. Robert G. Goelet
Mr. George Putnam Jr.
Mr. George Putnam III
Dr. Barbara Jil Wu
Mr. Paul J. Zofnass
President Lawrence S. Bacow

Acknowledgements

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

Editors
James Hanken, Director
Melissa Aja, Museum Projects Coordinator

Copy, Design & Production
Cyndi Wood
Creative Project Management, Inc.
creativeprojectmgmt.com

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.