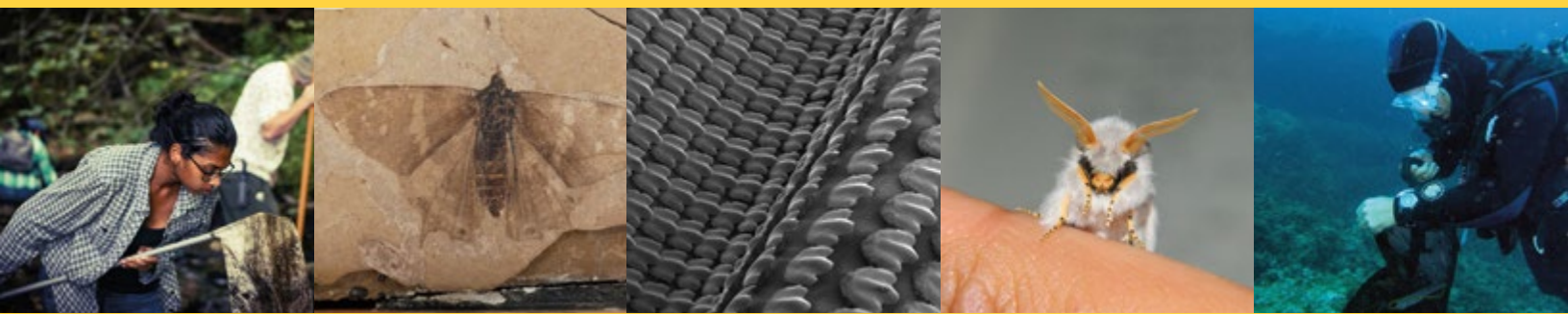
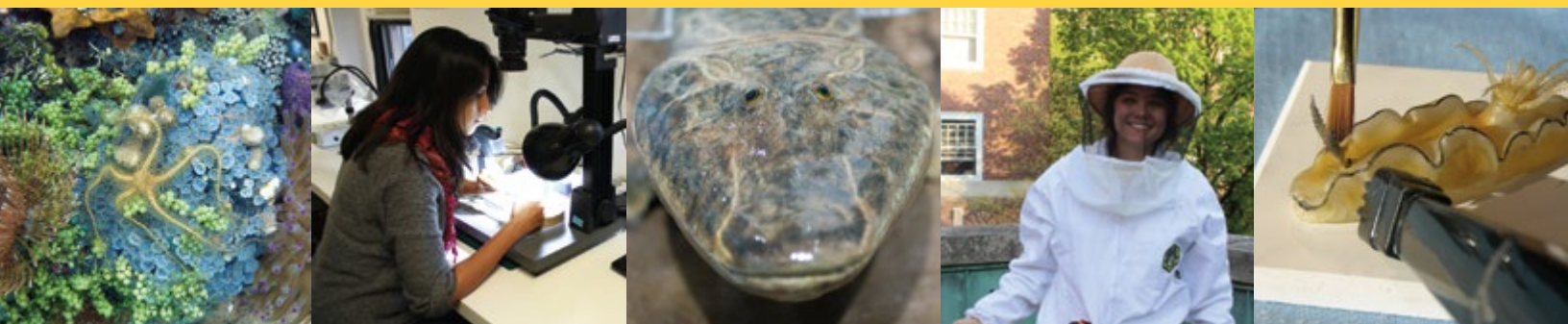




MUSEUM OF COMPARATIVE
ZOOLOGY
ANNUAL REPORT
HARVARD UNIVERSITY



2013–2014



DIRECTOR’S MESSAGE

It is impossible to be a productive naturalist in this country without money.
I am going to get some money if I can and then I will be a naturalist.

—Alexander Agassiz

These words, spoken over a century ago by former MCZ director and son of MCZ’s founder Louis Agassiz, still ring true today. Contemporary scientific research is expensive, and students, postdoctoral fellows, and faculty spend much of their time applying for grants and other means of funding their work. We in the MCZ are fortunate to be able to sponsor several competitive grant programs, which are highlighted in the opening pages of this report. The MCZ has awarded an average of \$150,000 per year, and these funds have been used to support both field trips and laboratory work by MCZ personnel and to enable non-Harvard scientists to visit collections at the MCZ and other institutions. Our newest program, the Farish A. Jenkins, Jr. Memorial Fund to support student fieldwork, is made possible through the generous contributions of Farish’s family, friends and colleagues. I am deeply grateful to those individuals who have made these sources of funding available.

Last year, we introduced our newest faculty-curator, Dr. Stephanie E. Pierce. Stephanie arrived on campus this past summer and is in the process of establishing her lab. I am very pleased to announce that, following Stephanie’s successful recruitment, we have hired another new faculty-curator, Mansi Srivastava, AB, PhD. Mansi, who will formally join the MCZ in summer 2015 as Assistant Professor of Organismic and Evolutionary Biology, will share curatorial responsibilities for our invertebrate collections. Her research examines the evolution of regeneration in animals, including underlying molecular and developmental mechanisms. I look forward to introducing Mansi and her research more extensively in the next annual report.

The MCZ sadly lost two emeritus faculty this year, Kenneth J. Boss and Herbert Walter Levi. Ken spent nearly his entire professional career at the MCZ, curating the Museum’s enormous mollusk collection for more than 30 years. Herb is widely regarded as one of the grand arachnologists of the 20th century. Both Ken and Herb trained generations of zoologists who became leaders in their respective fields. While they will truly be missed among the specimen cabinets and halls of the MCZ, their impact will be enduring.

The MCZ continues to make steady progress transitioning into the third phase of our migration of several collections into the Northwest Building. Malacology and Ornithology, as well as portions of Marine Invertebrates and Invertebrate Zoology, joined Mammalogy in the new state-of-the-art collections, lab and teaching space. Invertebrate Paleontology is the next collection slated to move. While we provide a short update in the enclosed report, I’m looking forward to sharing more details about this immense undertaking—and accomplishment—in a future annual report.

All of the work highlighted in this report would not be possible without the tremendous efforts of our faculty-curators, staff, postdoctoral fellows, and students. I am thankful for their contributions to making the MCZ a successful and respected institution year after year.

James Hanken
Director



Catherine Weisel

Cover photo credits:
Top, left to right: Thomas Dai; MCZ Entomology Collection; George Lauder; Julianne Pelaez; Gonzalo Giribet

Bottom, left to right: Gonzalo Giribet; Jonathan Woodward; Stephanie Mitchell, Harvard University News Office; Bridget Irvine; Jonathan Woodward

Opposite page: MCZ Special Collections



SUPPORTING VITAL SCIENTIFIC RESEARCH AND STUDENT TRAINING

The Museum of Comparative Zoology is proud to offer grants that enable scientific research, an important part of our teaching and research missions.



Robert Cooke

Zachary Lewis (center) with Prof. Jim Hanken and members of the Hanken lab on a collecting expedition on Cape Cod

studies. Several GUR grant recipients have gone on to receive Harvard University's Thomas T. Hoopes Prize, which recognizes outstanding scholarly work by students. **Tanner Strickland** (Losos lab) investigated the relationship between environmental and morphological variation in the large-headed anole, *Anolis cybotes*. "With my GUR, I was able to sequence genes that illuminated the dynamic inter-island relationships of one lizard species across a number of Caribbean islands," says Strickland.



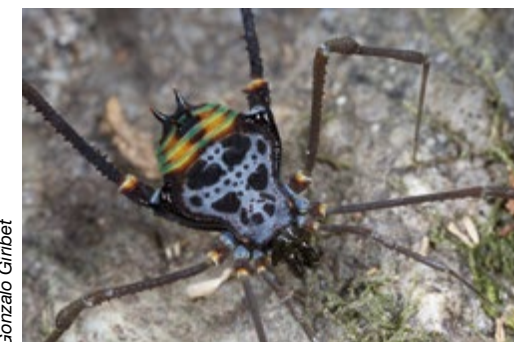
Tanner Strickland

Graduate students in MCZ faculty-curator labs are eligible for **Robert G. Goelet Summer Research Awards** and **Miyata Grants**. Funded through gifts from MCZ Faculty member Mr. Robert G. Goelet and Mrs. Alexandra Goelet, Goelet Awards support travel to field sites and related expenses. The Miyata Grants program was established in 2008 through gifts from MCZ Faculty member Dr. Barbara Wu, PhD 1981, and Mr. Eric Larson, AB 1977, in commemoration of their friend Dr. Kenneth Miyata, PhD 1980. Miyata grants are intended to defray field research costs for graduate students, primarily in the field of herpetology.

Graduate student **Zachary Lewis** (Hanken lab) received a Miyata grant in 2012 and a Goelet award in 2013. His research focuses on evolutionary and developmental patterns of lung and heart development. The Goelet award made it possible for Lewis to collect lungless salamander embryos in the field, and the Miyata grant supported the collection of *Hemidactylum scutatum* embryos on Cape Cod.

Putnam Expedition Grants have taken MCZ faculty, postdoctoral researchers and students on collecting expeditions around the globe. The program, made possible by gifts from MCZ Faculty member Mr. George Putnam, Jr., AB 1949 and MBA 1951, and Mrs. Nancy Putnam, was established to assist with travel expenses incurred in the collection of specimens and data relating to the study of comparative zoology; the specimens collected on these expeditions are subsequently added to the MCZ's collections. Preference is given to projects that acquire living specimens in regions where habitats are threatened and for collecting fossil specimens in regions most likely to hold important clues for unraveling evolutionary strategies.

Since 2000, **Gonzalo Giribet** has received several Putnam grants that have taken him to New Zealand, Australia, Sri Lanka and South Africa. Most recently he has been examining



Gonzalo Giribet

soil invertebrates in Chile. Prof. Giribet plans to amass a comprehensive collection of harvestmen, centipedes and velvet worms from the highly fragmented temperate forests of Chile and further his ongoing projects on Gondwanan biogeography to test hypotheses of landmass breakup and submersion.

"Putnam grants have allowed me to explore and collect in the many terrains of the former supercontinent and have contributed to some of my best-cited papers and most exciting biogeographic discoveries," says Giribet. "But most importantly, the grants have provided resources for the PhD work of three stellar graduate students. They will always remember the generosity and the opportunities provided by their Putnam expedition grants."

The MCZ's collections anchor the Museum's mission to serve as a teaching and research institution. **Ernst Mayr Travel Grants**, made possible by a gift from renowned systematist Ernst Mayr, former Professor of Zoology and Director of the MCZ, facilitate short visits to museum collections for researchers around the world at every stage of their careers. The principal objective of these grants is to stimulate taxonomic work on neglected taxa; they are particularly designed for scientists who might otherwise have difficulty in obtaining access to museum specimens that are necessary for their research. While preference is given to studies that use the MCZ's collections, applications to work at other museums are also eligible.

Susan Drymala, a graduate student from North Carolina State University, received an Ernst Mayr Travel Grant in spring 2013. By observing fossil specimens at the MCZ and three other institutions, she was able to gather important data for her master's thesis, which involves improving phylogenetic analyses and understanding of paracrocodylomorph reptiles. "With my Ernst Mayr Grant, I was able to clarify relationships at the origin of Crocodylomorpha, revealing trends in body size and bauplan evolution across a key transition in early archosaur evolution," says Drymala. She was also able to conduct close examination of taxa closely related to a new fossil species she is describing, adding to the phylogenetic analysis.



Gonzalo Giribet in Chile



Specimen of *Saurosuchus galilei* examined by Susan Drymala

Jessica Cundiff



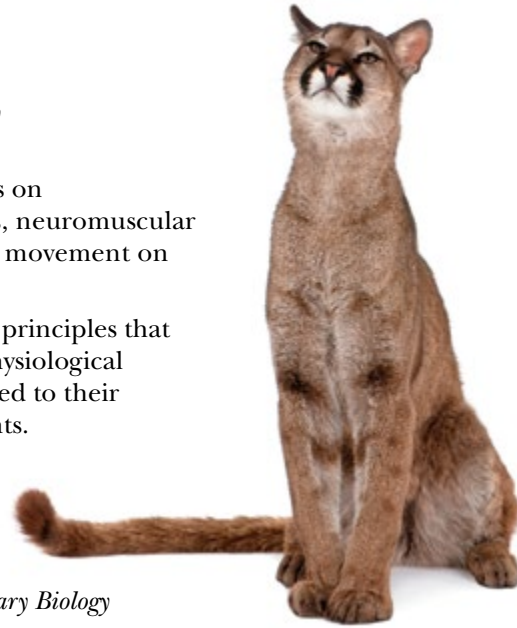
MCZ FACULTY-CURATORS



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.



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

Prof. Edwards' research focuses on the evolutionary biology of birds and related species, combining field, museum and genomics approaches to understand the basis of avian diversity, evolution and behavior. Current projects utilize genomics technologies to study comparative genomics and the evolution of flightlessness in birds; phylogeography and speciation of Australian and North American birds; and the genomics of host-parasite co-evolution between house finches and a recently acquired bacterial pathogen, *Mycoplasma*.



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

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

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

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

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 multidisciplinary studies for Assembling the Bivalve Tree of Life; the diversity of Neotropical and Gondwanan arachnids; and systematics and biogeography of arthropods, mollusks, platyhelminthes and onychophorans. He is also interested in philosophical aspects of DNA sequence data analysis, emphasizing homology-related issues and the use of genomic-level data for inferring phylogenies.



© Casey Dunn



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



Prof. Hanken's research focuses on the evolutionary morphology, development and systematics of vertebrates, especially amphibians. Current interests include the evolution of cranial form and patterning; the developmental basis of life-history evolution; systematics, taxonomy and evolution of Neotropical salamanders; and biodiversity informatics. Over the years, his laboratory has conducted extensive fieldwork in Africa, Asia, and Central and South

America. The lab also maintains captive breeding colonies of numerous amphibian species.

Prof. Hanken is a member of the Executive Committee of the Encyclopedia of Life and until recently served on the Board of Directors of the Natural Science Collections Alliance and of the American Institute of Biological Sciences. He is Past-president of both the American Society of Ichthyologists and Herpetologists and the International Society of Vertebrate Morphologists; former Chair, International Board of Directors, of the Declining Amphibian Populations Task Force; and former Co-chair of the Scientific Advisory Board of the Consortium for the Barcode of Life.

He is also a member of the Biological Sciences in Dental Medicine Program, Harvard School of Dental Medicine, and a faculty member of the Center for Health and the Global Environment, Harvard School of Public Health. He has authored more than 120 scientific publications, edited four books, and is an accomplished nature and scientific photographer.



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

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

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

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

Prof. Losos' research focuses on the behavioral and evolutionary ecology of lizards, specifically how lizards interact with their environment and how lizard clades have diversified evolutionarily. His laboratory integrates approaches from systematics, ecology, behavior, genetics and functional morphology, taking both observational and experimental approaches in the field and in the laboratory.



Rose Lincoln



Gretchen Ertl

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

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





Jon Chase

James J. McCarthy

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

Prof. McCarthy's research focuses on factors that regulate the processes of primary production and nutrient supply in the ocean.

Through controlled laboratory studies and field investigations, Prof. McCarthy and his group examine the effects of strong seasonal or interannual climate change on marine life and biogeochemical systems.



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

Prof. Pierce's research is focused on assessing the link between form and function of the vertebrate skeletal system—especially with respect to muscle/skeletal interactions during feeding and

locomotor behaviors in modern and extinct animals.

Recently, she has been using 3-D modeling to examine the locomotion of the earliest limbed vertebrates to decipher how their skeletal systems evolved as they made the transition from water to land.



Kris Sribbe

Naomi E. Pierce

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

Prof. Pierce's primary research focuses on the behavioral ecology of species interactions, particularly cooperative interactions between plants and their pollinators, and symbioses between ants and many different organisms, including bacteria, fungi, plants and caterpillars of butterflies in the family Lycaenidae. Prof. Pierce is interested in how species associations such as parasitism and mutualism influence the evolutionary trajectories of each partner.



Jean-Francois Bertrand

Robert M. Woollacott

*Professor of Biology
Curator of Marine Invertebrates*

Prof. Woollacott's research focuses on aspects of marine invertebrate life history, such as synchronization of reproductive events and ecology and physiology of larvae. Topics of particular interest include larval dispersal and population connectivity, as well as human impacts on the distribution of marine organisms.

MCZ EMERITI

In Memoriam: Kenneth J. Boss

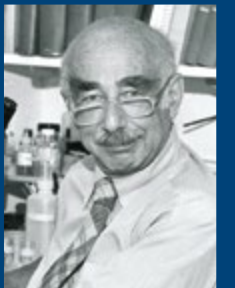
Kenneth Jay Boss, Professor of Biology, Emeritus, and retired Curator of Malacology, passed away on May 22, 2014. Prof. Boss was hired in 1966 during Ernst Mayr's tenure as Director of the MCZ and curated MCZ's vast mollusk collection until his retirement in 2004. He regularly taught three courses, including the introductory course, Biology of Invertebrates.



Prof. Boss's research focused on the systematics of mollusks, especially the speciose and ecologically important bivalve families Tellinidae and Vesicomyidae. His most widely cited publication was the 225-page treatment of the Mollusca in the *Synopsis and Classification of Living Organisms* (1982), which provided detailed diagnoses for the 8 classes, 44 orders and 528 families of mollusks and reviewed the higher-level classification of the entire phylum. Prof. Boss contributed extensively to the *Occasional Papers on Mollusks* and formerly served as editor for *Breviora* and the *Bulletin of the Museum of Comparative Zoology*.

In Memoriam: Herbert W. Levi

Herbert Walter Levi, Alexander Agassiz Professor of Zoology, Emeritus, and retired Curator of Arachnology, passed away on November 3, 2014. Considered one of the grand arachnologists of the 20th century, Prof. Levi's research focused on the taxonomy of New World orb-weaving spiders of the family Araneidae. He wrote numerous articles and taxonomic monographs, as well as the popular guide *Spiders and Their Kin*, which he co-authored with his wife, Lorna. His research enabled the identification of 1,500 species in 66 genera in the Americas, and several species of arachnids are named in his honor. Perhaps Levi's greatest contribution to the field of arachnology is the generation of arachnologists he supervised, many of whom have become world leaders in the field.



Prof. Levi was an editorial board member for the *Journal of Arachnology* and an elected honorary member of the American Arachnological Society. He served as president of the International Society of Arachnology and, in 2007, won the ISA's Eugene Simon Award for lifetime achievement for his immense influence on spider research.

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 and the former Director of the Peabody Museum of Natural History, Yale University, and the South African Museum, Capetown. His primary research interests are the origin and evolution of mammals, functional anatomy, 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 evolutionary psychology and has developed the basis of modern biodiversity conservation. He has received many of the world's leading prizes in recognition of his research and environmental activism. He was awarded two Pulitzer Prizes for his books *The Ants* (1990, with Bert Hölldobler) and *On Human Nature* (1978). Prof. Wilson received the TED Prize in 2007, where he articulated the concept of the Encyclopedia of Life, and the National Geographic Society's Hubbard Medal in 2013.

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. Prof. Lewontin's current research involves computer simulation and evaluation of statistical tests for selection. 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*.



COURSES IN 2013–2014 LED BY MCZ FACULTY-CURATORS

Organismic and Evolutionary Biology

OEB 10: Foundations of Biological Diversity (undergraduate)

Brian D. Farrell (and Elena M. Kramer, Andrew Richardson)

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

OEB 51: Biology and Evolution of Invertebrate Animals (undergraduate)

Gonzalo Giribet

Introduction to invertebrate diversity, with special emphasis on the broad diversity of animal forms, their adaptations to different ecosystems and how these phenomena shape animal evolution.

OEB 57: Animal Behavior (undergraduate)

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 121a & Human Evolutionary Biology 1210: Research in Comparative Biomechanics Seminar (undergraduate and graduate)

Andrew A. Biewener, George V. Lauder (and Stacey A. Combes, Daniel E. Lieberman, Anna G. Warrener)

Introduction to experimental techniques used to investigate the structure and physiology of vertebrates, where each instructor offers research projects that are undertaken in their laboratory.

OEB 155r: Biology of Insects (undergraduate and graduate)

Naomi E. Pierce (and Michael R. Canfield)

Introduction to the major groups of insects—life history, morphology, physiology and ecology—through a combination of lecture, lab and field exercises.

OEB 157: Global Change Biology (undergraduate and graduate)

James J. McCarthy (and Paul R. Moorcroft)

Examines how natural and anthropogenic changes in the Earth system are affecting the composition and the functioning of the world's land and ocean ecosystems.

OEB 167: Herpetology (undergraduate and graduate)

James Hanken, Jonathan B. Losos

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

OEB 173: Comparative Biomechanics (undergraduate and graduate)

Andrew A. Biewener (and Stacey A. Combes)

Explores how animals and plants contend with their physical environment, considering their biomaterial properties, structural form and mechanical interactions with the environment.



OEB 181: Systematics (undergraduate and graduate)

Gonzalo Giribet

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

OEB 234: Topics in Marine Biology (graduate)

Robert M. Woollacott

Examines human impacts on marine life and ecosystems of the sea.

OEB 258: Adaptive Radiation and Macroevolution (graduate)

Jonathan B. Losos

A critical examination of the concepts and methods related to the study of adaptive radiation and macroevolutionary diversification.

Graduate Courses of Reading and Research

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 167: Herpetology

OEB 325: Marine Biology

Robert M. Woollacott

OEB 334: Behavioral Ecology

Naomi E. Pierce

OEB 341: Coevolution

Brian D. Farrell

OEB 345: Biological Oceanography

James J. McCarthy

OEB 355: Evolutionary Developmental Biology

James Hanken

OEB 362: Research in Molecular Evolution

Scott V. Edwards

OEB 367: Evolutionary and Ecological Diversity

Jonathan B. Losos

OEB 370: Mammalian Evolutionary Genetics

Hopi E. Hoekstra



OEB 51: Biology and Evolution of Invertebrate Animals



OEB 51: Biology and Evolution of Invertebrate Animals

OEB 155r: Biology of Insects



Thomas Dai



OEB 51: Biology and Evolution of Invertebrate Animals

Environmental Science and Public Policy

ESPP 90j: Environmental Crises, Climate Change and Population Flight (undergraduate)

James J. McCarthy (and Jennifer Leaning)
Explores the consequences of population flight due to war, drought and famine in which climate change is a contributing factor. Examines the extent and permanence of environmental destruction wrought by these crises, people’s attachment to their homes and ecosystems, the circumstances of departure, the destinations of refuge, and the possibilities for return.

OEB 167: Herpetology



Zachary Lewis

Freshman Seminar

FRSEMR 22t: Why We Animals Sing

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

Life Sciences

LIFESCI 1b: An Integrated Introduction to the Life Sciences: Genetics, Genomics and Evolution (undergraduate)

Hopi E. Hoekstra (and Maryellen Ruvo, Kevin C. Eggan, Pardis Sabeti)
Demonstrates how genetics and evolution are intimately related using an integrated approach, 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 (undergraduate)

George V. Lauder (and Peter T. Ellison, Daniel E. Lieberman)
Explores human anatomy and physiology from an integrated framework, combining functional, comparative and evolutionary perspectives on how organisms work.

General Education

Science of Living Systems 22: Human Influence on Life in the Sea (undergraduate)

Robert M. Woollacott, James J. McCarthy
Over-harvested fish stocks, pollution and anthropogenic climate change affect the stability and productivity of marine ecosystems. This course asks what we need to know about the causes and effects of anthropogenic change to best protect marine ecosystems and ensure sustainable harvests from the sea.



Harvard Extension School and Harvard Summer School

BIOS E-225: Human Impacts on Marine Organisms and Ecosystems

Robert M. Woollacott
Examines how anthropogenically driven events are impacting the structure and function of marine communities.

BIOS S-74: Marine Life and Ecosystems of the Sea

Robert M. Woollacott
A review of the life history and adaptations of marine life and the ecosystems of the sea, with emphasis on understanding the fragility and resilience of marine systems in the face of anthropogenically driven perturbations.

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

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

MCZ History

MCZ’s past, present and future were never more closely aligned than in the past year, when the Museum received a new copper roof. For it was copper to which Alexander Agassiz, son of MCZ’s founder Louis Agassiz, owed his vast fortune, which to this day supports most of the Museum’s activities.

As Alexander Agassiz wrote to a friend in 1867, “I am going to Michigan for some years as a superintendent of the Calumet and Hecla Mines. I want to make money; it is impossible to be a productive naturalist in this country without money. I am going to get some money if I can and then I will be a naturalist. If I succeed, I can then get my own papers and drawings printed and help my father at the Museum.” By the 1870s, Agassiz’s mines were responsible for nearly half of all copper produced in the U.S.

The original slate roof was replaced with copper in the early 1900s, by which time Alexander had succeeded his father as the Museum’s second director. Although major repairs were made in the 1960s, the first copper roof effectively shielded the MCZ for more than 100 years. Almost all of the old copper that was removed during the recent installation will be recycled into new copper sheets.



Perry and Radford Architects

HIGHLIGHTS FROM THE COLLECTIONS

Restoring the Sparkle to the Blaschka Glass Animals

In the 1870s and 1880s, Leopold and Rudolf Blaschka, the father and son creators of Harvard's Glass Flowers, meticulously shaped lifelike glass models of marine animals.

Renowned for their beauty and exacting detail, the Blaschka models were widely used as teaching models since marine invertebrates, when preserved in spirits, rapidly lost their color and form. To craft the glass animals, the Blaschkas used small alcohol lamps to mold glass rods, tubes and minute pieces of glass, which they later painted.

A new exhibition at the Harvard Museum of Natural History, *Sea Creatures in Glass*, is the culmination of the effort to curate, clean and repair MCZ's collection of 430 [Blaschka invertebrate models](#). Restorer Elizabeth Brill worked on the models over an eight-year period. Brill cleaned and reassembled the models—some of which have more than a hundred parts—and replaced the failed animal-hide glue with reversible, archival adhesive.

"*Sea Creatures in Glass* is a permanent exhibition, but the models will change over time," says **Linda S. Ford**, Director of Collections Operations in the MCZ. "Rotating the selection will allow the public to see a greater variety of the animal models while also preventing prolonged exposure to light and vibrations while on display, which can degrade them." Support for *Sea Creatures in Glass* and the ongoing restoration was made possible by a generous gift in memory of Melvin R. Seiden, AB 1952, LLB 1955. More information on the exhibition can be found on page 19.

Collections Move to the Northwest Building

The MCZ's dry collections continued to move into upgraded, climate-controlled storage facilities in the Northwest Building. Ornithology, Malacology, Invertebrate Zoology and Marine Invertebrates completed their relocations in late 2013 and the spring of 2014.

MCZ's Ornithology collection consists of nearly 400,000 specimens. At least 330,000 of these are bird skin specimens, 12,000 are skeletons and 40,000 eggs or nests. "The department made a monumental effort to prepare specimens for the move," says **Jeremiah Trimble**, Curatorial Associate for Ornithology. "We reorganized nearly every family of birds, organizing the specimens taxonomically and geographically, and thoroughly cleaned all boxes of eggs and skeletons." Trimble, **Katherine Eldridge**, **Alison Pirie** and **Emily Braker** prepared for and carried out the move.

The Malacology collection consists of around 10 million specimens of dry preserved mollusk shells. "The entire collection was inventoried and completely reorganized from a phylogenetic arrangement to an alphabetical arrangement by family, genus, then species," says **Adam Baldinger**, Curatorial Associate for Malacology, Invertebrate Zoology and Marine Invertebrates. Baldinger, **Murat Recevik** and **Alana Rivera** worked on the Malacology move. In addition to Baldinger, the preparation and move of Invertebrate Zoology's 5,000 specimens of dry preserved sponges and crustacea and Marine Invertebrate's 50,000 specimens of dry preserved echinoderms and bryozoans were performed by **Penny Benson**, **Jennifer Lenihan**, and **Jessica Mullen**.

Ichthyology Obtains White Shark

In 2012, a fishing boat off the coast of California inadvertently snared a young white shark (*Carcharodon carcharias*). The one-year-old shark was brought to the Monterey Bay Aquarium and then sent to the Woods Hole Oceanographic Institution where a full-body CT scan was made of the 5-foot, 94-pound specimen. After the shark was moved to the University of Massachusetts, **Karsten Hartel**, Curatorial Associate, and **Andrew Williston**, Curatorial Assistant, in the MCZ's Ichthyology collection, worked with colleagues to obtain tissue samples for DNA plus scale and skin samples for morphology before preserving the shark in formalin and moving it to the MCZ in February 2014.

MCZ's Ichthyology collection contains 3,350 shark specimens. The new white shark is only the third alcohol-preserved specimen of the species in the collection and the first that is fully intact. Because the Ichthyology Department has several new oversized stainless-steel tanks that can hold fish up to eight feet in length, one of their goals has been to obtain this kind of large, rare specimen.

Sharks figure significantly in the work of **George V. Lauder**, Curator of Ichthyology. "Analysis of this new white shark will provide an invaluable contribution to our research," says Prof. Lauder, "and its size makes it easy to handle for student demonstrations. We'll be performing genetic studies on the tissue samples, analyzing the shape and structure of the surface scales as part of our work on artificial shark skins, and studying the structure of the tail muscles as part of our research on how fish move through the water."

Alfred S. Romer's Medals Find a New Home at the MCZ

In September 2013, seven medals awarded to Alfred Sherwood Romer were donated to the MCZ on behalf of the Romer family by his son Robert H. Romer, Professor of Physics, Emeritus, Amherst College.

Dr. Romer (1894–1973) was a dominant figure in vertebrate paleontology throughout the 20th century. Romer's major research contributions dealt with the ancestry of vertebrates, Paleozoic tetrapods and the antecedents of mammals. During his career, Romer published more than 200 papers and books on vertebrate paleontology, anatomy and evolution. He was appointed Professor of Zoology and Curator of Vertebrate Paleontology at Harvard in 1934 and Alexander Agassiz Professor of Zoology from 1947 to 1965. He served as MCZ's director from 1946 to 1961.

Romer's medals include the Mary Clark Thompson Medal, 1954, and the Daniel Giraud Elliot Medal, 1956, from the U.S. National Academy of Sciences; the XVI International Congress of Zoology Medal, 1963; the Penrose Medal, 1962, from the Geological Society of America; the Linnean Medal, 1972, from the Linnean Society of London; an Honorary Member Medal, 1970, from the Fundación Miguel Lillo (Argentina); and the Wollaston Medal, 1973, from the Geological Society of London. They are currently on display in the Ernst Mayr Library's Special Collections.



George V. Lauder (left) with the new white shark and members of the Ichthyology Department

Catherine Weisel



Jonathan Woodward



Jeremiah Trimble



Catherine Weisel



Alfred S. Romer

Ernst Mayr Library Archives



MCZ RESEARCH MAKING HEADLINES



Justin Ide
Farish Jenkins with a model of *Tiktaalik roseae*

Marine Origins of Land Limbs

Did hind limbs evolve in vertebrates on land or in the water, and which limbs evolved first? It has been widely believed that this important transition from fish to tetrapod—four-legged creatures capable of walking—occurred on land. However, research by Neil Shubin, Edward Daeschler and the late **Farish A. Jenkins, Jr.** indicates otherwise.

In 2004, the team made the groundbreaking discovery of *Tiktaalik roseae*, the 375-million-year-old missing link between fish and land animals, in the Canadian Arctic. Growing up to nine feet long, *Tiktaalik* was a lobe-finned fish that looked like a cross between a fish and a crocodile and hunted in shallow freshwater environments.

Tiktaalik had transitional features like a mobile neck, robust ribcage and primitive lungs. Its large forefins had shoulders,

elbows and partial wrists, which would have allowed it to support itself on land. But the fossils initially described in 2006 did not include its posterior.

Recent investigation of fossil blocks retrieved during the original and subsequent excavations revealed the missing rear portion of the *Tiktaalik* specimen. Analysis of the *Tiktaalik* pelvis shows that while still fishlike, it was larger and similar in size to the shoulder girdle, as in tetrapods. It had a ball-and-socket hip joint connected to a highly mobile femur that could extend beneath its body. Crests on the hip for muscle attachment indicated strength and advanced fin function. These findings suggest that the transition from the “front-wheel drive” of fish to the “all-wheel drive” of land dwellers occurred in the ocean.

The paper, published in the *Proceedings of the National Academy of Sciences*, completes the work begun by Prof. Jenkins before his death in 2012.

[Shubin NH, Daeschler EB, Jenkins FA \(2014\) Pelvic girdle and fin of *Tiktaalik roseae*. PNAS 111:893-899.](#)

Lucky Number Seven

In vertebrates, the fastest sperm gets to fertilize the egg. In a number of species, the sperm cooperate, joining together in groups to improve their swimming performance. But how does this work?

Heidi S. Fisher, Hopi E. Hoekstra and colleagues developed a mathematical model to predict the performance of the sperm groupings of two closely related species, the promiscuous deer mouse, *Peromyscus maniculatus*, and the monogamous oldfield mouse, *Peromyscus polionotus*. They then directly observed live sperm to validate their model. Their findings were published in *Proceedings of the Royal Society B*.

In both species of mice, the researchers found that the optimal grouping is seven sperm cells—larger aggregates tend to form more star-shaped structures, forcing the cells to swim against each other and

decreasing performance. Interestingly, these ideal groups of seven didn’t actually swim with greater speed. Their success occurred because they swim in a straighter path, thereby reaching their goal more rapidly.

However, the species differed in how often their sperm groups reached the magic number seven. In the monogamous oldfield mouse, aggregates form a greater range of sizes. In the deer mouse, where the females mate with multiple males, sperm tended to form the ideal group size more often. This suggests that in the more competitive world of deer mice, sexual selection favors those individuals that can more consistently create the optimum group of sperm.

[Fisher HS, Giomo L, Hoekstra HE, Mahadevan L \(2014\) The dynamics of sperm cooperation in a competitive environment. P Roy Soc B 281:20140296.](#)

Swim Like an (Artificial) Shark

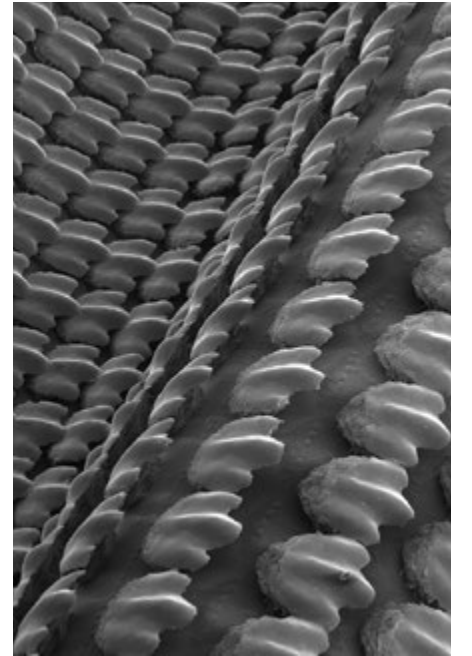
Shark skin isn’t smooth. It’s covered with millions of microscopic toothlike scales, or denticles. Scientists have hypothesized that these denticles disrupt the flow of water over the surface of the shark, reducing drag and improving speed and efficiency. Now, for the first time, **George V. Lauder** and colleagues have constructed a biologically realistic shark skin using 3-D printing and studied its effects on swimming performance.

The researchers constructed a 3-D model of the pattern of denticles on the skin of a shortfin mako (*Isurus oxyrinchus*) using micro-CT scanning, and modeled the hook-like structure of a single denticle in minute detail. The team then faced significant challenges in manufacturing the artificial shark skin, which required creating rigid denticles and embedding them, in an overlapping pattern, in a flexible substrate that could bend and flex like real skin. Accomplishing this feat required a year of testing with a 3-D printer that could work with multiple materials, but they finally succeeded.

They studied the artificial skin’s performance using a robotic flapping device and smooth-skinned control. At lower swimming speeds, the artificial skin on a static surface reduced drag by 8.7% and improved speed by 6.6%. Interestingly, at higher speeds, the drag on the rigid surface increased and speed slowed. However, when the surface was allowed to flex like a shark’s skin when it swims, the speed again increased by 6.6%.

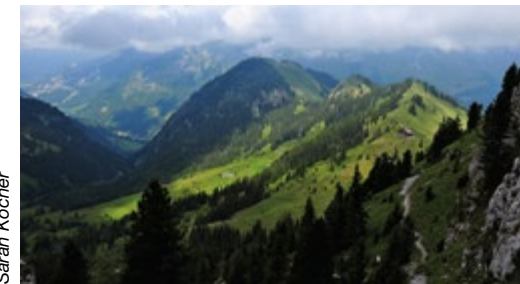
The ability to manufacture and study artificial shark skin—and manipulate its properties—could lead to improved performance in swimming robots and other applications. Prof. Lauder, Li Wen and James Weaver described their manufacturing process and findings in *The Journal of Experimental Biology*.

[Wen L, Weaver JC, Lauder GV \(2014\) Biomimetic shark skin: design, fabrication and hydrodynamic function. J Exp Biol 217:1656-1666.](#)



Social Behavior May Be in Their Genes

In evolutionary biology, social behavior represents a major transition from an individual to a coordinated group. Honeybees are a well-documented example of a complex coordinated society, with social castes that perform specific tasks like gathering food or caring for the young. However, the vast majority of bees are not social but solitary, and one special type of bee, *Lasioglossum albipes*, can be either.



Sarah Kocher

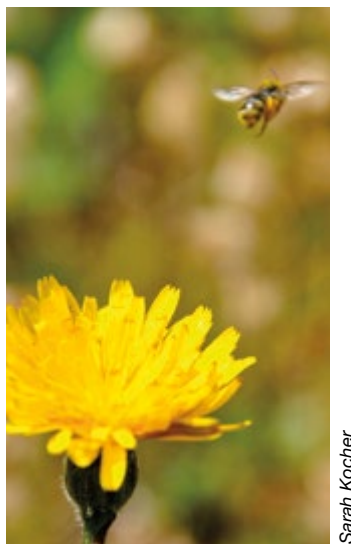
Lasioglossum albipes is a halictid bee, also known as a “sweat bee.” It is solitary in inland France and Germany, but social in southwestern France. Experiments have shown that the bees exhibit the same behavior when raised in the lab as in the

wild, which suggests their social behavior may have an underlying genetic component.

Postdoctoral fellow **Sarah Kocher** sequenced the genome of this bee—the first bee genome since the honeybee—for both a social and a solitary individual. Comparing genomes of the same species with different social behavior should prove especially useful in investigating the forces that have shaped the evolution of that behavior. For example, differences in the olfactory genes, which can be used to recognize nest mates or specific castes, suggest the role that odor receptors play in the development of social behavior.

Initial analyses are yielding intriguing clues that point to further research into the underlying genetic components of the evolution of social behavior. Dr. Kocher was the lead author of the paper published in *Genome Biology*. Co-authors included **Hopi E. Hoekstra** and **Naomi E. Pierce**.

[Kocher SD, Li C, Yang W, Tan H, Yi SV, Yang X, Hoekstra HE, Zhang G, Pierce NE, Yu DW \(2013\) The draft genome of a socially polymorphic halictid bee, *Lasioglossum albipes*. Genome Biol 14:R1 42.](#)



Sarah Kocher



Collaboration Highlights Bryozoan Biologists

Since 2008, **Robert Woollacott**, Professor of Biology and Curator of Marine Invertebrates, and **Mary Sears**, Head of Public Services and

Reference Librarian for the Ernst Mayr Library, have co-authored three biographies of biologists who studied bryozoans, a phylum of invertebrates. Their collaboration highlights lesser-known researchers who made important contributions, but whose work remains underappreciated.

In 2008, they chronicled Alice Robertson (1849–1922), one of the few women scholars in early American marine

biology. Robertson, a professor at Wellesley College, worked on identification of bryozoan specimens from the 1906 MCZ *Albatross* expedition. Her main contributions, however, lay in pioneering studies of bryozoan fauna of the west coast of North America and of the events in polyembryony, or “identical twinning,” in a cyclostome bryozoan—a phenomenon now recognized to be ubiquitous throughout the order Cyclostomatida.

Their 2011 biography highlights William Lynch (1905–1960), a Roman Catholic priest who was a professor at St. Ambrose College in Iowa and researcher at Woods Hole, Massachusetts. His work centered on the behavior and metamorphosis of bryozoan larvae and later expanded to include the larva of an ascidian.

The 2014 paper features Benjamin Harrison Grave (1878–1949), a Quaker who was a professor at several colleges in Wyoming and the Midwest. Grave had diverse interests ranging from the effect of agricultural development on fragmentation of the prairie habitat and its consequences for avian faunal composition to the establishment of marine fouling communities at Woods Hole. These latter studies also touched on the role of species introductions and their establishment or rejection within a recipient community.

Research is presently underway for a 2017 biography.

The original articles can be found in the [Annals of Byrozoology](#) (Wyse Jackson P, Spenser Jones M, eds) International Bryozoological Association, Trinity College: Dublin, Ireland.

Egg Signatures Thwart Cuckoo Invaders

The common cuckoo (*Cuculus canorus*) lays its eggs in the nests of other bird species, duping them into raising the chicks as their own. Cuckoo chicks hatch first, destroying their nest mates to become the only offspring of their adoptive parents.

To avoid detection, the cuckoo has evolved the ability to mimic the egg markings of the host species. In defense, the host birds have developed pigmentation patterns that allow them to recognize their own eggs, identify intruders and remove them from the nest.

The manner in which the birds recognize these markings, however, has been poorly understood.

Postdoctoral fellow **Mary Caswell Stoddard** and colleagues studied hundreds of eggs from eight host species, including the cuckoo eggs laid in their midst.

The researchers developed a computer vision tool called NATUREPATTERNMATCH, derived from sophisticated software used for facial recognition and image stitching programs, to analyze the visual patterns on the host birds' eggs, adjusting for the way birds see and how their brains are thought to process this information.

They found that the host species most intensely targeted by the cuckoo have evolved the most identifiable pattern signatures. And in these signatures, complexity is not as desirable as supposed. It seems that, beyond a certain point, increased complexity renders the pattern less recognizable. Their research was published in *Nature Communications*.

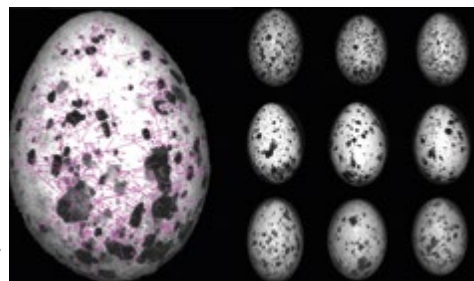
[Stoddard MC, Kilner RM, Town C \(2014\) Pattern recognition algorithm reveals how birds evolve individual egg pattern signatures. *Nature Comm* 5:4117.](#)



Alice Robertson, 1904 (front row, third from left)



A reed warbler caring for a much larger cuckoo chick



PROJECTS & INITIATIVES

MCZ Awarded NSF Grants for Digitization Projects

Centuries of discovery document the diversity of life on Earth. Records of that biodiversity are, for the most part, in varied and distinct natural history collections, making assessing the information a difficult task. The National Science Foundation (NSF), through its Advancing Digitization of Biological Collections program, is responding to the need for greater accessibility of biological collections data by awarding grants to projects that contribute to developing a national resource of digital data that documents existing biological and paleontological collections, which will become an important tool in understanding contemporary biological issues and challenges.



Brian D. Farrell, Principal Investigator, was supported for the Harvard component of the project, [Fossil Insect Collaborative: A Deep-Time Approach to Studying Diversification and Response to Environmental Change](#). Fossil insects provide a unique deep-time record of ecological and evolutionary response to past environmental changes and, therefore, are invaluable for understanding the impacts of climate change on the current biodiversity. Given models of future climate change and the important role that insects play in human society (biodiversity, pests, pollination, vectors of disease), the ability to access these data and make predictions about future insect populations becomes even more urgent. The Fossil Insect Collaborative, based at the University of Colorado, Boulder, will create electronic specimen records for all the major U.S. fossil insect collections and make them broadly accessible through the project website and a central site, iDigPaleo. Mobile apps and activities will also be developed.

Principal Investigator **Naomi E. Pierce** received a Partners to Existing Network (PEN) grant to complement the [Southwest Collections of Arthropods Network \(SCAN\) Thematic Collection Network](#). SCAN is a museum collaborative digitizing specimen information for ground-dwelling insects and close relatives, and the MCZ will contribute expertise in the identification and digitization of ants. More than 90,000 specimens of ants from the American Southwest will be imaged, digitized and made available online. The project will benefit scientists studying biodiversity and the responses of ant species to climate change in the Southwest, and non-scientists seeking to identify their species. The broader impacts of this project, led by the [Encyclopedia of Life's Learning + Education](#) group, also based at the MCZ, will focus on the Navajo Nation, where researchers from the MCZ, Navajo scientists and student interns have collected more than 15,000 ants. Encyclopedia of Life educators will train Navajo graduate students to use EOL tools and resources and will jointly create Navajo-appropriate educational resources, including a downloadable field guide to the ants of the Navajo Nation.

James Hanken, Principal Investigator, received support for the Harvard component of the project, [InvertEBase: Reaching Back to See the Future: Species-rich Invertebrate Faunas Document Causes and Consequences of Biodiversity Shifts](#). Rapid biodiversity change has significant effects on essential ecosystem services, and exploding populations of invasive species threaten water and land habitats, potentially impacting U.S. natural resources. Easy access to expertly vetted baseline data will support the protection of the nation's natural resources and improve the capacity for effective restoration, land management planning and conservation management. The goal of this four-year collaborative project is the rapid digitization of more than two million specimens and location data from ten arthropod and mollusk collections housed at six major U.S. museums. This project will significantly automate specimen data capture by utilizing optical character and voice-recognition technologies. Numerous undergraduate students will receive training in digitization technologies, and the digitized data from this project will be immediately deployed for habitat-based distribution modeling and analyses. A modular exhibit will also be developed to engage public interest in biodiversity changes.

All data resulting from these awards will be available through the national resource [iDigBio.org](#) and [MCZbase](#), the Museum database.



Jonathan Woodward



Encyclopedia of Life

In collaboration with the Encyclopedia of Life (eol.org), **Jessica Rykken**, MCZ Associate in Entomology, developed a set of Bee Observer Cards designed to foster the art and science of observing nature by focusing on the key traits and behaviors that make different bee species unique. The Bee Observer Cards were distributed to 50 national parks in support of the grant *Multiregional Evaluation of Pollinator Response to Climate Change in Critical Habitats*, and enthusiastic reviews with links to these cards have appeared on many pollinator websites. The cards are available at eol.org/info/disc_observer.

The EOL Learning + Education group was awarded a Department of Defense Education Activity (DoDEA) grant. The lead institution is the Okaloosa County School District in Florida, where around 30% of the students are from military families. “Okaloosa S.C.I.E.N.C.E.” will provide students with opportunities to learn about local ecosystems and biodiversity—and human impacts

Ernst Mayr Library and MCZ Archives

[The Ernst Mayr Library](#) is partnering on Purposeful Gaming, a project that will use the transcription of historical documents to test a crowdsourcing game. The project is led by the Missouri Botanical Garden and supported by an Institute of Museum and Library Services (IMLS) National Leadership Grant.

A key goal will be to improve searching and retrieval in digitized historic literature. Historic literature, especially handwritten field notes and horticultural catalogs,

cannot be accurately transcribed using optical character recognition (OCR) software. “Purposeful Gaming intends to demonstrate that digital games are an excellent tool for analyzing and improving digital outputs from OCR and transcription activities because large numbers of users can be harnessed quickly and efficiently to focus on the review and correction of particularly problematic

thereon—and participate in projects to monitor, conserve and preserve those ecosystems. EOL resources and tools will be used in STEM (Science, Technology, Engineering and Math) learning and in support of an annual BioBlitz, a biodiversity survey where students and their families work alongside scientists.

UC Davis and the MCZ were awarded NSF funding for their proposal *Kurator: A Provenance-enabled Workflow Platform and Toolkit to Curate Biodiversity Data*, designed to foster public participation in data-cleaning projects. The EOL Learning + Education group will coordinate development, testing and use of tools, services and learning modules created through the project.

The MCZ-supported One Species at a Time podcast series (podcast.eol.org/podcast) was listed as one of 7 Essential Public Radio STEM Education Resources on the Public Radio Exchange blog. EOL is partnering with ListenCurrent and the Encyclopedia of Earth to create lesson plans around the podcasts.

words when the task is presented as a game,” says **Connie Rinaldo**, Librarian of the Ernst Mayr Library, who—with **Joe de Veer**, head of technical services at Ernst Mayr—is leading the project in the MCZ.



Kris Sribbe

Volunteers will create initial transcriptions of the original notebooks and electronic images of the diaries of **William Brewster**, a late-19th- and early-20th-century ornithologist/naturalist, which were digitized with the support of a previous IMLS National Leadership Grant. Two video games will be developed to compare problematic words in the documents—one with minimal gameplay features for the more altruistic volunteer, and the other with more gaming features that will be engaging for players who might not be interested in natural history.

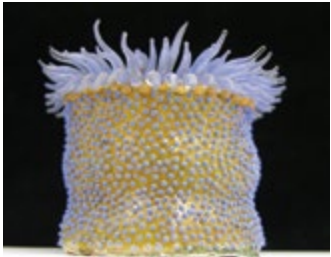


Sea Creatures in Glass

On May 24, 2014, the [Harvard Museum of Natural History](#) opened *Sea Creatures in Glass*, a permanent exhibition that showcases the MCZ’s collection of Blaschka glass marine invertebrates.

These magnificent models were created as 19th-century teaching tools, and they are as anatomically accurate as they are beautiful. Delicate jellyfish and anemones, octopus, tentacled squid, bizarre-looking sea slugs, or nudibranchs, and other soft-bodied sea creatures captured in glass are a sparkling testament to the legacy of Leopold and Rudolf Blaschka.

The permanent exhibit features a rotating selection of 60 of the MCZ’s 430 newly restored Blaschka invertebrate models, many on public display for the first time. *Sea Creatures in Glass* is made possible by a generous gift in memory of Melvin R. Seiden, AB 1952, LLB 1955.



Final Flight: The Extinction of the Passenger Pigeon

Passenger pigeons (*Ectopistes migratorius*) were once extraordinarily abundant in North America. Reports from the 1800s recount flocks that could darken the sky with their number, and some believe they were the most abundant bird on Earth. But by the 20th century, the birds disappeared in one of the most dramatic extinctions caused by humans.

The Harvard Museum of Natural History exhibit [Final Flight](#) marked the 100th anniversary of the death of Martha, the last passenger pigeon, in 1914 at the Cincinnati Zoo. The exhibit included two mounted specimens donated by William Brewster, Curator of Mammals and Birds at the MCZ, in 1917.

Loss of the passenger pigeon prompted the passage of the Migratory Bird Treaty Act in 1918, which made it illegal to hunt, kill or capture at-risk bird species. This legislation served as a template for other laws, including the Endangered Species Act of 1973.



Catherine Weisel



Catherine Weisel

Thoreau's Maine Woods: A Journey in Photographs with Scot Miller

In commemoration of the 150th anniversary of the publication of Henry David Thoreau’s *The Maine Woods*, the Harvard Museum of Natural History hosted an exhibition of prints by noted photographer Scot Miller, who spent years tracing Thoreau’s steps with his camera. Miller’s stunning images reflect much of what Thoreau saw in his Maine Woods journeys and also document contemporary change in one of the most remote and magnificent “wild” places in the continental U.S.

Striking specimens from the MCZ’s Mammalogy and Ornithology collections grace [Thoreau’s Maine Woods](#): white-tailed deer (*Odocoileus virginianus*), American black bear cub (*Ursus americanus*), Eastern gray squirrel (*Sciurus carolinensis*), yellow-shafted Northern flicker (*Colaptes auratus*) and a common raven (*Corvus corax*). The exhibition, made possible by the financial support of Dr. John Freedman, AB 1984, will remain on display until February 2015.



AWARDS & RECOGNITION

Stephanie Mitchell



Brian D. Farrell

Emeritus

Edward O. Wilson was presented with the Franklin Founders Award in recognition of his lifetime of work in the natural sciences and his insights into the genetic basis of the social behavior of animals. The award was given during the *Celebration! Benjamin Franklin, Founder* festivities in Philadelphia, honoring Franklin's 308th birthday.

Faculty

Andrew A. Biewener was appointed Chair of the NIH *Musculoskeletal Rehabilitation Sciences* grant review study section for 2014–2015.

Brian D. Farrell was named the Director of the David Rockefeller Center for Latin American Studies. Prof. Farrell has conducted extensive molecular and ecological research on beetles and other insects in the region, and hopes to strengthen scientific ties between Harvard and Mexico, the Caribbean, and the nations of Central and South America.

James Hanken was invited to be Chief Guest at the International Peradeniya University Research Sessions (iPURSE), Kandy, Sri Lanka.

Hopi E. Hoekstra was awarded a Harvard College Professorship, which recognizes excellence in undergraduate education. Hoekstra also received the Spark Award from Women in Science at Harvard-Radcliffe for continually inspiring young women in science.



Andrew A. Biewener

Staff

Judith Chupasko, Curatorial Associate in Mammalogy, and **Kenneth Wilcox**, Building Superintendent at the Concord Field Station, were each honored by Harvard for 25 years of service to the University.

Linda S. Ford, Director of Collections Operations, was elected President-Elect for SPNHC (Society for the Preservation of Natural History Collections) and was invited to be on the External Advisory Board to iDigBio (Integrated Digitized Biocollections), the NSF-funded National Resource for Advancing Digitization of Biodiversity Collections (ADBC).

Bridget Power, Faculty/Collections Assistant, received a Dean's Distinction Award, which recognizes outstanding citizenship and exceptional contributions in support of the Faculty of Arts and Sciences' mission.

Connie Rinaldo, Ernst Mayr Librarian, received an Impact Award for her sustained, superior performance and exceptional effectiveness in the Faculty of Arts and Sciences.



Catherine Weisel

Bridget Power

Postdoctoral Fellows

Christina Riehl received the Cooper Ornithological Society Young Professional Award, which recognizes early-career ornithological researchers for their outstanding contributions to ornithology.



Mary Caswell Stoddard

Mary Caswell (Cassie) Stoddard was honored with a 2013 L'Oréal USA Fellowship for Women in Science, a program that partners with the American Association for the Advancement of Science (AAAS) to recognize and reward five outstanding U.S.-based post-doctoral women researchers.

Graduate Students

Emily Jacobs-Palmer received the Derek C. Bok Award for Excellence in Graduate Student Teaching of Undergraduates.

Zachary Lewis received the E.E. Williams Award from the Herpetologist's League and the Harvard University Certificate of Distinction in Teaching.

Hillery Metz was awarded an American Association for University Women Fellowship.



Christofer Clemente

Talia Moore

Talia Moore received a Deakin-Royce Graduate Research Fellowship in Australian Studies to support her research on the locomotor ecology of desert marsupial hopping mice. Moore also received the Harvard University Certificate of Distinction in Teaching.

Martha Muñoz received the Raymond B. Huey Award for the Best Student Presentation in the Division of Ecology and Evolution at the 2014 Society of Integrative and Comparative Biology meeting.

Elizabeth Sefton was a recipient of the Vessa Notchev Fellowship, sponsored by the Sigma Delta Epsilon/Graduate Women in Science.

Allison Shultz received the American Ornithologists' Union Student Presentation Award.

Undergraduates

Ariana Kam's animation of "[Genetics of Mouse Burrowing](#)" was recognized by Harvard's Program in General Education and was awarded a Conant Prize honoring creative pedagogical innovations.

Graduating seniors **Georgia Shelton** and **Tanner Strickland** were Thomas Temple Hoopes Prizes for their senior theses: "The biodiversity of the bees at the Arnold Arboretum" (Shelton) and "Lizards bridging the gap: Phylogeography of the Puerto Rican crested anole (*Anolis cristatellus*) across the Puerto Rican Bank" (Strickland). Strickland also received a Harvard Herchel Smith Undergraduate Research Fellowship.



Animation by Ariana Kam



Matthias Markolf

Judith Chupasko



MCZ GRANT RECIPIENTS

ACADEMIC YEAR 2013–2014

Grants in Aid of Undergraduate Research (GUR)

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

Recipient	Faculty Sponsor/ Academic Dept.	Project Title	Amount
Emily A. Burke	Gonzalo Giribet/ Organismic and Evolutionary Biology	Phylogeography of Bdellouridae	\$2,144
Inanna L. Carter	Charles C. Davis/ Organismic and Evolutionary Biology	Insect herbivore community of Hawaiian Lobelioideae	\$2,500
Stephanie N. Caty	Lauren O’Connell/ Center for Systems Biology	Investigating enzymes involved in poison frog toxicity	\$1,500
Thomas Dai	Naomi E. Pierce/ Organismic and Evolutionary Biology	A comparative study of UV reflectivity and androconial structures in lycaenid and riodinid butterflies	\$2,000
Taras B. Dreszer	Gonzalo Giribet/ Organismic and Evolutionary Biology	Describing a new species of harvestmen and developing a new imaging technique for the taxon	\$1,645
Sally Gee	Elizabeth Wolkovich/ Organismic and Evolutionary Biology	Trees, traits and the future of North American forests with climate change	\$2,010
Kimberly B. Johansson	Cassandra Extavour/ Organismic and Evolutionary Biology	Interrogation of cricket germ line development by Vasa transgenic analyses	\$2,500
Sang Il Kim	Brian D. Farrell/ Organismic and Evolutionary Biology	Phylogeny of world stag beetles may reveal the Gondwanan origin of Darwin’s beetle: testing Jenneal’s hypothesis	\$2,385
Mikhaila C. Marecki	George V. Lauder/ Organismic and Evolutionary Biology	What is the function of the Aw muscle in <i>Chauliodus sloani</i> jaw adduction?	\$2,500
Jenna R. McGugan	Lauren O’Connell/ Center for Systems Biology	Dietary contributions to chemical defenses in the little devil frog, <i>Oophaga sylvatica</i>	\$1,500
Emily A. Mistick	Stacey Combes/ Organismic and Evolutionary Biology	Aerodynamic effects of passive vein-joint deformation in hymenopteran wings	\$2,160
Rachel M. Moon	Jonathan B. Losos/ Organismic and Evolutionary Biology	The effects of anthropogenic habitat change on territorial behavior in the brown anole lizard	\$2,500
Li E.K. Murphy	Naomi E. Pierce/ Organismic and Evolutionary Biology	Ventilation in overwintering honeybee colonies	\$2,500
Johnny L. Pulice	Kirsten Bomblies/ Organismic and Evolutionary Biology	Developing neutral evolution models for tetraploid population genetics in <i>Arabidopsis</i> and <i>Mimulus</i>	\$2,500
Taylor E. Reiter	Terence Capellini/ Human Evolutionary Biology	Evolutionary and functional implications of selective pressures on amylase in canines and humans	\$2,500

Recipient	Faculty Sponsor/ Academic Dept.	Project Title	Amount
Valentina S. Rodriguez	Donald Pfister/ Organismic and Evolutionary Biology	Diversity and biology of <i>Orbilbia</i> xeric species in Massachusetts	\$2,466
Claire D. Stolz	James Hanken/ Organismic and Evolutionary Biology	Tracing the origin of squamate viviparity through eggshell analysis	\$2,500
Alexandra Stote	George V. Lauder/ Organismic and Evolutionary Biology	Participation in the 2014 conference of the Society for Integrative & Comparative Biology	\$500
Tanner R. Strickland	Jonathan B. Losos/ Organismic and Evolutionary Biology	Gene flow and divergence among populations of <i>Anolis cristatellus</i> across the Puerto Rican Bank	\$1,243
Jennifer L. Wong	Richard W. Wrangham/ Human Evolutionary Biology	Suckling behavior in juvenile red colobus of Kibale, Uganda	\$2,000
		Total Awards	\$41,553

Miyata Grants

The Ken Miyata Fund for Field Research Awards are intended to enable herpetological fieldwork by MCZ graduate students and postdoctoral fellows. Non-herpetological fieldwork may be eligible when there are no deserving herpetological projects. These grants are made possible by a gift from Dr. Barbara Jil Wu, PhD 1981, and Mr. Eric Larson, AB 1977.

Recipient	MCZ Department	Project Title	Amount
Katherine E. Boronow	Herpetology	Investigating personality in a globally invasive lizard, <i>Anolis sagrei</i>	\$4,800
Kadeem J. Gilbert	Entomology	The ecology and evolution of <i>Nepenthes</i> -anuran symbioses: <i>Nepenthes</i> oxygenation	\$6,440
Mara Laslo	Herpetology	Maternal hormones in direct-developing <i>Eleutherodactylus coqui</i>	\$2,915
		Total Awards	\$14,155

Robert G. Goelet Summer Research Awards

Goelet Awards support MCZ graduate student summer research projects. Funds support travel to field sites and related subsistence expenses incurred in pursuit of research objectives. These grants are made possible through a gift from Mr. Robert G. Goelet.

Recipient	MCZ Department	Project Title	Amount
Elizabeth Sefton	Herpetology	Transgenic <i>Xenopus</i> lines for mesoderm and neural crest fate-mapping	\$500
		Total Awards	\$500



Rachel Moon



Kate Velssis



Travis Ingram



Bridget Irvine



Li Murphy

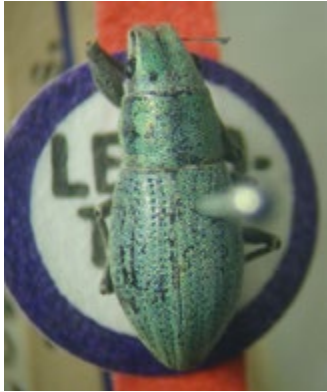


Travis Ingram

Meaghan Emery



Analia Lanteri



Nikhil Modak



Analia Lanteri



Ernst Mayr Travel Grants in Animal Systematics

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

Recipient	Institutional Affiliation	Project Title	Amount
Timothy J. Anderson	Purdue University	Review of the species limits for the lichen moth genus <i>Hypoprepia</i> (Lepidoptera: Erebiidae: Arctiinae: Lithosiini)	\$1,500
Juan Francisco Araya Araya	Universidad de Chile, Santiago	Biodiversity of Chilean Mollusca	\$1,500
Stephen M. Baca	University of Kansas	Review of the burrowing water beetles (Coleoptera: Noteridae) of the New World	\$1,500
Viktor Baranov	Leibniz Institute for Freshwater Ecology and Inland Fisheries	Non-biting midges (Diptera; Chironomidae) of the Faroe Islands: fauna and taxonomy	\$1,000
Manuel Alejandro Barrios Izas	Universidad Nacional Autónoma de México	A taxonomic monograph of a new Mesoamerican leaf litter weevil genus (Coleoptera: Molytinae, Conotrachelini), with notes on its phylogeny	\$1,500
Oleksii Bidzilia	Kiev Taras Shevchenko National University	A taxonomic study of Gelechiidae deposited at Ditsong National Museum of Natural History, with special consideration of types	\$1,440
Bonnie B. Blaimer	Smithsonian National Museum of Natural History	Resolving the <i>Crematogaster castanea</i> (Hymenoptera: Formicidae) species complex in southern and eastern Africa	\$1,500
Arthur E. Bogan	North Carolina State Museum of Natural Sciences	Verification of types of freshwater gastropods in the family Pleuroceridae	\$730
Patricia Cabezas-Padilla	Brigham Young University	A hard shell to crack: the taxonomic puzzle of pagurid hermit crabs	\$1,100
Pablo Matías Dellapé	Museo de La Plata, Universidad Nacional de La Plata, CONICET	Systematic revisions of the genera <i>Anomaloptera</i> Amyot & Serville and <i>Nysius</i> Stål	\$1,500
Maria Guadalupe del Rio	Museo de La Plata, Universidad Nacional de La Plata, CONICET	Systematics on the weevil tribe Naupactini (Coleoptera)	\$1,500
Meaghan M. Emery	University of Oregon	Character variability in modern Artiodactyla and implications for fossil taxonomy	\$1,098
David M. General	University of Philippines at Los Baños	Revision of <i>Calomyrmex</i> (Formicidae: Formicinae) and of the Philippine species of <i>Myopias</i> (Formicidae: Ponerinae)	\$1,500
Grey T. Gustafson	The University of New Mexico	Revision of the southeast Asian whirligig beetle genus <i>Porrorhynchus</i> Laport, 1834	\$1,500
Yoalli Quetzalli Hernández-Díaz	Instituto de Ciencias del Mar y Limnología, Universidad Nacional Autónoma de México	Phylogenetic revision of the genus <i>Ophiothrix</i> Müller & Troschel, 1840 (Echinodermata: Ophiuroidea) with emphasis on species distributed in the western Atlantic	\$1,500
Garrett B. Hughes	University of Arizona	Exploring the taxonomy of pseudoscorpions from under-sampled localities	\$1,500
Zeehan Jaafar	Smithsonian National Museum of Natural History	Systematic revision of <i>Oxudercine gobies</i> and evolution of terrestriality in fishes	\$1,140

Patrick McCormick



Sidclay Dias



Franco Faraci



Analia Lanteri



Recipient	Institutional Affiliation	Project Title	Amount
Jacqueline Karras	The University of New South Wales	Systematics, morphometrics and coevolution of grass-inhabiting lygaeoid true bugs (Insecta: Heteroptera) and evolution of host affiliated traits	\$1,500
Sang Il Kim	Harvard University	Systematic review of the <i>Dorcus velutinus</i> species group (Lucanidae: Coleoptera) through an integrative taxonomic approach	\$1,200
Analia Alicia Lanteri	Museo de La Plata, Universidad Nacional de La Plata, CONICET	Systematics of weevils of the <i>Pantomorus-Naupactus</i> complex (Insecta: Coleoptera: Curculionidae)	\$1,500
Thomas C. McElrath	University of Georgia	Revision of <i>Bactridium</i> , LeConte 1861	\$1,460
Nikhil Sujat Modak	Mes' Abasaheb Garware College, India	Examination of specimens of the genus <i>Indirana</i> from the Natural History Museum, London and Muséum National d'Histoire Naturelle, Paris	\$1,500
Anna A. Namyatova	The University of New South Wales	Revision and systematics of the paleotropical genus <i>Felisacus</i> (Heteroptera: Miridae)	\$1,200
Francisco Andrés Rivera Quiroz	Universidad Nacional Autónoma de México	Several new species of Theridiidae (Araneae: Araneomorphae) from a tropical forest in Mexico	\$1,500
Tatiana Alejandra Sepúlveda Villa	Universidad Federal do Paraná, Brazil	Revision, cladistic and biogeographic analysis of Neriidae (Diptera)	\$1,450
Lidianne Salvatierra Paz Triguero	Instituto Nacional de Pesquisas da Amazônia and The George Washington University	Simon, Petrunkevitch & O.P.-Cambridge collection: examination of <i>Miagrammopes</i> types from Natural History Museum, London	\$1,500
Daniela Yepes-Gaurisas	Universidad Nacional Autónoma de México	Review and phylogeny of the genus <i>Ophiozonella</i> Matsumoto, 1915 (Ophiuroidea: Ophiopodidae) based in morphological characters	\$1,450
Rita I. Velez	South Dakota State University	Examination of specimens of <i>Ptiloglossa</i> (Colletidae: Diphaglossinae) contained at the Pe. Moure's Collection in Brazil	\$1,303
		Total Awards	\$38,571

Barry Brown



Anna Namyatova



James Crall



Sarah Lerner



Sarah Kocher



Julianne Pelaez



Julien Ayroles



Putnam Expedition Grants

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

Recipient	MCZ Department	Project Title	Amount
Christopher Baker	Entomology	Biodiversity and fine-scale distribution of myrmecophiles in <i>Acacia drepanolobium</i> ant plants	\$7,584
John H. Boyle	Entomology	Nest architecture of ant associates of <i>Acacia drepanolobium</i>	\$7,584
Shane C. Campbell-Staton	Herpetology/Ornithology	Climate-induced natural selection: measuring the response of cold tolerance in green anoles to the polar vortex of 2013-2014	\$3,544
James D. Crall	Entomology	Movement ecology of orchid bees (Apidae: Euglossini) in tropical forest fragments	\$5,700
Rosa M. Fernández	Invertebrate Zoology	Exploring cryptic diversity in soil animals (part II): a case study in centipedes and velvet worms	\$12,480
Sebastian B. Kvist	Invertebrate Zoology	Shark leeches (Hirudinida: Piscicolidae): evolution, anticoagulant diversity and prey choice	\$8,131
Jean-Marc Lassance	Mammalogy	The genetic basis of adaptive traits in prey species: variation in predator aversion in <i>Peromyscus</i> of the Channel Islands Archipelago, California	\$8,674
Sarah Lerner	Invertebrate Zoology	Collecting East Pacific species of Pinnidae in Baja California	\$7,450
Talia Moore	Concord Field Station/Herpetology	Does bipedal locomotion evolve for similar reasons in all desert rodents?	\$1,100
Lori R. Shapiro	Entomology	Identifying potential insect disease vectors threatening <i>Cucurbita</i> spp. in Mesoamerica	\$8,575
Shantanu P. Shukla	Entomology	Microbial ecology of African dung beetles	\$7,050
Allison J. Shultz	Ornithology	Genomic signatures of pathogen-mediated selection in diachronic populations of the house finch	\$3,920
Bruno A. Souza de Medeiros	Entomology	Insect-host interactions and rates of evolution in a community of palm weevils	\$6,400
Callin M. Switzer	Concord Field Station	What's the buzz in Australia? Mechanism of buzz pollination by native Australian bees	\$5,859
Melissa R. Whitaker	Entomology	Gut bacteria and the evolution of diet in lycaenid butterflies	\$11,226
		Total Awards	\$105,277



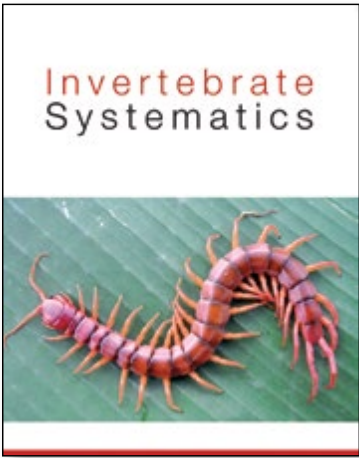
Allison Shultz



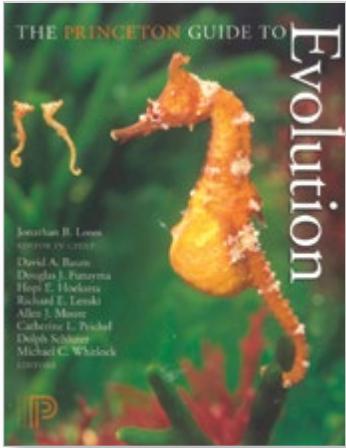
Julianne Pelaez

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- **Arnold AS, Lee DV, Biewener AA** (2013) Modulation of joint work in the goat hindlimb with locomotor speed and surface grade. *J Exp Biol* 216:2201–2212
- **Benavides LR, Giribet G** (2013) A revision of selected clades of Neotropical mite harvestmen (Arachnida, Opiliones, Cyphophthalmi, Neogoveidae) with the description of eight new species. *Bull MCZ* 161:1–44
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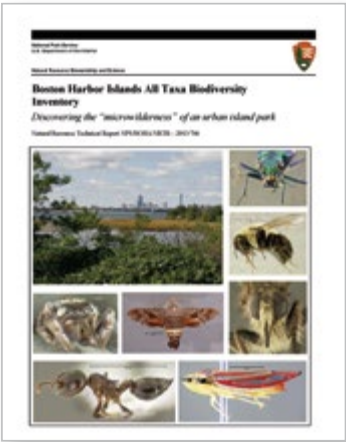
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“Stable phylogenetic patterns in scutigermorph centipedes (Myriapoda: Chilopoda: Scutigermorpha): dating the diversification of an ancient lineage of terrestrial arthropods” by **Gonzalo Giribet** and MCZ Associate Gregory Edgecombe was the cover story in *Invertebrate Systematics*.



The Princeton Guide to Evolution is edited by a distinguished team of evolutionary biologists including **Hopi Hoekstra** and editor-in-chief **Jonathan Losos**. This new reference work covers the major subjects and key concepts in evolutionary biology, from genes to mass extinctions and contains over 100 articles.



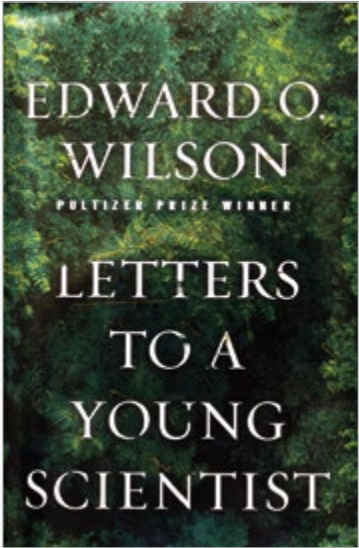
Brian Farrell and MCZ Associate Jessica Rykken published “Boston Harbor Islands All Taxa Biodiversity Inventory: Discovering the ‘microwilderness’ of an urban island park” as part of the All Taxa Biodiversity Inventory (ATBI) project, aimed to document arthropod and mollusk taxa in Boston Harbor Islands national parks.

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- **Lucas K**, Colin SP, Costello JH, Katija K, Klos E (2013) Fluid interactions that enable stealth predation by the upstream-foraging hydromedusa *Craspedacusta sowerbyi*. *Biol Bull* 225:60–70
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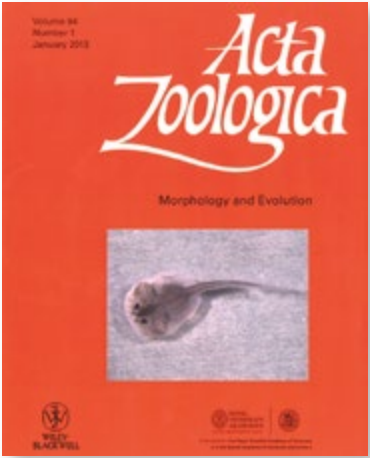
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Edward O. Wilson reflects on his sixty-year career as a scientist and gives advice for how the next generation can succeed—and why it is vitally important that they do—in *Letters to a Young Scientist*.

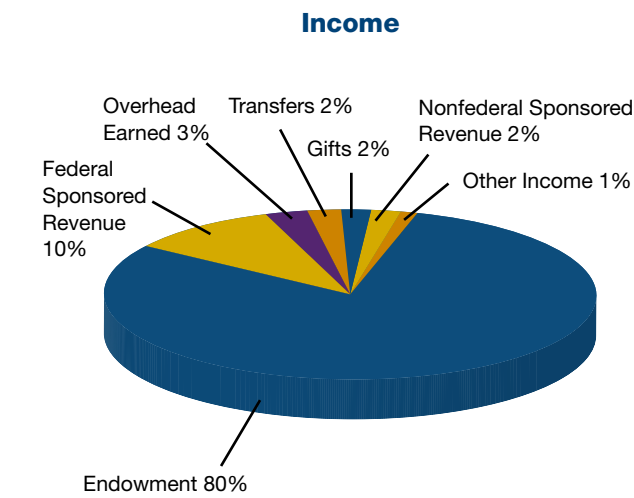


James Hanken, former graduate student **Carlos Infante**, and colleagues contributed “Morphology of the cranial skeleton and musculature in the obligate carnivorous tadpole of *Lepidobatrachus laevis* (Anura: Ceratophryidae)” as the cover story of *Acta Zoologica*.

FINANCIAL DATA

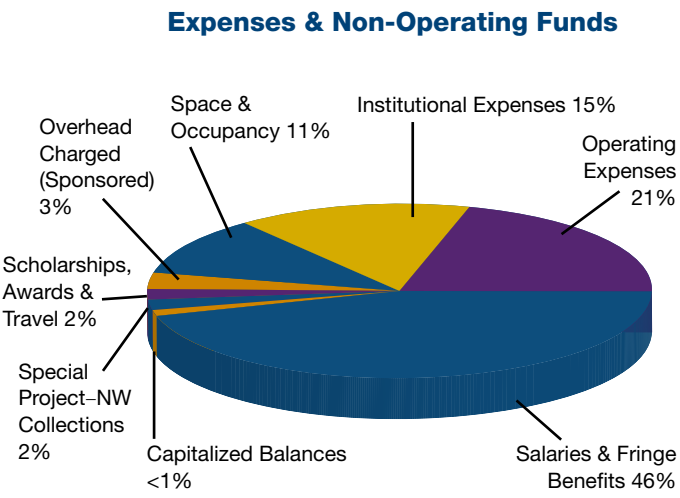
These charts describe the income and expenses of the Museum of Comparative Zoology in fiscal year 2014.

Endowment income funds much of the Museum’s activities, including acquisition and maintenance of collections, faculty and staff salaries, capital projects, facilities renovation and maintenance. Included in **Endowment** income is the annual distribution, revenue generated from assets purchased through endowments, and endowed funds decapitalized per donor request. **Transfers** include Harvard University-funded faculty research, 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 other cost recovery from other MCZ-sponsored activities. **Overhead** is funding paid from MCZ-based sponsored projects to cover facilities and administrative costs for those projects. It is shown as both income (**Overhead Earned**) and expenses (**Overhead Charged**).



Income	
Endowment	\$14,146,220
Federal Sponsored Revenue	\$1,780,583
Overhead Earned	\$547,104
Nonfederal Sponsored Revenue	\$427,397
Transfers	\$404,405
Gifts	\$315,453
Other Income	\$154,915
Total	\$17,776,077

Special Project–NW Collections includes deployment of collections to the newly constructed space in the Northwest Building. 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. 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 Museum of Natural History.



Expenses	
Salaries & Fringe Benefits	\$8,193,171
Operating Expenses	\$3,662,857
Institutional Expenses	\$2,602,858
Space & Occupancy	\$1,939,583
Overhead Charged (Sponsored)	\$547,104
Scholarships, Awards & Travel	\$348,103
Special Project–NW Collections*	\$292,319
Capitalized Balances	\$88,824
Total	\$17,674,820

* In FY14, \$2,009,204 in prior year NW Collections expenses were transferred from MCZ accounts to FAS Physical Resources accounts (funded by MCZ in FY12)

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