



MUSEUM *of* COMPARATIVE
ZOOLOGY
ANNUAL REPORT
HARVARD UNIVERSITY



2008–2009

Director's Message



This year, the MCZ celebrates its 150th anniversary. Louis Agassiz's vision to build a zoological museum that would provide a comprehensive resource for scientists from Harvard and beyond came to fruition long ago. Today, this vision is sustained through the efforts of a dedicated contingent of faculty-curators, staff, and students. Although scientific theories, controversies, and methods may evolve, the core mission of the Museum remains paramount: to serve as a world-renowned center for research and education in evolutionary and comparative biology through the maintenance and study of scientific collections. This annual report, the first in thirty years, chronicles important activities of the past year, highlights noteworthy accomplishments, and provides an annual record of this remarkable institution.

The past academic year is defined by many successes and opportunities. As does any institution with a long history, we constantly seek to improve our facilities. This year, we extensively renovated several collection rooms and made more modest improvements to many others. The herpetology library was transformed into a multi-purpose facility for course lectures, specimen-based labs and seminars; it also provides a workspace for curatorial staff and visiting scientists. Looking forward, we anticipate relocating several collections to a state-of-the-art belowground facility in Harvard's new NorthWest Building and, in November 2009, installing two whale skeletons to float over the main staircase at its 52 Oxford Street entrance.

The MCZ recognizes the importance of sharing data with the larger scientific community. To that end, we continue our multiyear effort to digitally capture essential information regarding our 21+ million specimens. Once migrated to MCZbase, our museum-wide database, these data are fully searchable online. MCZbase facilitates worldwide collaborations through integration with other global biodiversity databases, among them the Encyclopedia of Life and the Global Biodiversity Information Facility.

The MCZ is both a research and a teaching museum, hence I am particularly proud

of our active involvement in, and support of, Harvard's education programs. Undergraduate and graduate courses offered by our faculty-curators always are in high demand. Additionally, an in-house grants program funds curator-supervised research projects by students that typically take them out of the classroom and into the field.

The MCZ's collections and research continue to be showcased in the Harvard Museum of Natural History. Opening in spring of 2010, a temporary exhibition will focus on the diversity and evolution of horns and antlers in mammals. *New England Forests*, a permanent exhibition opening in spring of 2011, will feature the role of forests in carbon sequestration and address threats from invasive species.

As we begin the MCZ's next 150 years, we remain committed to our ambitious agenda to promote and enable cutting-edge research, to teach the next generation of professional zoologists and educated laypersons, to forge partnerships with a global network of scientists, and to ensure the longterm conservation and utility of our invaluable collections. I am grateful for the dedication and hard work of everyone associated with the MCZ who insure this institution's success.

James Hanken
Director

MUSEUM of COMPARATIVE ZOOLOGY ANNUAL REPORT HARVARD UNIVERSITY



2008–2009

Cover photo credits:

Top, left to right: Marie Manceau, Emily Berl/Harvard News Office, Cyndi A. Wood, Catherine Weisel, Cyndi A. Wood

Bottom, left to right: Cyndi A. Wood, Gonzalo Giribet, Don Lyman, Cyndi A. Wood, Camille Bonneaud

Opposite page photo credits:

Left to right: Catherine Weisel, Adam Baldinger, Renee Duckworth, Rose Lincoln/Harvard News Office, Farish A. Jenkins, Jr.

Innovative Research, Rich Collections, and a Vibrant Future

For 150 years, the Museum of Comparative Zoology (MCZ) at Harvard University has been an eminent center for research and education focused on the comparative relationships of animal life, devoted to the advancement of evolutionary biology and biodiversity science, and dedicated to the preservation, order, and use of its collection and archives.

The MCZ was founded in 1859 primarily through the efforts of Louis Agassiz, a brilliant lecturer and natural history scholar from Switzerland. As a leading institution for modern zoological research, the MCZ honors Agassiz's desire to illuminate the structures of living things, their natural classification, and the relationship with their surroundings.

INNOVATIVE RESEARCH

Today, the Museum of Comparative Zoology is comprised of 14 faculty-curators who oversee the Museum's 12 departments: Biological Oceanography, Entomology, Herpetology, Ichthyology, Invertebrate Paleontology, Invertebrate Zoology, Malacology, Mammalogy, Marine Invertebrates, Ornithology, Populations Genetics, and Vertebrate Paleontology. The faculty-curators also retain a professorial appointment through Harvard's Department of Organismic and Evolutionary Biology, conducting research and educating Harvard's undergraduate and graduate students. An active and productive roster of faculty, researchers, postdoctoral fellows, and graduate students contribute to the world's knowledge in the fields of systematics, evolution, biomechanics, genetics, behavior, and ecology.

The MCZ's Ernst Mayr Library and its archives assist the work of the Museum by providing and preserving information resources and services that support the research and teaching activities of the Harvard community. The Concord Field Station, a 62-acre research facility located in Bedford, Massachusetts, houses specimen preparation facilities and the largest specimens from some of the MCZ's collections.

RICH COLLECTIONS

Museum collections are an integral and fundamental component of zoological research and teaching. The MCZ holds one of the world's richest and most varied resources for studying the diversity of life, with more than

21 million extant and fossilized specimens in ten research collections. As a premier university museum and research institution, the specimens and their related data are available to researchers and educators worldwide.

The Harvard Museum of Natural History was established in 1998 as the public face of the Museum of Comparative Zoology and other natural history museums at Harvard. The HMNH showcases the incomparable collections of its parent museums and the research of scientists across the University as well as an array of educational programs for school age children to adults.

INTERNATIONAL INITIATIVES

The Museum of Comparative Zoology is active in several global projects that are exploring evolutionary relationships and the diversity of life through collaborative research and data sharing. New information in the field of comparative zoology is generated continuously, and the MCZ is proud to participate in these innovative efforts to capture, integrate, manipulate, and share these data:

- **Encyclopedia of Life**, an unprecedented effort to make information on Earth's 1.8 million identified species freely accessible through the Internet.
- **Biodiversity Heritage Library**, an effort to digitize the published literature of biodiversity into one comprehensive web-based collection.
- **Assembling the Tree of Life**, a U.S. National Science Foundation program that seeks to reconstruct the evolutionary origins of all living things by demonstrating their genealogical relationships.
- **Biodiversity Informatics** initiatives that develop and integrate specimen databases and collection records to provide unprecedented access to primary biodiversity information. Such initiatives include the Global Biodiversity Information Facility (GBIF), FishNet 2, HerpNet, Mammal Networked Information System (MaNIS), Ornithological Information System (ORNIS), and VertNet.

The Vision of Louis Agassiz

The Museum of Comparative Zoology owes its founding to the extraordinary vision and energy of Louis Agassiz. In 1845, while directing a small museum and teaching natural history in Switzerland, Agassiz was asked to deliver the Lowell Lectures in Boston. Agassiz promoted a new discipline he called "comparative zoology," endorsing the classification of living things based on their anatomical similarity, a message that was well received in Boston. Once installed as a professor at Harvard University,

Agassiz began raising funds for a grand, new museum that would illustrate patterns of organic similarity through morphology, embryology, paleontology and geographic distribution, primarily to provide material for scientific research by professionals.

When the MCZ opened in 1859, Agassiz filled the Museum with his personal collection, specimens gathered from Harvard faculty and students on collecting expeditions, and fossil collections purchased from Europe. According to Mary Winsor, author of *Reading the Shape of Nature*, "Probably the most novel and important difference between the MCZ and any existing collection was that Agassiz's new museum was a training ground for a new generation of professional zoologists." Agassiz's students played a central role in the Museum, with responsibilities for collecting and curating specimens, as well as research.

The 150-year anniversary of the MCZ will be commemorated with a series of lectures beginning in October 2009. Director James Hanken will speak on "This Brick Ark: Celebrating the Museum of Comparative Zoology's First 150 Years and the Beginning of the Next 150." Dr. Cristián Samper, Director of the National Museum of Natural History at the Smithsonian Institution, will examine "Natural History Museums and Society," and Dr. Michael Novacek, American Museum of Natural History Paleontologist, Senior Vice-President and Provost of Science, will discuss the importance of "Natural History Museums in the Environmental Century."

February 10, 2009: MCZ specimens are among the first objects to be photographed and "synthed" by using innovative Photosynth digital-imaging technology from Microsoft.

Photosynth combines digital photos of a single object to produce a three-dimensional, on-screen image that can be zoomed and rotated.



Cyndi A. Wood



Jessica Cundiff



Justin Ide/Harvard News Office

MCZ Faculty-Curators



Andrew A. Biewener
Charles P. Lyman Professor of Biology
Director, Concord Field Station
Chair, Department of Organismic and Evolutionary Biology
Prof. Biewener's research focuses on the biomechanics, neuromuscular function, and control of animal movement. His goal is to understand general principles that govern the biomechanical and physiological design of vertebrate neuro-musculoskeletal systems.



Tony Rinaldo

Scott V. Edwards
Professor of Biology
Alexander Agassiz Professor of Zoology
Curator of Ornithology
Prof. Edwards' research focuses on the evolutionary biology of birds and relatives, using the guiding principles of population genetics, geographic variation, genome evolution, systematics, and natural history. Current projects include utilizing genomic technologies to examine sex chromosome and genome evolution across the reptile-bird transition, speciation analysis and phylogeography in Australian and North American birds, as well as genomics of host-parasite co-evolution in House Finches and their bacterial pathogens.



Stu Rosner

Brian D. Farrell
Professor of Biology
Curator of Entomology
Prof. Farrell's research is broadly concerned with whether the diversity of species on earth is a cause or consequence of the diverse roles different species play in ecosystems, particularly between insects and plants. The Farrell Lab serves as a base for the Beetle Tree of Life project, a collaborative and comprehensive phylogenetic study of this most diverse group of animals.



James Hanken
Professor of Biology
Alexander Agassiz Professor of Zoology
MCZ Director
Curator of Herpetology
Prof. Hanken utilizes laboratory-based analyses and field

surveys to examine the evolution of morphology, developmental biology, and systematics in amphibians. Current areas of research include the evolution of craniofacial patterning in vertebrates; the developmental basis of life-history evolution; systematics, taxonomy, and evolution of neotropical and Asian salamanders; and amphibian declines and conservation.



Lynn Johnson

Hopi E. Hoekstra
John L. Loeb Associate Professor of Natural Sciences
Curator of Mammalogy
Prof. Hoekstra combines field and laboratory work to understand the evolution of mammalian diversity from morphology to behavior. Specifically, her research

focuses on the genetic basis of adaptive change—identifying both the ultimate causes (e.g., the strength and timing of selection) and the proximate mechanisms (e.g., the underlying molecular changes) responsible for traits that help organisms survive and reproduce in the wild.



Farish A. Jenkins, Jr.
Professor of Biology
Alexander Agassiz Professor of Zoology
Curator of Vertebrate Paleontology
Professor of Anatomy in the Harvard-MIT Division of Health Sciences and Technology (Harvard Medical School)

Prof. Jenkins' research interests are broadly in the area of vertebrate evolution, focusing on comparative anatomy of fossil and recent vertebrates and the evolutionary pathways of structural and functional development. Prof. Jenkins maintains active field research in vertebrate paleontology, and in 2006 was part of an expedition that discovered *Tiktaalik roseae*, the missing link between fish and land animals, in the Canadian Arctic.



George V. Lauder
Professor of Biology
Alexander Agassiz Professor of Zoology
Curator of Ichthyology
Prof. Lauder's research examines the structure, function, and evolution of vertebrates,

particularly fishes and amphibians. His current studies include investigating the biomechanics of aquatic locomotion in sharks and ray-finned fishes and analyses of musculoskeletal function during feeding and locomotion. Additional interests include biological fluid mechanics, theoretical approaches to the analysis form and function in organisms, and the history and philosophy of morphology and physiology.



Karel F. Liem
Professor of Biology
Henry Bryant Bigelow Professor of Ichthyology
Curator of Ichthyology
Prof. Liem's research focuses on the functional morphology, ecology, and evolutionary aspects of teleost fishes. His particular interests include

examining the interface between functional morphology of the feeding apparatus and trophic ecology, and how functional morphological features relate with patterns of diversity and evolutionary rates.



Rose Lincoln/Harvard News Office

Jonathan Losos
Professor of Biology
Monique and 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.



Gonzalo Giribet
Professor of Biology
Curator of Invertebrate Zoology

Prof. Giribet's primary research focuses on the evolution and biogeography of invertebrate animals. Working in molecular systematics since the field's early days, he is also interested in philosophical aspects of sequence data analysis, emphasizing homology-related issues.

Prof. Giribet's interests have remained diverse, with research concentrating in arthropods—including arachnids, myriapods, insects, and crustaceans—in locations around the world, and he is the primary investigator for a National Science Foundation's Assembling the Tree of Life grant. Consequently, researchers in the Giribet Lab have studied a wide range of invertebrates since the lab's inception in 2000. Current projects in the Giribet Lab include a multidisciplinary study for Assembling the Protostome Tree of Life, Assembling the Bivalve Tree of Life and other research into molluscan phylogeny and evolution, phylogeography and evolution of marine invertebrates, as well as multiple projects involving research on arthropod systematics, evolution, and biogeography. In addition to Prof. Giribet, the 14 lab members include a faculty assistant, research assistant, five postdoctoral associates, five graduate students, one undergraduate student, and several visiting researchers.



Charles R. Marshall

*Professor of Biology and Professor of Geology
Curator of Invertebrate Paleontology*

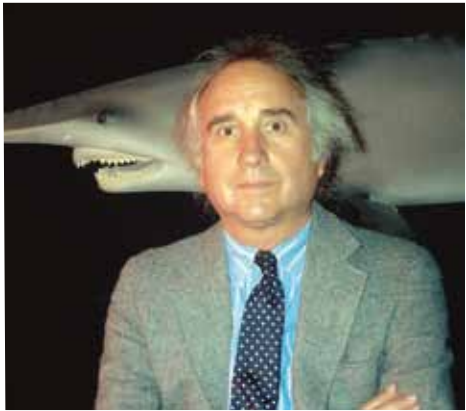
Prof. Marshall uses techniques in paleontology, developmental biology, statistics, molecular and morphological phylogenetics to understand the nature and causes of evolutionary innovation and extinction over geological time scales.



Naomi E. Pierce

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

Prof. Pierce's research uses molecular and morphological data to reconstruct the evolutionary history of Lepidoptera. The goal of this research is to clarify the systematics and classification of these insects, and to investigate how host plant and ant associations have shaped their patterns of diversification.



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.



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.

Prof. McCarthy has served on national and international planning committees, advisory panels, and commissions relating to oceanography, polar science, and the study of climate and global change for federal agencies, intergovernmental bodies, and international organizations. For the past two decades Prof. McCarthy has worked as an author, reviewer, and as a co-chair with the Nobel Peace Prize winning Intergovernmental Panel on Climate Change (IPCC), heading the working group addressing impacts of and vulnerabilities to global climate change at the Third IPCC Assessment. He was also one of the lead authors on the Arctic Climate Impact Assessment, and a Vice-Chair of the 2007 Northeast Climate Impacts Assessment.

Prof. McCarthy, former Director of the MCZ from 1982 to 2002, is a Fellow and former President of the American Association for the Advancement of Science (AAAS), a Fellow of the American Academy of Arts and Sciences, and a Foreign Member of the Royal Swedish Academy of Sciences. He is the recipient of the New England Aquarium's David B. Stone award for distinguished service to the environment and the community and was named 2009 Scientist of the Year by the Harvard Foundation.

Kenneth J. Boss

*Faculty-Curator Emeritus
Professor of Biology, Emeritus*

Prof. Boss, former Curator of Malacology, has been with Harvard for 40 years. His research focus is the classification, systematics, and evolution of molluscs, using data from shell morphology, anatomy, and zoogeography to analyze the phylogenetic relationships within various groups of gastropods and bivalves. He has also published on the history of Malacology. Prof. Boss has contributed extensively to the Occasional Papers on Mollusks and formerly served as editor for *Breviora* and the *Bulletin of the Museum of Comparative Zoology*.

Alfred W. Crompton

*Faculty-Curator Emeritus
Fisher Professor of Natural History, Emeritus*

Prof. Crompton, former Curator of Mammalogy, was the Director of the MCZ from 1970-1982 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 is a fellow of the American Academy for Arts and Sciences, and the American Association for the Advancement of Science. He received two Guggenheim fellowships for his research on vertebrate paleontology and functional morphology.

Herbert W. Levi

*Faculty-Curator Emeritus
Professor of Biology, Emeritus*

A former Curator of Arachnology, Prof. Levi's research focuses on the taxonomy of new world orb weaving araneid spider genera. The author of *Spiders and Their Kin*, as well as numerous articles on various spider genera, his research has made possible identification of 1,500 species in 66 genera in the Americas. Prof. Levi 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. He has made his extensive collection of drawings of orb weavers' genitalia available online.

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*. He served as President of the Society for the Study of Evolution, the American Society of Naturalists, and the Society for Molecular Biology and Evolution.

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 base 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). In 2007, Prof. Wilson received the Technology, Entertainment, Design (TED) Prize, where he articulated the concept of the Encyclopedia of Life—a contemporary, dynamic web page for every named species.



Carlton SoofTao

In Memoriam

On the 3rd of September 2009, the MCZ lost a dear friend and colleague, Karel F. Liem, Henry Bryant Bigelow Professor of Ichthyology. In addition to his distinguished research career in the evolutionary morphology of fishes, Karel was an esteemed lecturer, author, and

mentor. Karel and Hetty, his wife, were treasured members of the Harvard community, serving as master and co-master of Dunster House for 12 years and leading international cultural and ecological tours through the Harvard Museum of Natural History travel program. Karel's professional contributions, personal warmth, and raucous laughter will be missed tremendously.

A symposium celebrating Karel's life and work will be held at the annual meeting of the American Society of Ichthyologists and Herpetologists in Providence, Rhode Island, in July 2010.

Courses in 2008–2009 Led by MCZ Faculty-Curators

ORGANISMIC AND EVOLUTIONARY BIOLOGY

OEB 10: Foundations of Biological Diversity (undergraduate)

Brian D. Farrell (and N. Michele Holbrook)

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 (and Cassandra G. Extavour)

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 53: Evolutionary Biology (undergraduate)

Hopi E. Hoekstra (and Andrew J. Berry)

Micro- and macro-evolution, ranging from population genetics through molecular evolution to the grand patterns of the fossil record.

OEB 91r: Supervised Reading: Mammalogy (undergraduate)

Hopi E. Hoekstra

Classification, distribution, life histories, economic importance, techniques of field study, method of collection, and preservation of mammals.

OEB 113: Paleobiological Perspectives on Ecology and Evolution (undergraduate)

Charles R. Marshall

Introduction to the analysis of key problems in paleobiology, with an emphasis on how evolutionary and ecological processes operate on geologic timescales.

OEB 121a: Advanced Structure and Physiology of the Vertebrates (undergraduate)

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

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 121b: Advanced Structure and Physiology of the Vertebrates (undergraduate)

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

Optional extension of initial project undertaken in OEB 121a into a thesis research project.

OEB 139: Evolution of the Vertebrates (undergraduate)

Farish A. Jenkins, Jr.

Origination and evolution of the major groups of vertebrates, with emphasis on the anatomical and physiological transformations that occurred during the transitions to diverse lineages of fish, amphibians, reptiles, birds, and mammals.

OEB 155r: Biology of Insects (undergraduate)

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)

James J. McCarthy (and Paul R. Moorcroft)

Examines natural and anthropogenic changes in the earth system and their impact on the structure and functioning of terrestrial and oceanic ecosystems.

OEB 173: Comparative Biomechanics (undergraduate)

Andrew A. Biewener (and Jacques Dumais)

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

OEB 181: Systematics (undergraduate)

Gonzalo Giribet and Charles R. Marshall

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

OEB 190: Biology and Diversity of Birds (undergraduate)

Scott V. Edwards

Introduction to the biology of birds covers avian origins, physiology and anatomy, higher-level systematics and field characters, speciation processes, nesting and courtship behavior, vocalizations, mating systems and sexual selection, cooperative breeding, demography, and conservation.

OEB 211r: Form, Function, and Evolution (undergraduate)

Karel F. Liem

Evolutionary mechanisms underlying the diversity in design of living vertebrates.



OEB 234: Topics in Marine Biology

OEB 230: Speciation (undergraduate)

Hopi E. Hoekstra

The latest advances in speciation with a focus on controversial issues and new approaches.

OEB 234: Topics in Marine Biology (undergraduate)

Robert M. Woollacott

Human impacts on marine life and ecosystems of the sea.

OEB 255: Nature and Regulation of Marine Ecosystems (undergraduate)

James J. McCarthy

A presentation of topics of current interest in marine ecosystems, with emphasis on identification and quantification of biological and environmental factors important in the regulation of community structure in the intertidal, deep benthic, and planktonic realms.

OEB 261r: Developmental Mechanisms of Evolutionary Change (graduate)

James Hanken (and Arkhat Abzhanov)

Graduate seminar course in evolutionary developmental biology discussing the latest advances in understanding the cellular and molecular developmental mechanisms that underlie important evolutionary phenomena.



OEB 10: Foundations of Biological Diversity

OEB 130: Patterns & Processes in Fish Diversity





OEB 234: Topics in Marine Biology

OEB 275r: Frontiers of Ecology and Evolutionary Biology (graduate)

Scott V. Edwards (and other OEB Faculty)

A survey of the foundations and frontiers of ecology and evolutionary biology, delivered by OEB faculty.

GRADUATE COURSES OF READING AND RESEARCH

OEB 307: Biomechanics, Physiology and Musculoskeletal Biology

Andrew A. Biewener

OEB 310: Metazoan Systematics

Gonzalo Giribet

OEB 313: Paleobiological Approaches to Evolution and Ecology

Charles R. Marshall

OEB 320: Biomechanics and Evolution of Vertebrates

George V. Lauder

OEB 323: Advanced Vertebrate Anatomy

Farish A. Jenkins, Jr.

OEB 325: Marine Biology

Robert M. Woollacott



Farish A. Jenkins, Jr.

OEB 167: Herpetology

OEB 334: Behavioral Ecology

Naomi E. Pierce

OEB 335: Ichthyology and Functional Anatomy of Fishes

Karel F. Liem

OEB 341: Coevolution

Brian D. Farrell

OEB 345: Biological Oceanography

James J. McCarthy

OEB 355: Evolutionary and Ecological Diversity

James Hanken

OEB 362: Research in Molecular Evolution

Scott V. Edwards

OEB 367: Evolutionary and Ecological Diversity

Jonathan Losos

OEB 370: Mammalian Evolutionary Genetics

Hopi E. Hoekstra

FRESHMAN SEMINAR

Freshman Seminar 31v: The Beasts of Antiquity and their Natural History (undergraduate)

Farish A. Jenkins, Jr. (and Kathleen M. Coleman)

A study of the animals of the ancient Mediterranean basin, offering parallel introductions to the classics and to organismal and evolutionary biology. Includes first-hand study of specimens in the Museum of Comparative Zoology and coins and artifacts from Harvard's collection of antiquities.

LIFE SCIENCES

LIFESCI 2: Evolutionary Human Physiology and Anatomy (undergraduate)

George V. Lauder, Andrew A. Biewener (Peter T. Ellison and Daniel E. Lieberman)

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

CORE CURRICULUM

SCIENCE B-53: Marine Biology (undergraduate and Gen Ed Credit Course)

Robert M. Woollacott

Explores the life histories and adaptations of marine life and the ecosystems of the sea.

SCIENCE B-65: Evolutionary Biology (undergraduate)

Jonathan Losos

The process of biological evolution, the way the biosphere and its inhabitants have changed through time, and how human actions affect the evolutionary process.

ENVIRONMENTAL SCIENCE AND PUBLIC POLICY

ESPP 90f: Global Change and Human Health (undergraduate)

James J. McCarthy (and Paul R. Epstein)

Explores hypothesized linkages between changes in ecosystems, climate, and the epidemiology of certain infectious diseases.

ESPP 91r: Supervised Reading and Research (undergraduate)

James J. McCarthy (and members of the Committee)

Supervised reading and research on topics not covered by regular courses of instruction.

HARVARD EXTENSION SCHOOL AND HARVARD SUMMER SCHOOL

BIOS E-225: Human Impacts on Marine Communities

Robert M. Woollacott

How anthropogenic-driven events are impacting the structure and function of marine communities.

BIOS E-25: Comparative Functional Anatomy of the Vertebrates

Karel F. Liem

Introduction to vertebrate evolution, development, and function with discussion of the structure, function, and evolutionary patterns of each major organ system.

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

Robert M. Woollacott

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-21: A Comparative Anatomical Perspective of Human Origins and Health

Karel F. Liem

A functional perspective of comparative vertebrate anatomy, with concentration on the important evolutionary transformations of selected organ systems and their functional meaning during the diversification of the major groups of vertebrates.

BIOL S-112: Study Abroad at Oxford: Darwin and the Origins of Evolutionary Biology

Naomi E. Pierce (and Andrew Berry)

The history of thought on evolution from its mythic beginnings in creation stories through the theories of Charles Darwin.

BIOL S-113: Study Abroad at Oxford: Darwin and Contemporary Evolutionary Biology

Naomi E. Pierce (and Andrew Berry)

The history of evolutionary biology in the post-Darwinian world, following strands of thought either introduced or ignored by Darwin in *The Origin of Species* through to the present.

BIOL S-165: Study Abroad in Malaysia: The Biodiversity of Borneo

Naomi E. Pierce (Campbell Webb, Charles Davis, and Paul Moorcroft)

The evolutionary and ecological processes that lead to the amazingly high biodiversity on Borneo, as well as the issues that seriously threaten that diversity today.



OEB 167: Herpetology

Farish A. Jenkins, Jr.



Collections: Critical to the Study of the Earth's Biodiversity

The Museum of Comparative Zoology was founded on the concept that collections are an integral and fundamental component of zoological research and teaching. The MCZ contains more than 21 million specimens in ten research collections that comprise one of the world's richest and most varied resources for studying the diversity of life. As a premier university museum and research institution, the MCZ's specimens and their related data are available to researchers and educators worldwide, and use of the collections in student research and teaching is also encouraged.

DIGITAL SPECIMEN RECORDS MIGRATE TO MCZBASE

In order to make the MCZ's historically and scientifically significant holdings increasingly accessible to researchers and the public, the MCZ is migrating all digital specimen records to MCZbase, a new centralized database. MCZbase has been populated with more than one million specimen records, and this data capture effort is a museum-wide priority. In addition, existing specimen images are being linked to the relevant data record. MCZbase conforms to emerging standards for natural history collections and will facilitate data sharing with organizations like the Global Biodiversity Information Facility (GBIF), Encyclopedia of Life (EOL), MaNIS, HerpNET, ORNIS, FishNet 2, and VertNet.

COLLECTIONS HIGHLIGHTS

Entomology

The insect collection is among the richest and most historically significant in North America, second only to the Smithsonian Institution for primary type holdings. Records for all of the 28,000 primary types are online and 17,000 type specimens and labels have also been imaged. Ongoing digitization and imaging projects include the Caribbean Islands Biodiversity Project, the Boston Harbor Islands Biodiversity Project, and the Butterfly Collection Database/Imaging Project.

Herpetology

The herpetology collection is nearly unparalleled in research opportunities, containing more than 325,000 specimens of great historical value. Specimen data is available for search online and through HerpNET and GBIF. All of the standard catalog data has been migrated to MCZbase. Digital imaging of type material is ongoing; all amphibian types, turtles, crocodilians, and about two thirds of the lizards are completed, and digital X-ray images are being uploaded as they are obtained. The original catalog ledgers have all been digitized and will be linked to MCZbase, decreasing physical use to aid in their preservation.

Ichthyology

The ichthyological collection is among the best in the world, with specimens dating back to the late 1700s. The fish collection has been fully renovated and collection data are available online. Traditional preparations have been databased and almost 8,000 digital images—with emphasis on primary types—are available along with more than a thousand digital X-rays of specimens. These X-rays are a great asset; in many cases, providing an X-ray and photograph to a researcher has been as effective as sending a specimen on loan.

Invertebrate Paleontology

The Department of Invertebrate Paleontology represents one of the oldest

systematic invertebrate paleontological collections in North America with more than 1 million specimens, including 10,000 type specimens. The majority of specimens are loose fossils or fossils on slabs. Approximately 100,000 specimens, including all type specimens, are searchable online. The department also completed data capture of the historic catalog ledgers—around 98,000 specimen records—and they are being prepared for migration to MCZbase.

Invertebrate Zoology

The collection is comprised of more than 1 million specimens of which 7,663 are primary types, and includes extensive and historically important metazoan (and protozoan) collections. The Araneae collection is one of the largest in the world, with all major families represented, and the crustacean collection is among the most important in the world. Over 90,000 lots have been databased and are being prepared for migration to MCZbase.

Malacology

The collection is one of the largest and most diverse collections in the world, with 360,000 cataloged lots, 140,000 uncataloged lots, and at least 5,000 primary type specimens. More than 286,000 lots have been entered into an electronic database from historic ledgers and specimen labels. The migration to MCZbase is in progress.

Mammalogy

The mammal collection is one of the largest historic, geographic, and taxonomically diverse university systematic mammal collections in the world and is an important resource for research in organismic and evolutionary biology. It comprises over 80,000 voucher specimens, and includes more than 350 holotypes. All specimen data has been migrated to MCZbase since July of 2009.

Marine Invertebrates

The department houses the extant Echinodermata, Bryozoa, Urochordata, and some of the Brachiopoda. The echinoderm collection is one of the largest in the world,

containing more than 200,000 specimen lots. The collection is type-rich, and contains historical specimens from the late 19th and early 20th centuries. Recent and ongoing projects include databasing the collection, rehousing all fluid-preserved specimens, and assessing the collections' storage needs for current and future curation.

Ornithology

The ornithology collection is one of the most diverse collections of its kind containing every genus of birds and approximately 85% of the known species of birds, including 2,300 primary type specimens. The collection is rich in historical specimens, with an extensive archive of extinct birds. More than 90% of the collection has been databased. Additionally, the Aves 3D project—made possible by a National Science Foundation grant—will construct an open access online database containing three-dimensional digital skeletal scans.

Vertebrate Paleontology

The vertebrate paleontology collection has approximately 90,000 specimens of fossil fish, amphibians, reptiles, birds, and mammals. Specimen data capture has been completed from the historic catalog ledgers and totals more than 42,000 specimen records. These records will be searchable online after their migration to MCZbase in FY 2010.



Father and son artists Leopold and Rudolph Blaschka meticulously shaped glass and wire into lifelike models of invertebrate animals. The Blaschka Glass Invertebrate collection at the Museum of Comparative Zoology consists of over 400 models including sea anemones, jelly fish, octopus, sea cucumbers, marine worms, and land snails purchased by the MCZ throughout the 1870s and 1880s.

Ernst Mayr Library

The Library maintains approximately 320,000 books and journals, as well as a collection of archival materials and natural history art. Over the previous academic year, 901 books were added to the collection, circulation increased to 13,000 transactions, and interlibrary borrowing and lending activity increased to 3,000 transactions. The Ernst Mayr Library averages about 100 visits per day and undergraduate use of the Library is up to 16% of the total from 10%. Lending has more than doubled in the last year, as have borrowing requests from Ernst Mayr Library users. The Library continues its efforts to enhance the presentation of library resources on course websites. Staff members are active in local projects such as building general and specific intranet portals (iSites) for the sciences, international projects such as the Biodiversity Heritage Library, Harvard library committees, professional associations, and publishing.



COLLECTIONS AT A GLANCE		
	Collection Size	Growth in 2008–2009
Entomology	7.5 million pinned specimens; 30,000 fossils	155,000 specimens
Herpetology	325,686 total (139,484 amphibians & 186,202 reptiles)	1,724 amphibians & reptiles
Ichthyology	1.3 million specimens	670 lots of 23,978 specimens
Invertebrate Paleontology	Over 1 million specimens; 10,000 type specimens	35 large slabs & 25 small slabs; 6 specimens
Invertebrate Zoology	More than 1 million specimens in 307,000 lots; 7,663 primary type specimens	1,379 lots
Malacology	360,000 cataloged lots & 140,000 uncataloged lots; 5,000 type specimens	332 lots
Mammalogy	80,000 specimens	1,835 specimens
Marine Invertebrates	200,000 specimen lots	
Ornithology	363,823 specimens	605 specimens
Vertebrate Paleontology	90,000 specimens	31 specimens of the temnospondyl plagiosaur, <i>Gerrhthorax pulcherrimus</i> , from the Carlsberg Fjord Formation of East Greenland

FACILITIES UPGRADES

Herpetology Library and Collection Rooms

During the year the herpetology library (B06) was renovated to function as a multi-purpose room, with a digital projector, audiovisual equipment, laboratory tables, and desks installed for classroom use. Additionally, high-density compactor units were installed in the area previously occupied by the *Anolis* lizard collection, and reprints and books were

moved onto the shelves. In the lizard (B08) and snake (B14) rooms, 8 new tank racks and 32 new stainless steel tanks were installed to house large and oversized reptiles.

Ichthyology Collection Rooms

The final phase of renovating four major ichthyological collection rooms (B13, B15, B17, and B18X) was completed. Floors were lowered, rooms were refitted to maximize space, and compacting shelving was installed, allowing almost all of the collection to fit into the four rooms. A part of this phase was the installation of 9 new tank racks and 31 new stainless steel tanks in three rooms. The placement of the largest tanks now stored in a temporary location will be completed in FY 2010.

Malacology Collection Rooms

Two dry collection rooms (454, 455) were renovated this year, and newly installed metal cabinets replaced wooden cabinets. Specimen lots of more than 18,600 species were arranged alphabetical by family, genus, and species within 3,200 new metal drawers. Books and serials within the departmental library have been cataloged into the HOLLIS system and journals were inventoried, assigned, and arranged by call numbers.



James Hanken

MCZ Research Making Headlines

USING DNA TO REORGANIZE THE TREE OF LIFE

A groundbreaking study published in *Nature* by **Gonzalo Giribet** and colleagues has introduced a potent methodology for mapping the animal tree of life. The study presented a wide-ranging DNA-based survey of 77 species of animals, where new data from 29 species representing 21 important phyla in the animal kingdom—more than half of which had never been examined using the researchers’ method of genomic analysis—were studied alongside better-characterized specimens.

After incorporating new data from protostomes—including worms, sea spiders, squids, snails, and comb jellies—the researchers found that the resulting phylogenetic trees were unexpectedly reorganized. Most surprising was evidence contradicting a long-held hypothesis that placed sponges on the most primitive branch of the taxonomic tree. Instead, the data strongly indicated that comb jellies—gelatinous zooplankton—deserved that position.

THE GENETICS OF EVOLUTION

In a commentary in *Evolution*, evolutionary geneticist **Hopi E. Hoekstra** and evolutionary biologist Jerry Coyne challenged a popular idea about the molecular mechanisms that underlie evolutionary change, generating considerable discussion and controversy in the scientific community. The idea they challenged is that shifts in how genes are regulated, rather than alterations in the genes themselves, are the key to evolution. Dubbed “evo-devo,” the field emerged when developmental biologists proposed that mutations in regulatory DNA called cis elements underlie many changes in body plans that allow evolution to proceed, known as the “cis-regulatory hypothesis.” In the *Evolution* article, Professors Hoekstra and Coyne argued that the idea was far from proven, deconstructing evidence submitted as proof and its supporting rationale. The ensuing debate was covered in the August 8, 2008, issue of *Science*.

Other findings included the disappearance of the entire taxonomic group of Coelomata—animals with fluid-filled body cavities—due to earlier deficient taxon sampling, and resolution of a long-standing debate about the relationships among centipedes and millipedes, arachnids, and jawed insects such as ants and beetles. The spiders, rather than the insects, clustered more closely with the centipedes and millipedes.

The study, funded by three collaborative grants from the National Science Foundation’s Protostome Assembling the Tree of Life Project, was recognized by *Discover* magazine as one of the Top 100 Stories of 2008.

Dunn CW, Hejnlol A, Matus DQ, Pang K, Browne WE, Smith SA, Seaver EC, Rouse GW, Obst M, Edgecombe GD, Sørensen MV, Haddock SHD, Schmidt-Rhaesa A, Okusu A, Kristensen RM, Wheeler WC, Martindale MQ, Giribet G (2008) Broad taxon sampling improves resolution of the Animal Tree of Life. *Nature* 452: 745-749



Hopi E. Hoekstra

Justin Ide/Harvard News Office

Professor Hoekstra was also featured in the 2009 *National Geographic* article “Modern Darwins.” Florida’s oldfield mice have lighter coats when living on the beaches than when dwelling inland, making them less visible to predators. Prof. Hoekstra and colleagues have traced the color difference to the change of a single nucleotide in a single gene, which cuts down the production of pigment in the fur. Prof. Hoesktra’s research helps explain Darwin’s process of natural selection on a molecular level by showing how natural selection molds and modifies the DNA of genes and their expression to adapt members of a species to their particular circumstances.

Hoekstra HE, Coyne JA (2007) The locus of evolution: evo devo and the genetics of adaptation. *Evolution*. 61(5):995-1016.



Farish A. Jenkins, Jr.



Jonathan Losos

NATURE’S 15 EVOLUTIONARY GEMS

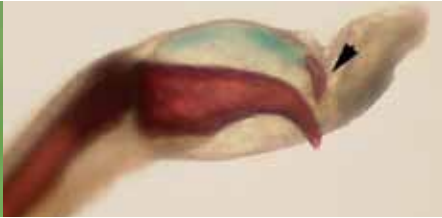
Given that many concepts of Darwinian evolution are still being defined, or even challenged, *Nature* prepared the resource “15 Evolutionary Gems” to illustrate the empirical existence of evolution and the mechanisms that drive it.

Number 2 in “Gems from the Fossil Record,” “From Water to Land” recognizes the significance of the discovery of *Tiktaalik* by **Farish A. Jenkins, Jr.**, and colleagues.^{1,2} More than 360 million years ago, land-dwelling tetrapods emerged from an aquatic ancestry. The animals that made this landmark evolutionary transition were long suspected to be shallow-water, fleshy finned fishes (Sarcopterygii), but direct fossil evidence remained elusive. In 2006, Professor Jenkins and colleagues described well-preserved fossils of *Tiktaalik* from Arctic Canada that document the existence of an amphibious fish with distinct similarities to tetrapods—from flexible neck to limb-like fin structure—thus filling an important evolutionary gap in the fossil record.

SURPRISING CONCEALED WEAPONS: CLAWS IN FROGS



David C. Blackburn



Vertebrate claws are typically a keratinous sheath overlying the end of a digit, but this type of claw is rare in amphibians. In an article in *Biology Letters*, authors **David C. Blackburn, James Hanken**, and **Farish A. Jenkins, Jr.**, show that certain African frogs have a different type of claw that is unique in design among living vertebrates.

Certain African frogs struggle and kick violently when picked up, raking their erectile, bony claws to cut their antagonist’s skin. The researchers completed the first detailed anatomical study and interpretation

Number 7 in “Gems from Habitats,” “Natural Selection in Lizards” highlights the research of **Jonathan Losos** and colleagues.³ The researchers introduced a large ground-dwelling predatory lizard to six small islands in the Bahamas, with six other islands as controls. They found that the lizard’s prey—the smaller *Anolis sagrei*—spent more time higher up in vegetation on the islands with the predator; natural selection favored larger size in females and longer legs in males. Their research showed that the introduction of a predator could cause individuals of a prey species to change their behavior—and also cause an evolutionary response—to improve survival.

1 Daeschler EB, Shubin NH, Jenkins FA (2006) A Devonian tetrapod-like fish and the evolution of the tetrapod body plan. *Nature* 440: 757-763.
2 Shubin NH, Daeschler EB, Jenkins FA (2006) The pectoral fin of *Tiktaalik roseae* and the origin of the tetrapod limb. *Nature* 440: 764-771.
3 Losos JB, Schoener TW, Spiller DA (2004) Predator-induced behavior shifts and natural selection in field-experimental lizard populations. *Nature* 432: 505-508.

of these specialized structures since their discovery more than 100 years ago. The authors examined museum specimens of 63 species in seven arthroleptid frog genera and found that in two genera, *Astylosternus* and *Trichobatrachus*, certain toe bones are distinctly claw shaped with pointed tips. Flexing the claw causes it to break free of the bone and pierce the skin, exposing the barb-like tip. Due to the remarkable regenerative capacity documented in many amphibians, subsequent healing of the skin and connective tissue would be unsurprising, but this healing—and a return of the claw to functionality—is still to be determined. The research was covered by *AAAS ScienceNow Daily News* and was named as one of its top 10 stories of 2008.

Blackburn DC, Hanken J, Jenkins FA (2008) Concealed weapons: erectile claws in African frogs. *Biology Letters* 4: 355-357.

MCZ Projects and Initiatives

ENCYCLOPEDIA OF LIFE



The Encyclopedia of Life is making authenticated information for the world’s biodiversity accessible through a single free website—**www.eol.org**—offering people everywhere a better understanding of the planet’s 1.8 million named, living species. Harvard University is one of six cornerstone institutions leading this unprecedented effort.

EOL’s species pages will include scientifically verified information and access to a wealth of other materials, including peer-reviewed articles, photos, videos, and DNA sequences. Launched in 2007, EOL currently has 160,000 detailed species pages and 1.4 million base pages. It is being assembled by a growing consortium of scientists, international organizations, technology leaders, and prestigious research institutions, and tools are being developed to allow all interested individuals to contribute.

As a cornerstone institution, Harvard University is extensively involved in the Encyclopedia of Life project. **E.O. Wilson**, Professor Emeritus, initially articulated the concept of EOL at the 2007 Technology, Entertainment, Design (TED) Conference. MCZ Director **James Hanken** chairs the EOL Steering Committee, and EOL’s Learning and Education component, headed by **Marie Studer**, is housed at the MCZ. Two of Harvard’s libraries—the MCZ’s Ernst Mayr Library and Harvard University Botany Libraries—are members of the Biodiversity Heritage Library, another EOL cornerstone institution. In addition, Harvard scientists have written several EOL species pages, with more contributions expected in the future.

Engaging Students and the Public

EOL’s Learning and Education Group at the MCZ works to generate global awareness of EOL as a collaborative learning tool, exploring and promoting new and exciting uses that foster understanding and appreciation of biological diversity.

Through the Undergraduate Initiative, the Learning and Education Group is making it possible for students to contribute to species pages through EOL content partners Mushroom Observer, AmphibiaWeb, and Animal Diversity Web, who then serve the student submissions through EOL. Via Mushroom Observer (**www.mushroomobserver.org**), students at Harvard and three other universities assembled fungal species accounts that were added to EOL in early 2009. Harvard herpetology students prepared species accounts for AmphibiaWeb (**www.amphibiaweb.org**) as their course project, and the educational resource Animal Diversity Web (**animaldiversity.org**)—with species accounts written by nearly 3,000 students from 35 universities—is now being served through EOL.

EOL is also partnering with the National Geographic Society and the National Park Service to organize and participate in the BioBlitz system, where scientists, naturalists, educators, and students document all living things in a geographically defined ecosystem in a 24-hour blitz and upload their findings to EOL. The collaborators are also creating web-based educational materials and resources that utilize EOL. **www.nationalgeographic.com/field/projects/bioblitz.html**

Another Learning and Education Group effort is INVOLV—a visualization of life on earth for educational purposes—being developed in collaboration with computer scientists at Harvard. The visualization—displayed on an interactive, multi-touch tabletop computer screen and a high-resolution data wall—debuted at HMNH in the arthropod exhibit in summer 2009. **www.involvweb.org**



Encyclopedia of Life



Encyclopedia of Life



Chia Shen and Michael Horn, Scientists’ Discovery Room Lab, Harvard University



Evolution



Language of Color

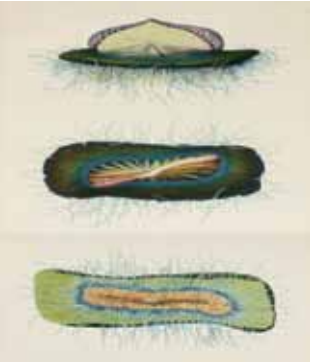
HARVARD MUSEUM OF NATURAL HISTORY

The research of MCZ faculty-curators and the MCZ’s rich natural history collections were featured in two new exhibitions at the HMNH—*Evolution* and *The Language of Color*—overseen by HMNH Executive Director Elisabeth Werby.

Opening in April 2009, the permanent exhibition *Evolution* fulfills the museum’s mission to be the public face of the important work occurring beyond its galleries. **Farish A. Jenkins’** discovery of the missing link between fishes and terrestrial vertebrates—*Tiktaalik roseae*—greet visitors in both fossil and model form. Other MCZ research topics include a display on the evolution of *Anolis* lizards on Caribbean islands—research conducted by **Jonathan Losos**—and the investigation into the evolution of mammalian ear bones from reptilian jawbones by **Alfred “Fuzz” Crompton**. The exhibit also includes a “trophic pyramid” of beetles, conceived by **Brian D. Farrell**, with each specimen representing approximately 1,000 species.

The Language of Color was originally a temporary exhibit, but due to an overwhelming public response, it will remain a permanent exhibit at HMNH. The exhibit explores how animal colors are produced, the varied ways in which color is perceived, and the diverse messages that animal colors convey. The exhibition employs specimens from the MCZ’s vast collections and highlights the cutting edge evolutionary research being conducted by its faculty-curators. The opening lecture, “Nature’s Palette: The Biological Significance of Color,” was given by **Hopi E. Hoekstra**. Professor Hoekstra’s research into the genetic mechanism that allows the adaptation of camouflage coloration in two subspecies of mice is illustrated in a display on the oldfield mice of central Florida, which are brown inland and white when living on coastal beaches. Featuring the research of **Jonathan Losos**, a display of *Anolis* lizards shows their extraordinary species variation and demonstrates how diversity in animal color, size, and behavior is shaped by variations in habitat and lifestyle.

IMLS & THE BIODIVERSITY HERITAGE LIBRARY



In September 2008, the Institute of Museum and Library Services (IMLS) awarded MCZ’s Ernst Mayr Library a planning grant of \$40,000 to plan an efficient, cost-effective, large-scale digitization workflow with enhanced metadata for biodiversity library materials designated as “special collections.” Under the direction of Librarian **Connie Rinaldo** and Judy Warnement, Librarian of the Harvard University Botany Libraries, the Ernst Mayr Library and its partners propose to identify solutions for the challenges of digitizing these rare and valuable book and other materials by developing and comparing various technological, economic, and process models.

The IMLS grant will benefit the Biodiversity Heritage Library (BHL), a project initiated in 2005 to digitize the published literature of biodiversity held in major natural history museum libraries, botanical libraries, and research institutions into one comprehensive web-based collection. The Ernst Mayr Library is one of ten institutions participating in the BHL project, playing a leading role in digitization of rare collections and artwork. To date, BHL has more than 14,000 titles and 37,000 volumes available online. The BHL is also a key component of the Encyclopedia of Life, with links to almost 15 million pages of BHL digitized biodiversity literature from the EOL species pages.

Awards & Recognition

On March 20, the Harvard Foundation presented the 2009 Scientist of the Year award to **James J. McCarthy** at the annual Albert Einstein Science Conference, “Advancing Minorities and Women in Science, Engineering, and Mathematics.” Prof. McCarthy was honored for his outstanding work in climate science and marine biology, as well as his studies of climate change across the Arctic region. Prof. McCarthy is the Alexander Agassiz Professor of Biological Oceanography and was Director of the MCZ from 1982 to 2002.

In June, **Jonathan Losos** received the 2009 E.O. Wilson Naturalist Award from the American Society of Naturalists. The award, established in recognition of Professor Wilson’s lifetime contributions to ecology and evolutionary biology, is given each year to a scholar who has made significant contributions to the knowledge of a particular ecosystem or group of organisms. Prof. Losos’ work with anole lizards in the West Indies has contributed fundamentally to understanding of the roles of natural selection, competition, and niche evolution in shaping assemblages of *Anolis* species. Four current and former members of the Losos lab from MCZ and Washington University won the American Society of Naturalists’ 2009 Young Investigators’ Prizes: **Renee Duckworth**, **Luke Harmon**, **Jason Kolbe**, and **Brian Langerhans**. The Young Investigators’ Prizes recognize outstanding and promising work by investigators who received their doctorates in the three years preceding the award or who are in their final year of graduate school.

Scott V. Edwards was elected to the 2009 class of Fellows of the American Academy of Arts and Sciences, joining one of the nation’s most prestigious honor societies and center for independent policy research. Founded in 1780, the American Academy of Arts and Sciences studies complex and emerging problems and conducts a wide range of interdisciplinary, long-term policy research endeavors.



James J. McCarthy



HRH The Princess Royal, Princess Anne, and Dino Martins

The 2009 Whitley Award was presented to graduate student **Dino Martins** by HRH The Princess Royal, Princess Anne, during a ceremony at the Royal Geographical Society, London, on May 13, 2009. The award recognizes his work with the East Africa Natural History Society to inform small-scale farmers of the vital role insects play in pollinating crops and encourage them to adopt conservation-friendly methods of agriculture.

Jesse Weber, a graduate student in Hopi E. Hoekstra’s lab, was awarded the W.D. Hamilton Award for Outstanding Student Presentation at Evolution 2009, the joint annual meeting of the Society for the Study of Evolution, the Society of Systematic Biologists, and the American Society of Naturalists.



• Abzhanov A, Extavour C, Groover A, Hodges S, **Hoekstra HE**, Kramer EM, Monteiro A (2008) Are we there yet? Tracking the development of new model systems. *Trends in Genetics* 24:353-360

• **Aktipis SH, Giribet G**, Lindberg DR, Ponder WF (2008) Gastropoda: An overview and analysis. In *Phylogeny and Evolution of the Mollusca* (Ponder WF, Lindberg DR, eds) pp 201-237. University of California Press, Berkeley

• Alberti G, Lipke E, **Giribet G** (2008) On the ultrastructure and identity of the eyes of Cyphophthalmi based on a study of *Stylocellus* sp. (Opiliones, Stylocellidae). *Journal of Arachnology* 36:379-387

• Alroy J, Aberhan M, Bottjer DJ, Foote M, Fürsich FT, Harries PJ, Hendy AJW, Holland SM, Ivany LC, Kiessling W, Kosnik MA, **Marshall CR**, McGowan AJ, Miller AI, Olszewski TD, Patzkowsky ME, Peters SE, Villier L, Wagner PJ, Bonuso N, Borkow PS, Brenneis B, Clapham ME, Fall LM, Ferguson CA, Hanson VL, Krug AZ, Layou KM, Leckey EH, Nürnberg S, Powers CM, Sessa JA, Simpson C, Tomasovych A, Visaggi CC (2008) Phanerozoic trends in the global diversity of marine invertebrates. *Science* 321:97-100

• **Barr D, Rinaldo C** (2008) It's a zoo out there: zoology resources. *College & Research Library News* 69:221-225

• **Berg AM, Biewener AA** (2008) Kinematics and power requirements of ascending and descending flight in the pigeon (*Columbia livia*). *The Journal of Experimental Biology* 211:1120-1130

• **Blackburn DC, Hanken J, Jenkins FA, Jr** (2008) Concealed weapons: erectile claws in African frogs. *Biology Letters* 4:355-357

• **Bonneaud C**, Burnside J, **Edwards SV** (2008) High-speed developments in avian genomics. *Bioscience* 58:587-595

• Bozhurttas M, Tangorra J, **Lauder G**, Mittal R (2008) Understanding the hydrodynamics of swimming: from fish fins to flexible propulsors for autonomous underwater vehicles. *Advances in Science and Technology* 58:193-202

• Calderón I, **Giribet G**, Turon X (2008) Two markers and one history: phylogeography of the edible common sea urchin *Paracentrotus lividus* in the Lusitanian region. *Marine Biology* 154:137-151

• **Canfield MR**, Greene E, **Moreau CS**, Chen N, **Pierce NE** (2008) Exploring phenotypic plasticity in Emerald Moths: A phylogeny of the genus

Nemoria (Lepidoptera: Geometridae) inferred from COI, COII, and EF1-alpha. *Molecular Phylogenetics and Evolution* 49:477-487

• **Danos N**, Fisch N, Gemballa S (2008) The musculotendinous system of an anguilliform swimmer: muscles, myosepta, dermis, and their interconnections in *Anguilla rostrata*. *Journal of Morphology* 269:29-44

• Downs JP, Daeschler EB, **Jenkins FA, Jr**, Shubin NH (2008) The cranial endoskeleton of *Tiktaalik roseae*. *Nature* 456:925-929

• Dunn CW, Hejnol A, Matus DQ, Pang K, Browne WE, Smith SA, Seaver EC, Rouse GW, Obst M, Edgecombe GD, Sørensen MV, Haddock SHD, Schmidt-Rhaesa A, Okusu A, Kristensen RM, Wheeler WC, Martindale MQ, **Giribet G** (2008) Broad taxon sampling improves resolution of the animal tree of life. *Nature* 452:745-749

• Edgecombe GD, **Giribet G** (2008) A New Zealand species of the trans-Tasman centipede order Craterostigmomorpha (Arthropoda: Chilopoda) corroborated by molecular evidence. *Invertebrate Systematics* 22:1-15

• **Edwards SV** (2008) A smorgasbord of markers for avian ecology and evolution. *Molecular Ecology* 17:945-946

• **Flammang BE, Lauder GV** (2008) Speed-dependent intrinsic caudal fin muscle recruitment during steady swimming in bluegill sunfish, *Lepomis macrochirus*. *The Journal of Experimental Biology* 221:587-598

• **Giribet G** (2008) On the identity of *Pettalus cimiciformis* and *P. brevicauda* (Opiliones, Pettalidae) from Sri Lanka. *Journal of Arachnology* 36:199-201

• **Giribet, G** (2008) Assembling the lophotrochozoan (= spiralian) tree of life. *Philosophical Transactions of the Royal Society B: Biological Sciences* 363:1513-1522

• **Giribet G** (2008) Bivalvia. In *Phylogeny and Evolution of the Mollusca* (Ponder WF, Lindberg DR, eds) pp 105-141. University of California Press, Berkeley

• Gross JB, **Hanken J** (2008) Segmentation of the vertebrate skull: neural-crest derivation of adult cartilages in the clawed frog, *Xenopus laevis*. *Integrative and Comparative Biology* 48:681-696

• Gross JB, **Hanken J** (2008) Review of fate-mapping studies of osteogenic cranial neural crest in vertebrates. *Developmental Biology* 317:389-400

• **Hartel KE**, Kenaley CP, Glabraith JK,

Sutton TT (2008) Additional records of deep-sea fishes from off Greater New England. *Northeastern Naturalist* 15:317-334

• **Herrel A**, Vanhooydonck B, Porck J, Irschick DJ (2008) Anatomical basis of differences in locomotor behavior in *Anolis* lizards: a comparison between two ecomorphs. *Bulletin of the Museum of Comparative Zoology* 159:213-238

• **Hughes DP, Pierce NE**, Boomsma JJ (2008) Friends and foes within the factory: the evolutionary biology of symbionts in social insect societies. *Trends in Ecology and Evolution* 23:672-677

• **Janes DE**, Ezaz T, Graves JAM, **Edwards SV** (2008) Characterization, chromosomal location and genomic neighborhood of a ratite ortholog of a gene with gonadal expression in mammals. *Integrative and Comparative Biology* 48:505-511

• **Janes DE, Organ CL**, Valenzuela N (2008) New resources inform study of genome size, content, and organization in nonavian reptiles. *Integrative and Comparative Biology* 48:447-453

• **Jenkins FA, Jr**, Shubin NH, Gates SM, Warren A (2008) *Gerrothorax pulcherrimus* from the Upper Triassic Fleming Fjord Formation of East Greenland and a reassessment of head lifting in temnospondyl feeding. *Journal of Vertebrate Paleontology* 28:935-950

• Johnson MA, Leal M, Rodríguez Schettino L, Chamizo Lara A, **Revell LJ, Losos JB** (2008) A phylogenetic perspective on foraging mode evolution and habitat use in West Indian *Anolis* lizards. *Animal Behaviour* 75:555-563

• **Kay EH, Hoekstra HE** (2008) Rodents. *Current Biology* 18:R406-410

• **Kerney R, Hanken J** (2008) Gene expression reveals unique skeletal patterning in the limb of the direct-developing frog, *Eleutherodactylus coqui* (Anura: Leptodactylidae). *Evolution & Development* 10:439-448

• Kolbe JJ, Larson A, **Losos JB**, de Queiroz K (2008) Admixture determines genetic diversity and population differentiation in the biological invasion of a lizard. *Biology Letters* 4:434-437

• **Lauder GV**, Madden PGA (2008) Advances in comparative physiology from high-speed imaging of animal and fluid motion. *Annual Review of Physiology* 70:143-163

• **Lee JY, Edwards SV** (2008) Divergence across the Carpentarian barrier: statistical phylogeography of the Red-backed Fairy

Wren (*Malurus melanocephalus*). *Evolution* 62:3117-3134

• Limaye N, Belobrajdic KA, Wandstrat AE, Bonhomme F, **Edwards SV**, Wakeland EK (2008) Prevalence and evolutionary origins of autoimmune susceptibility alleles in natural mouse populations. *Genes and Immunity* 9:61-68

• **Linnen CR, Farrell BD** (2008) Comparison of methods for species-tree inference in the sawfly genus *Neodiprion* (Hymenoptera: Diprionidae). *Systematic Biology* 57:876-890

• **Linnen CR, Farrell BD** (2008) Phylogenetic analysis of nuclear and mitochondrial genes reveals evolutionary relationships and mitochondrial introgression in the *sertifer* species group of the genus *Neodiprion* (Hymenoptera: Diprionidae). *Molecular Phylogenetics and Evolution* 48:240-257

• **Liu L**, Pearl DK, Brumfield RT, **Edwards SV** (2008) Estimating species trees using multiple-allele DNA sequence data. *Evolution* 62:2080-2091

• Lohman DJ, Djunijanti P, **Pierce NE**, Meier R (2008) Phylogeography and genetic diversity of a widespread Old World butterfly, *Lampides boeticus* (Lepidoptera: Lycaenidae) *BMC Evolutionary Biology* 8:301-305

• **Losos JB** (2008) Phylogenetic niche conservatism, phylogenetic signal and the relationship between phylogenetic relatedness and ecological similarity among species. *Ecology Letters* 11:995-1007

• **Losos JB** (2008) Rejoinder to Wiens (2008): Phylogenetic niche conservatism, its occurrence and importance. *Ecology Letters* 11:1005-1007

• **Marshall CR** (2008) A simple method for bracketing absolute divergence time on molecular phylogenies using multiple fossil calibration points. *American Naturalist* 171:726-742

• Mateos E, **Giribet G** (2008) Exploring the molecular diversity of terrestrial nemerteans (Hoploneurtea, Monostilifera, Acteonemertidae) in a continental landmass. *Zoologica Scripta* 37:235-243

• Mathew J, Travassos MA, **Canfield M**, Murawski D, Kitching RL, **Pierce NE** (2008) The singing reaper: diet, morphology and vibrational signaling in the Nearctic species *Feniseca tarquinius*. *Tropical Lepidoptera Research* 18:24-29

• **Meegaskumbara M**, Pethiyagoda R, Chanson J, Wake D, **Hanken J** (2008) Pickled frogs help biodiversity assessment. In *Threatened Amphibians*

of the World (Stuart S, Hoffmann M, Chanson J, Cox N, Berridge R, Ramani P, Young B, eds) p 45. Lynx Edicions, Barcelona, Spain; IUCN, Gland, Switzerland; and Conservation International, Arlington, Virginia, USA

• **Moreno CA**, Main RP, **Biewener AA** (2008) Variability in forelimb bone strains during non-steady locomotor activities in goats. *The Journal of Experimental Biology* 211:1148-1162

• **Mullen LM, Hoekstra HE** (2008) Natural selection along an environmental gradient: a classic cline in mouse pigmentation. *Evolution* 62:1555-1570

• **Murienne J**, Harvey MS, **Giribet G** (2008) First molecular phylogeny of the major clades of Pseudoscorpiones (Arthropoda: Chelicerata). *Molecular Phylogenetics and Evolution* 49:170-184

• Nauwelaerts S, Wilga CD, **Lauder GV**, Sanford CP (2008) Fluid dynamics of feeding behaviors in white-spotted bamboo sharks. *The Journal of Experimental Biology* 211: 3095-3102

• **Organ CL, Moreno RG, Edwards SV** (2008) Three tiers of genome evolution in reptiles. *Integrative and Comparative Biology* 48:494-504

• **Organ CL, Janes DE** (2008) Evolution of sex chromosomes in Saurapsida. *Integrative and Comparative Biology* 48:512-519

• Pakes MJ, **Woollacott RM** (2008) Reproduction of the gorgonian *Plexaura flexuosa* in Bermuda. *Journal of Experimental Marine Biology and Ecology* 357:121-127

• **Sanger TJ**, Hime PM, Johnson MA, Diani J, **Losos JB** (2008) Laboratory protocols for husbandry and embryo collection of *Anolis* lizards. *Herpetological Review* 39:58-63

• **Sanger TJ, Losos JB**, Gibson-Brown JJ (2008) A developmental staging series for the lizard genus *Anolis*: a new system for the integration of evolution, development, and ecology. *Journal of Morphology* 269:129-137

• **Sears MAB, Woollacott RM** (2008) Alice Robertson: educator and marine zoologist. In *Annals of Bryozoology 2: Aspects of the History of Research on Bryozoans* (Wyse Jackson P, Spencer Jones M, eds) pp 305-345. International Bryozoology Association, Dublin

• **Shedlock AM, Janes D, Edwards SV** (2008) Amniote phylogenomics: Testing hypotheses with large-scale sequence data from reptiles. In *Phylogenomics* (Murphy W, ed) pp 91-117. Humana Press, Inc., Totowa, NJ

• Taft NK, **Lauder GV**, Madden PGA (2008) Functional regionalization of the pectoral fin of the benthic longhorn sculpin during

station holding and swimming. *Journal of Zoology* 276:1-9

• Travassos MA, Devries PJ, **Pierce NE** (2008) A novel organ and mechanism for larval sound production in butterfly caterpillars: *Eurybia elvina* (Lepidoptera: Riodinidae). *Tropical Lepidoptera Research* 18:20-23

• Turner LM, Chuong EB, **Hoekstra HE** (2008) Comparative analysis of testis protein evolution in rodents. *Genetics* 179:2075-2089

• Turner LM, **Hoekstra HE** (2008) The evolution of reproductive proteins: causes and consequences. *International Journal of Developmental Biology* 52:769-780

• Turner LM, **Hoekstra HE** (2008) Reproductive protein evolution within and between species: maintenance of divergent ZP3 alleles in *Peromyscus*. *Molecular Ecology* 17:2616-2628

• **Tytell ED, Lauder GV** (2008) Hydrodynamics of the escape responses in bluegill sunfish, *Lepomis macrochirus*. *The Journal of Experimental Biology* 211:3359-3369

• **Tytell ED, Standen EM, Lauder GV** (2008) Escaping Flatland: three dimensional kinematics and hydrodynamics of median fins in fishes. *The Journal of Experimental Biology* 211:187-195

• Van Wassenbergh S, Strother JA, **Flammang BE**, Ferry-Graham LA, Aerts P (2008) Extremely fast prey capture in pipefish is powered by elastic recoil. *Journal of The Royal Society Interface* 5:285-296

• **Whiteman NK, Pierce NE** (2008) Delicious poison: genetics of *Drosophila* host plant specialization. *Trends in Ecology and Evolution* 23:473-478

• Wilson JP, Knoll AH, Holbrook NM, **Marshall CR** (2008) Modeling fluid flow in *Medullosa*, an anatomically unusual Carboniferous seed plant. *Paleobiology* 34:472-493

• Winston JE, **Woollacott RM** (2008) Redescription and revision of some red pigmented species of *Bugula*. *Bulletin of the Museum of Comparative Zoology* 159:179-212

• **Zimkus BM, Blackburn DC** (2008) Distinguishing features of the sub-Saharan frog genera *Arthroleptis* and *Phrynobatrachus*: a short guide for field and museum researchers. *Breviora* 513:1-12

• Zimmermann JM, Hajibabaei M, **Blackburn D, Hanken J**, Cantin E, Posfai J, Evans T, Jr (2008) DNA damage in preserved specimens and tissue samples: A molecular assessment. *Frontiers in Zoology* 5:5-18

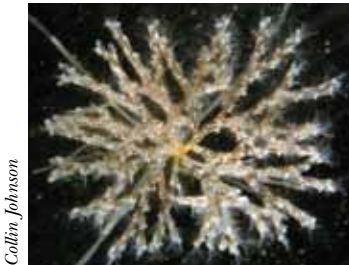
MCZ Grant Recipients

Academic Year 2008–2009

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 research collections, laboratories, and facilities.

Recipient	Faculty Sponsor	Project Title	Amount
Noor M. R. Beckwith	Naomi E. Pierce	Isolating the stimulus for chemotaxis behavior in leaf mining <i>Drosophilid</i> fly larvae	\$2,495
Adam T. Clark	Brian D. Farrell	Developing and testing species diversity models on the MCZ's Boston Harbor Islands ATBI site	\$1,390
Laura Horton	Naomi E. Pierce	The effect of ant attendance on the aggregation patterns of <i>Jalmenus evagoras</i> larvae	\$2,500
Kirsten Kester	Colleen M. Cavanaugh	Investigating temporal genetic variation in the deep-sea vent mussel symbionts of <i>Bathymodiolus thermophilus</i>	\$2,500
Robert P. Kirkham	Andrew Berry	Genetic constraints to sexually antagonistic selection in bluebirds	\$2,500
Krzysztof M. Kozak	Hopi E. Hoekstra	Evolution of tail length variation in the deer mouse (<i>Peromyscus maniculatus</i>) [Fall cycle]	\$2,000
Krzysztof M. Kozak	Hopi E. Hoekstra	Evolution of tail length variation in the deer mouse (<i>Peromyscus maniculatus</i>) [Spring cycle]	\$2,500
Mato Lagator	Scott V. Edwards	Large-scale multi-locus analysis of evolutionary history in the house finch, <i>Carpodacus mexicanus</i>	\$2,500
Joanna Larson	Hopi E. Hoekstra	Genetic relatedness and sex-biased dispersal of <i>Mus spicilegus</i>	\$1,657.40
Timothy Truer	Naomi E. Pierce	Impacts of land use on tropical insect biodiversity	\$5,000
Gil S. Weintraub	Richard W. Wrangham	The energetic significance of thermal and non-thermal processing of starch-rich foods: implications for human evolution diet	\$2,480
Jane C. Xie	Hopi E. Hoekstra	The genetic basis of sexual morphology in <i>Peromyscus</i> (deer mice)	\$2,500
		TOTAL AWARDS	\$30,022.40



Collin Johnson



Jerome Murienne



Renee Duckworth

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.

Recipient	MCZ Department	Project Title	Amount
Vera S. Domingues	Mammalogy	Adaptive coloration in beach mice: old or new mutations?	\$5,052
Gonzalo Giribet	Invertebrate Zoology	Into the heart of darkness—in search of the rarest of the rare	\$11,694
Evan Kingsley	Mammalogy	Evolution and development of adaptive tail-length variation in <i>Peromyscus</i>	\$4,145
June Yong Lee	Ornithology	Molecular evolution for reproductive genes in Australian fairy wren (Maluridae)	\$9,950
Hendrik Müller	Herpetology	Life history evolution and the terrestrialization of development in Tanzanian amphibians	\$16,515
Brant K. Peterson	Mammalogy	A natural history of genomes in the wild: measuring contributions of selection, drift, hybridization and migration to the generation and maintenance of diversity	\$7,179
Liam Revell	Herpetology	A comparative analysis of phenotypic and genetic differentiation in two species of Puerto Rican anoles	\$3,000
		TOTAL AWARDS	\$57,535



Gonzalo Giribet



Gonzalo Giribet



Yoel Stuart

MIYATA GRANTS

Miyata Grants are intended to enable herpetological fieldwork by MCZ graduate students. Non-herpetological fieldwork may be eligible when there are no deserving herpetological projects.

Recipient	MCZ Department	Project Title	Amount
Martha Muñoz	Herpetology	Local adaptation and morphological variation in the Guadeloupean <i>Anolis marmoratus</i> species complex	\$5,260
Yoel Stuart	Herpetology	The evolutionary response of <i>Anolis carolinensis</i> to competition with an invasive species, <i>Anolis sagrei</i>	\$5,073
		TOTAL AWARDS	\$10,333

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.

Recipient	MCZ Department	Project Title	Amount
Erin Blevins	Ichthyology	Influence of environment on locomotion by yellow stingray, <i>Urobatis jamaicensis</i>	\$1,610
Alexis Harrison	Herpetology	Evolutionary change in the invasive lizard <i>Anolis sagrei</i>	\$11,290
Collin Johnson	Marine Invertebrates	Effects of self-fertilization in bryozoans	\$2,015
		TOTAL AWARDS	\$14,915

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 using the MCZ’s collections.



Gonzalo Gribet



Gonzalo Gribet



Gonzalo Gribet

Recipient	Institutional Affiliation	Project Title	Amount
Lilia Akhmetova	Zoological Institute, Russian Academy of Sciences	Taxonomic studies of the genus <i>Aphodius</i> (Coleoptera, Scarabaeidae, Aphodiinae) of Russia with emphasis on the species described by V. Balthasar	\$1,040
Lina Maria Almeida-Silva	Universidade de São Paulo, Brazil	Generic revision of the neotropical and nearctic spiders of the Macrobulinae Petrunkevitch (Araneae: Amaurobiidae)	\$1,500
Ceslo Oliveira Azevedo	Universidade Federal do Espírito Santo, Brazil	Type analysis and key to the Afrotropical Bethyidae (Hymenoptera, Chrysidoidea)	\$1,500
Aylin Alegre Barroso	Instituto de Ecología y Sistemática, Cuba	Systematic and compared morphology of Biantidae, Thorell, 1879 in Cuba (Arachnida: Opiliones: Laniatores)	\$1,000
Elizabeth Borda	Scripps Institute of Oceanography, University of California, San Diego	Photo-documentation and databasing of museum types of fireworms (Annelida-Amphinomida)	\$1,001
David J. Clarke	Field Museum of Natural History	Biodiversity and speciation in Australasian soils: revisionary systematics and morphology of the rove beetle subfamily Euaesthetinae (Coleoptera: Staphylinidae)	\$1,500
Estevam L. Cruz da Silva	Pontifícia Universidade Católica do Rio Grande do Sul, Brazil	Revision of the subfamily Rhoicininae (Araneae, Trechaleidae)	\$1,500
Annelise D’Angiolella	Museu Paraense, Emilio Goeldi, Brazil	Taxonomy, molecular phylogentic and biogeography of <i>Anolis chrysolepis</i> Dumeril & Bibron, 1873 (Squamata: Polychrotidae)	\$1,500
Andrey Frolov	Zoological Institute, Russian Academy of Sciences	Revision of the Afrotropical species of the genus <i>Orphnus</i> Macleay	\$850
Fabio Akashi Hernandez	Universidade de São Paulo, Brazil	Taxonomic revision of the type specimens of the family Bdellidae (Acari: Prostigmata) of the MCZ	\$1,480

Recipient	Institutional Affiliation	Project Title	Amount
Eduard Jendek	Ontario Plant Laboratories, Canadian Food Inspection Agency	Monograph of the genus <i>Agrilus</i> (Coleoptera, Buprestidae) of northeastern Asia	\$1,500
Robert A. Johnson	Arizona State University	A revision of South American species of harvester ants in the genus <i>Pogonomyrmex</i>	\$1,000
Andrea D. Marshall	The University of Queensland, Australia	Investigation of <i>Manta</i> genus of devil rays	\$750
Abebe Ameha Mengistu	Universität Basel, Switzerland	Amphibian diversity and conservation in the Ethiopian Highlands	\$1,500
Kathryn E. Mickle	University of Kansas	Unraveling the systematics of palaeoniscoid fishes—lower actinopterygians in need of complete revision	\$1,200
Mónica I. Páez	El Museo de Zoología de la Pontificia Universidad Católica del Ecuador	Systematics of the <i>Hyloxalus bocagei</i> Clade (Anura: Dendrobatidae)	\$1,500
Roberta Paresque	Universidade de São Paulo, Brazil	Patterns of speciation and diversification of rodents of the genus <i>Oligoryzomys</i> (Rodentia: Cricetidae)	\$750
Christian Rabeling	University of Texas, Austin	The evolution of obligate social parasitism in the ant genus <i>Tapinoma</i>	\$1,100
Marcelo Salles Rocha	Instituto Nacional de Pesquisas da Amazônia, Brazil	A systematic revision of “ <i>Pimelodus</i> group” (Siluriformes: Pimelodidae)	\$1,000
Aldaberto José Santos	Universidade Federal de Minas Gerais, Brazil	Taxonomic revision of the neotropical species of the orb-weaving spider genus <i>Eustala</i> (Araneae: Araneidae)	\$1,500
Bernardo Ferreira Santos	Universidade Federal do Espírito Santo, Brazil	Systematics of neotropical Cryptinae (Hymenoptera, Ichneumonidae)	\$1,500
Jae-Cheon Sohn	University of Maryland	A taxonomic study of the North American Yponomeutoidea (Insecta: Lepidoptera)	\$740
Sergey Tarasov	Kaluga State Pedagogical University (Russia) and University of Copenhagen (Denmark)	1) Toward the revision of the oriental <i>Onthophagus</i> (Coleoptera, Scarabaeidae, Scarabaeinae) 2) Revision of the oriental genus <i>Cassolus</i> (Coleoptera, Scarabaeidae, Scarabaeinae)	\$1,400
Ilya Tëmkin	Smithsonian Institution National Museum of Natural History	Towards a global revision of pteriodean bivalves: The importance of MCZ’s historical collections	\$800
Michael C. Thomas	The Museum of Entomology, Florida State Collection of Arthropods	Revision of <i>Laemophloeus</i> and related genera of North and Central America (Coleoptera: Laemophloeidae)	\$1,200
		TOTAL AWARDS	\$30,311



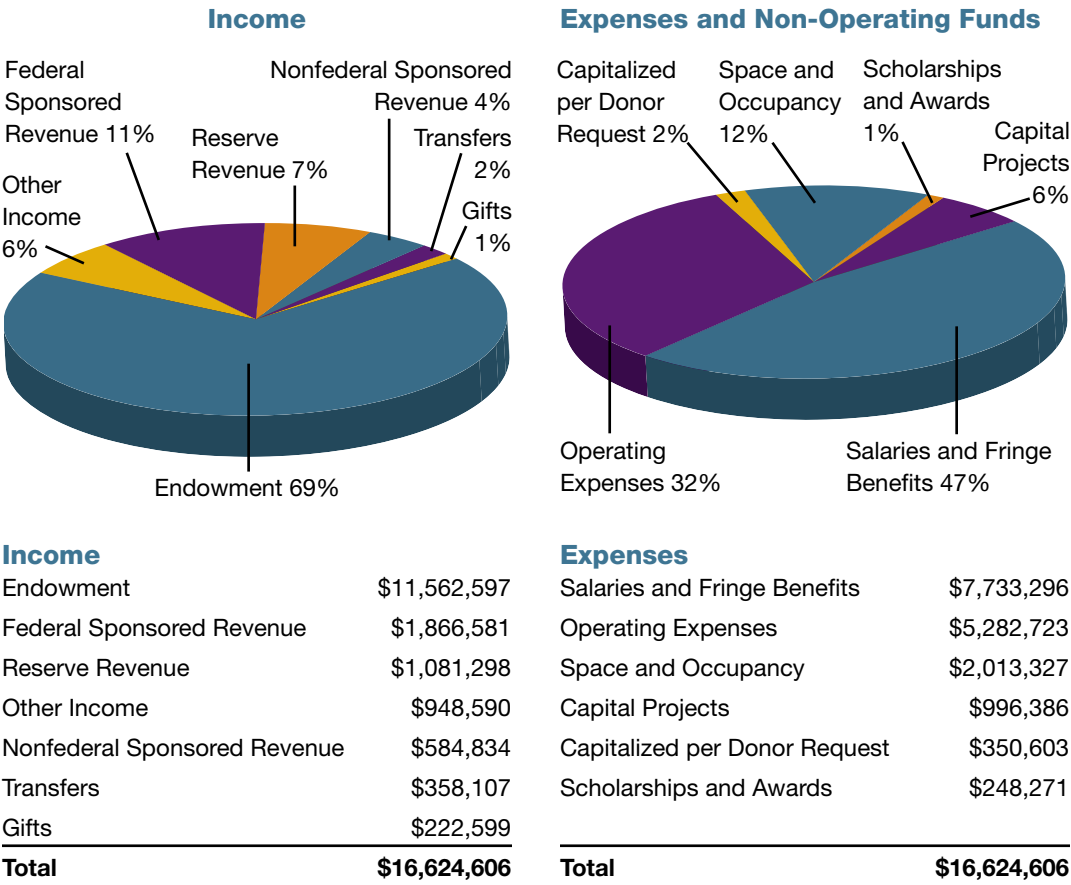
Gonzalo Gribet



Gonzalo Gribet

Financial Data

These charts represent the Museum of Comparative Zoology's income and expenses for fiscal year 2009. Endowment income funds much of the Museum's activities, including acquisition and maintenance of the collections, faculty and staff salaries, capital projects, and facilities renovations and maintenance. Transfers include Harvard University-funded faculty research and financial support for the Ernst Mayr Library. Other Income comprises interest from all remaining balances at the end of the fiscal year, miscellaneous income from publication subscriptions, royalties, sales and fees, and revenue generated from assets purchased through endowments. Capital Projects include renovation of the ichthyology, invertebrate zoology, and herpetology collection spaces. Building expenses such as maintenance, facility improvements, and utilities are captured in the Space and Occupancy category. Operating Expenses consist of equipment purchases, supplies, consultant and conferences fees, as well as annual contributions to the Department of Organismic and Evolutionary Biology and to the Harvard Museum of Natural History for general support, gallery installation, and renovations.



Faculty-Curators

- Andrew A. Biewener
Charles P. Lyman Professor of Biology; Director, Concord Field Station; Chair, Department of Organismic and Evolutionary Biology
- Scott V. Edwards
Professor of Biology; Alexander Agassiz Professor of Zoology; Curator of Ornithology
- Brian D. Farrell
Professor of Biology; Curator of Entomology
- Gonzalo Giribet
Professor of Biology; Curator of Invertebrate Zoology
- James Hanken
Professor of Biology; Alexander Agassiz Professor of Zoology; Curator of Herpetology; Director, Museum of Comparative Zoology
- Hopi E. Hoekstra
John L. Loeb Associate Professor of the Natural Sciences; Curator of Mammalogy
- Farish A. Jenkins, Jr.
Professor of Biology; Alexander Agassiz Professor of Zoology; Curator of Vertebrate Paleontology; Professor of Anatomy in the Harvard-MIT Division of Health Sciences & Technology (Harvard Medical School)
- George V. Lauder
Professor of Biology; Alexander Agassiz Professor of Zoology; Curator of Ichthyology
- Karel F. Liem
Professor of Biology; Henry Bryant Bigelow Professor of Ichthyology; Curator of Ichthyology
- Jonathan Losos
Professor of Biology; Monique and Philip Lehner Professor for the Study of Latin America; Curator of Herpetology
- Charles R. Marshall
Professor of Biology and of Geology; Curator of Invertebrate Paleontology
- James J. McCarthy
Professor of Biological Oceanography; Alexander Agassiz Professor of Biological Oceanography; Acting Curator of Malacology
- Naomi E. Pierce
Sidney A. and John H. Hessel Professor of Biology; Curator of Entomology
- Robert M. Woollacott
Professor of Biology; Curator of Marine Invertebrates

Emeritus Faculty

- Kenneth J. Boss
Faculty-Curator, Emeritus; Professor of Biology, Emeritus
- Alfred "Fuzz" Crompton
Faculty-Curator, Emeritus; Professor of Natural History, Emeritus
- Herbert W. Levi
Faculty-Curator, Emeritus; Professor of Biology, Emeritus
- Richard C. Lewontin
Professor of Biology, Emeritus; Alexander Agassiz Professor of Zoology, Emeritus
- Edward O. Wilson
Honorary Curator of Entomology; Pellegrino University Professor, Emeritus
- Miguel Alcaide
Ornithology, Edwards Lab
- Sonia Andrade
Invertebrate Zoology, Giribet Lab
- Marco Archetti
Entomology, Pierce Lab
- Allison Arnold-Rife
Concord Field Station, Biewener Lab
- Camille Bonneaud
Ornithology, Edwards Lab
- Rose Carlson
Ichthyology, Lauder Lab
- Andrew Carroll
Concord Field Station, Biewener Lab
- David C. Collar
Herpetology, Losos Lab
- Vera Domingues
Mammalogy, Hoekstra Lab
- Anna Dubiec
Ornithology, Edwards Lab
- Rodney Eastwood
Entomology, Pierce Lab
- Heidi Fisher
Mammalogy, Hoekstra Lab
- Megan Frederickson
Entomology, Pierce Lab
- Anthony Herrel
Herpetology, Losos Lab
- Tim Higham
Concord Field Station, Biewener Lab
- Shi-Tong Tonia Hsieh
Herpetology, Losos Lab
- David P. Hughes
Entomology, Pierce Lab
- Carlos Infante
Herpetology, Losos Lab
- Daniel Janes
Ornithology, Edwards Lab

- Gisele Kawauchi
Invertebrate Zoology, Giribet Lab
- Daniel Kronauer
Entomology, Pierce Lab
- David Lentink
Concord Field Station, Biewener Lab
- Catherine Ramsay Linnen
Mammalogy, Hoekstra Lab
- Liang Liu
Ornithology, Edwards Lab
- Marie M. Manceau
Mammalogy, Hoekstra Lab
- Duane McKenna
Entomology, Farrell Lab
- Madhava Meegaskumbura
Herpetology, Hanken Lab
- Hendrik Mueller
Herpetology, Hanken Lab
- Jerome Murienne
Invertebrate Zoology, Giribet Lab
- Terry Ord
Herpetology, Losos Lab
- Chris Organ
Ornithology, Edwards Lab
- Brant Peterson
Mammalogy, Hoekstra Lab
- Tiago Quental
Invertebrate Paleontology, Marshall Lab
- Holger Römpler
Mammalogy, Hoekstra Lab
- Jessica Rykken
Entomology, Farrell Lab
- Yael Salzman
Mammalogy, Hoekstra Lab
- Thomas Sanger
Herpetology, Losos Lab
- Andrew Shedlock
Ornithology, Edwards Lab
- Sacha Vignieri
Mammalogy, Hoekstra Lab
- Noah K. Whiteman
Entomology, Pierce Lab
- Graduate Students

Stephanie Aktipis
Invertebrate Zoology, Giribet Lab

Christopher Baker
Entomology, Pierce Lab

Maude Baldwin
Ornithology, Edwards Lab

Angela Berg
Concord Field Station, Biewener Lab

Erin Blevins
Ichthyology, Lauder Lab

Ron Clouse
Invertebrate Zoology, Giribet

Mark Cornwall
Entomology, Pierce Lab

Nicole Danos
Ichthyology, Lauder Lab

Amanda Evans
Entomology, Farrell Lab

Brooke Flammang
Ichthyology, Lauder Lab

Ricardo Godinez
Ornithology, Edwards Lab

Vanessa Gonzalez
Invertebrate Zoology, Giribet Lab

Gretchen Goodbody
Marine Invertebrates, Woollacott Lab

Alexis Harrison
Herpetology, Losos Lab

Emily Jacobs-Palmer
Mammalogy, Hoekstra Lab

Collin Johnson
Marine Invertebrates, Woollacott Lab

Zofia Kaliszewska
Entomology, Pierce Lab

Emily Kay
Mammalogy, Hoekstra Lab

Eunsuk Kim
Entomology, Pierce Lab

Evan Kingsley
Mammalogy, Hoekstra Lab

Christopher Laumer
Invertebrate Paleontology, Marshall Lab

June Yong Lee
Ornithology, Edwards Lab

Jeanette Lim
Ichthyology, Lauder Lab

Luke Mahler
Herpetology, Losos Lab

Ricardo Mallarino
Entomology, Pierce Lab

Dino Martins
Entomology, Pierce Lab

Carlos Moreno
Concord Field Station, Biewener Lab

Lynne Mullen
Mammalogy, Hoekstra Lab

Martha Muñoz
Herpetology, Losos Lab

Liam Revell
Herpetology, Losos Lab

Christopher Richards
Concord Field Station, Biewener Lab

Prashant Sharma
Invertebrate Zoology, Giribet Lab

Julie Shoemaker
Biological Oceanography, McCarthy Lab

MCZ PERSONNEL

Emily Standen
Ichthyology, Lauder Lab

Yoel Stuart
Herpetology, Losos Lab

Wenfei Tong
Mammalogy, Hoekstra Lab

Sebastian Velez
Invertebrate Zoology, Giribet Lab

Jesse Weber
Mammalogy, Hoekstra Lab

Yunke Wu
Herpetology, Hanken Lab

Shaoyuan Wu
Vertebrate Paleontology, Jenkins Lab

Edwin Yoo
Concord Field Station, Biewener Lab

Adrian Young
Mammalogy, Hoekstra Lab

Xuemai Zhai
Biological Oceanography, McCarthy Lab

Breda Zimkus
Herpetology, Hanken Lab

Associates

Bruce Archibald
*Associate of Entomology
Simon Fraser University*

Aaron Bauer
*Associate of Herpetology
Villanova University*

Reinier Beeuwkes, III
*Associate of Zoology
Ischemix Company (MA)*

Elizabeth Brainerd
*Associate of Ichthyology
Brown University*

Donald S. Chandler
*Associate of Entomology
University of New Hampshire*

Jae Choe
*Associate of Entomology
Seoul National University*

Janet Collett
*Associate of Population Genetics
University of Sussex*

Bruce Collette
*Associate of Ichthyology
National Marine Fisheries Service*

David Bruce Conn
*Associate of Invertebrate Zoology
Berry College*

James Costa
*Associate of Entomology
Western Carolina University*

Catherine Craig
*Associate of Invertebrate Zoology
Harvard University*

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

Lloyd Demetrius
*Associate of Population Genetics
Harvard University*

Philip DeVries
*Associate of Entomology
University of New Orleans*

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

Ben Evans
*Associate of Herpetology
McMaster University*

Stephen Gatesy
*Associate of Vertebrate Paleontology
Brown University*

Richard Glor
*Associate of Herpetology
University of Rochester*

Kelvin A. Guerrero
*Associate of Entomology
Systematic Entomologist/
Environmental Consultant*

Michael Hadfield
*Associate of Marine Biology
Kewalo Marine Laboratory*

Berthold Holldobler
*Associate of Entomology
University of Wurzburg*

Gustavo Hormiga
*Associate of Invertebrate Zoology
George Washington University*

Alan Kabat
*Associate of Malacology
Attorney, Bernabei & Wachtel, (DC)*

Leslie S. Kaufman
*Associate of Ichthyology
Boston University*

Timothy Laman
*Associate of Ornithology
National Geographic*

Hortencia Landrau
*Associate of Entomology
Autónoma de Santo Domingo*

James D. Lazell
*Associate of Herpetology
The Conservation Agency*

David Lohman
*Associate of Entomology
Harvard University*

Vladimir A. Lukhtanov
*Associate of Entomology
St. Petersburg State University*

Russell Mittermeier
*Associate of Herpetology
Conservation International*

William Montevecchi
*Associate of Ornithology Memorial
University of Newfoundland*

Piotr Naskrecki
*Associate of Entomology
Conservation International*

Michele Nishiguchi
*Associate of Invertebrate Paleontology
New Mexico State University*

Diane B. Paul
*Associate of Population Genetics
University of Massachusetts, Boston*

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

Stewart Peck
*Associate of Entomology
Carleton University*

Paulo Petry
*Associate of Ichthyology
The Nature Conservancy*

Steve Poe
*Associate of Herpetology
University of New Mexico*

Rolf Ream
*Associate of Mammalogy
National Marine Mammal
Laboratory*

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

Jury Rudyakov
*Associate of Invertebrate Zoology
Harvard University*

Chris Schneider
*Associate of Herpetology
Boston University*

Andrea Sequeira
*Associate of Entomology
Wellesley College*

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

Najvot Sodhi
*Associate of Ornithology
National University of Singapore*

Joel Sohn
*Associate of Ichthyology
Golden Mountain Trading
Company (CA)*

Stephen Tilley
*Associate of Herpetology
Smith College*

James Traniello
*Associate of Entomology Boston
University*

David Wagner
*Associate of Entomology
University of Connecticut*

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

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

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

Peter Weyand
Associate of Zoology Rice University

R. Haven Wiley
*Associate of Ornithology
University of North Carolina*

Judith Winston
*Associate of Marine Biology
Virginia Museum of Natural History*

Staff

William Amaral
*Preparation Facility Manager,
Vertebrate Paleontology*

Adam Baldinger
*Curatorial Associate, Invertebrate
Zoology and Malacology (acting)*

Dorothy Barr
*Public Services/MCB Liaison
Librarian, Ernst Mayr Library*

Emily Becker
*Faculty/Collection Assistant,
Herpetology*

Daniel Belich
*Reference Librarian, Ernst Mayr
Library*

Constance Brichford
*Curatorial Assistant, Collections
Operations*

Ronnie Broadfoot
*Circulation/Reference, Ernst Mayr
Library*

Greyson Brooks
*Curatorial Assistant, Collections
Operations*

Oliver Caplan
*Faculty/Collection Assistant,
Entomology*

Margaret Carayannopoulos
Financial Officer

Paul Chaikin
*Curatorial Assistant, Collections
Operations*

Mary Catherine Chaikin
*Curatorial Assistant, Collections
Operations*

Judith Chupasko
Curatorial Associate, Mammalogy

Stefan Cover
Curatorial Assistant, Entomology

Jessica Cundiff
*Curatorial Associate, Invertebrate
Zoology*

Susan DeSanctis
*Serials Acquisitions Assistant,
Ernst Mayr Library*

Joseph DeVeer
*Head of Technical Services, Ernst
Mayr Library*

Samantha Edelheit
*Faculty/Collection Assistant,
Malacology*

Katherine Eldridge
Curatorial Assistant, Ornithology

Anne Everly
Research Assistant, Herpetology

Charles Farnum
Curatorial Assistant, Entomology

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

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

Linda S. Ford
Director, Collections Operations

Miyako Fujiwara
*Curatorial Assistant, Collections
Operations*

Robert Emilio Furrow
Curatorial Assistant, Ornithology

Benjamin Goldman-Huertas
Curatorial Assistant, Entomology

Alejandra Guzman
*Research Assistant, Invertebrate
Zoology*

Brendan Haley
Database Administrator

Jane Harrison
*Faculty/Collection Assistant,
Mammalogy*

Karsten Hartel
Curatorial Associate, Ichthyology

Peg Hedstrom
Administrator, Concord Field Station

Anna Holden
*Faculty/Collection Assistant,
Invertebrate Paleontology*

Kathleen Horton
*Faculty/Collection Assistant,
Entomology*

Amie Jones
Faculty/Collection Assistant, Entomology

Lar Kaufman
*Interlibrary Loan Assistant, Ernst
Mayr Library*

Laura Leibensperger
*Curatorial Assistant, Invertebrate
Zoology*

Lisa Litchfield
Administrator, Concord Field Station

Sarah Lupis
Curatorial Assistant, Mammalogy

Annie Lussier
Curatorial Assistant, Mammalogy

Mara Lyons
*Faculty/Collection Assistant,
Vertebrate Paleontology*

Joseph Martinez
Curatorial Assistant, Herpetology

Christopher Meehan
Laboratory Technician, Entomology

Juri Miyamae
*Curatorial Assistant, Collections
Operations*

Paul Morris
Biodiversity Informatics Manager

April Mullins
*Acquisitions and Technology
Specialist, Ernst Mayr Library*

Catherine Musinsky
*Faculty/Collection Assistant,
Mammalogy*

John Nevins
*Laboratory Systems Manager for
Biological Oceanography and
Marine Biology*

Mark Omura
Curatorial Assistant, Mammalogy

Philip Perkins
Curatorial Associate, Entomology

Alison Pirie
*Faculty/Collection Assistant,
Ornithology*

Pedro Ramirez
*Research Assistant, Concord Field
Station*

Murat Recevik
Curatorial Assistant, Malacology

Mark Renczkowski
*Curatorial Assistant, Invertebrate
Paleontology*

Constance Rinaldo
Librarian, Ernst Mayr Library

Alana Rivera
Curatorial Assistant, Malacology

Ivo Ros
*Research Assistant, Concord Field
Station*

José Rosado
Curatorial Associate, Herpetology

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

Diane Sheridan
*Faculty/Collection Assistant,
Invertebrate Zoology*

Ingrid Soltero
Research Technician, Ornithology

Cheryl Souza
*Faculty/Collection Assistant,
Ichthyology*

Kira A. Sullivan-Wiley
Curatorial Assistant, Ornithology

Tsuyoshi Takahashi
*Curatorial Assistant, Herpetology
& Collections Operations*

Jennifer Thomson
*Faculty/Collection Assistant,
Populations Genetics*

Diana Tingley
*Curatorial Assistant, Collections
Operations*

Jeremiah Trimble
Curatorial Associate, Ornithology

Noemi Velazquez
*Curatorial Assistant, Collections
Operations*

Van Wallach
*Curatorial Assistant, Invertebrate
Zoology*

Catherine Weisel
Museum Projects Coordinator

Ken Wilcox
*Building Superintendent, Concord
Field Station*

Victoria Wilke
*Curatorial Assistant, Collections
Operations*

Andrew Williston
Curatorial Assistant, Ichthyology

Jonathan Woodward
*Curatorial Assistant, Herpetology
& Collections Operations*

Melissa Woolley
Faculty/Collection Assistant, Herpetology

Robert Young
*Special Collections Librarian, Ernst
Mayr Library*

Encyclopedia of Life, Learning and Education Group

Tracy Barbaro
Project Coordinator

Jeffrey T. Holmes
Digital Learning Editor

Marie M. Studer
Learning & Education Project Director

Acknowledgements:

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

Editors:
James Hanken, *Director*
Catherine Weisel, *Museum
Projects Coordinator*

Copy, Design, & Production:
Cyndi Wood &
Michael Molanphy
Creative Project
Management, Inc.
www.creativeprojectmgmt.com

MCZ PERSONNEL

Administration for the Department of Organismic and Evolutionary Biology

Rebecca Chetham
Director of Administration

Irv Dumay
Building Manager

Paul Dwyer
Mail Clerk

Jason Green
Financial Assistant

Ann Gubnitsky
Financial Assistant

Stephanie Hillsgrove
Financial Assistant

Philip Norton
Building Services Coordinator

Katie Parodi
Administrative Assistant

Mary Reynolds
Personnel Officer

Miguelina Romero
Financial Assistant

Shelarese Ruffin
Assistant for Human Resources

Anna Salvato
Manager of Financial Operations

Deborah Smiley
Web Project Manager

Angel Velarde
Financial Assistant

Ellin Wilkins
Financial Assistant

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**. The five current members of the Faculty are:

- Dr. John D. Constable
- Mr. Robert G. Goelet
- Mr. David B. Stone
- Mr. George Putnam, Jr.
- President Drew Gilpin Faust



MUSEUM OF COMPARATIVE ZOOLOGY

26 Oxford Street
Cambridge, MA 02138

617.495.2460
www.mcz.harvard.edu