

MUSEUM *of*
COMPARATIVE
ZOOLOGY



HARVARD UNIVERSITY

ANNUAL REPORT
2014 • 2015



DIRECTOR'S MESSAGE

An immense undertaking and accomplishment, the grand migration of MCZ's "dry" collections to the Northwest Building has just now come to an end.

All or part of eight taxonomic collections—Entomology, Invertebrate Paleontology, Vertebrate Paleontology, Invertebrate Zoology, Malacology, Mammalogy, Marine Invertebrates and Ornithology—plus the Blaschka glass animals and the historic Harvard Embryological Collection are now comfortably installed in one of Harvard's newest science buildings, next door to the original MCZ.

In addition to climate-controlled collection rooms outfitted with acres of compact shelving, the new space includes a classroom/teaching lab, specimen preparation labs, and ample work areas for staff, students and visitors. While perhaps lacking the character of the MCZ building (and definitely its musty odor), the absence of hardwood floors and large, lofty windows is more than compensated by a secure, state-of-the-art facility for research and teaching in comparative zoology.

Associated curatorial staff are only now settling into their new spaces, and it will be at least another year before the facility is fully operational, but regular classes began meeting there in fall 2015. The move has left behind abundant opportunities to renovate and repurpose former collection rooms in the MCZ building, which retains many important collections.

The Harvard Museum of Natural History opened two new exhibits this year; each draws heavily from and highlights MCZ's collections. All corners of Ornithology were probed to furnish *Birds of the World*, which reflects current understanding of avian evolution and

biogeography and is displayed in Victorian glass cabinets that encircle the balcony of the historic Great Hall. Numerous collections contributed to *Islands: Evolving in Isolation*, which illustrates the remarkable diversity of island flora and fauna and research by MCZ faculty and students.

This year also marked the arrival of MCZ's newest faculty-curator, Dr. Mansi Srivastava, AB, PhD. Following postdoctoral research at MIT's Whitehead Institute, Mansi joined us in July 2015. More about her professional background and exciting research plans are detailed on the second page of this report.

The year ended on a high note in May, when 34 descendants of Alexander and Anne Agassiz joined more than a dozen faculty-curators and staff for a memorable luncheon at the Harvard Faculty Club. Our guests shared wonderful accounts of Agassiz family history during lunch and then enjoyed guided tours of "the Agassiz museum." It was both an honor and a pleasure to reconnect with a family whose history is so closely entwined with that of the MCZ.

Year after year, the MCZ owes its accomplishments and accolades to its dedicated and innovative faculty-curators, researchers, staff and students. I hope you enjoy learning more about their awards, headline-making research, new projects and initiatives, publications and more.

James Hanken
Director



Melissa Aja



About the Cover:

A species of serpulid worm in the genus *Spirobranchus* from Bocas del Toro, Panama, photographed during the 2015 field trip for OEB 51. Photo by Gonzalo Giribet.

Opposite page: Collections space in the Northwest Building. Photo by Melissa Aja.



INTRODUCING OUR NEWEST FACULTY-CURATOR

The MCZ is delighted to welcome Dr. Mansi Srivastava as Curator of Invertebrate Zoology and assistant professor in the Department of Organismic and Evolutionary Biology.



Isaac Orderberg

Dr. Mansi Srivastava

Dr. Srivastava joined the MCZ in July 2015 after her postdoctoral research on the evolution of regenerative mechanisms in the lab of Dr. Peter Reddien at the Whitehead Institute of the Massachusetts Institute of Technology. “Mansi is a wonderful addition to the MCZ; her expertise in molecular biology and genomics and her broad knowledge of invertebrate animals are perfect complements to our existing strengths,” says Director **James Hanken**.

Most animals can heal wounds and some can regenerate extensively, regrowing organs or even entire body plans from small fragments. As an undergraduate, Dr. Srivastava became fascinated by the regenerative properties of a particular marine tube-dwelling worm. This early fascination has guided her scientific career to the point of setting up her own lab at the MCZ to study the regenerative process and its evolution.

“I want to understand this amazing process where an animal can regenerate a whole new brain or all new muscles or all new eyes,” says Dr. Srivastava. “The knowledge we obtain by studying the basic biology of how animals

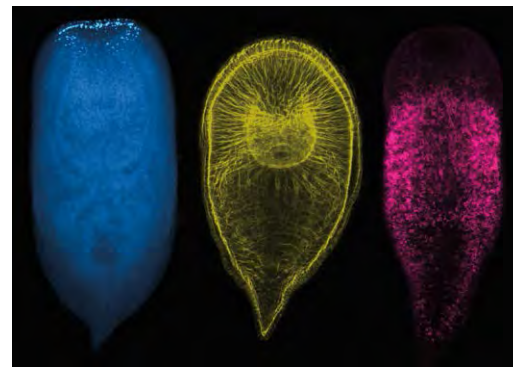
regenerate may be applied to human regenerative medicine much further down the line.”

Dr. Srivastava has developed a new

model organism for studying regeneration, the three-banded panther worm, *Hofstenia miamia*, a little-studied species she collected in a saltwater pond in Bermuda a few years ago. Back in the lab, she faced considerable challenges just to learn how to create the

proper habitat and feed the worms so they thrive and reproduce. With that problem solved, she found that they regenerate really well—you can cut off their heads and they will grow back. Then she was able to develop molecular techniques to study how the worm is able to regenerate.

The **Srivastava lab** will use the power of this new model system to reveal important steps in regeneration. One focus will be on the very early steps that happen once an injury occurs,



Mansi Srivastava & Kathleen Mazza-Curill

Molecular markers reveal specialized cell types in the anterior (blue), muscle (yellow), and somatic stem cells (magenta) in *Hofstenia*.

thereby building a map of all of the molecular and genetic signals that launch the process of regeneration. Another major aspect that they will study is stem cell biology. The worms have a type of pluripotent cell that can make all other types of cells, so they can be used to study how stem cells work.

The lab will be interested in identifying the processes of regeneration that are broadly applicable to all animals. “I’m interested in the evolution of regeneration,” says Dr. Srivastava, “so even though my lab is starting out with this new model organism, we’re hoping to expand our work to other species. There’s no better place to learn about diverse regenerative species than the Museum of Comparative Zoology.”



Mansi Srivastava & Kathleen Mazza-Curill

Three-banded panther worms show variations of their pigmentation patterns.

MCZ FACULTY-CURATORS



Andrew A. Biewener

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

Prof. Biewener’s research focuses on understanding the biomechanics, neuromuscular control and energetics of animal movement on land and in the air.

His goal is to understand general principles that govern the biomechanical and physiological design of vertebrate animals related to their movement in natural environments.



Tony Rinaldo

Scott V. Edwards

*Professor of Organismic & Evolutionary Biology
Alexander Agassiz Professor of Zoology
Curator of Ornithology*

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



Stephanie Mitchell

Brian D. Farrell

*Professor of Biology
Curator of Entomology
Director, David Rockefeller Center for Latin American Studies*

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

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

Gonzalo Giribet

*Alexander Agassiz Professor of Zoology
Professor of Organismic & Evolutionary Biology
Curator of Invertebrate Zoology*

Prof. Giribet’s primary research focuses on the evolution, systematics and biogeography of invertebrate animals, including the use of morphology and next-generation sequencing techniques. Current projects in the Giribet lab include multidisciplinary studies for Assembling the Bivalve Tree of Life; the evolution of orb-weaving spiders; and systematics and biogeography of arthropods, mollusks and onychophorans, among other groups. He is also interested in philosophical aspects of DNA sequence data analysis, emphasizing homology-related issues and the use of genomic-level data for inferring phylogenies.



© Casey Dunn





Catherine Weisel

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

Prof. Hanken utilizes laboratory-based analyses and field surveys to examine morphological evolution, developmental biology and systematics. Current areas of research include the

evolution of craniofacial patterning; the developmental basis of morphological novelty; biodiversity informatics; and systematics and evolution of neotropical salamanders. Prof. Hanken also serves on the Steering Committee of the Encyclopedia of Life (eol.org).



Stephanie Mitchell

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

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

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



Gretchen Ertl

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

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



Rose Lincoln

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



Jon Chase

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

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

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



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

Prof. Pierce's research is focused on major morphological and ecological transitions in vertebrate evolution through an examination of the fossil record.

Her work tends toward 3-D

modeling and experimentation of the musculoskeletal system, with particular attention to the link between form and function. Current projects include the fin-to-limb transition, the evolution of the mammalian backbone, and the origin of the avian neck.



Kris Sribbe

Naomi E. Pierce
Sidney A. & John Hessel Professor of Biology
Curator of Entomology

Prof. Pierce's research focuses on the behavioral ecology of species interactions, particularly insect/plant associations, and symbioses between ants and other organisms, including bacteria, fungi, plants and caterpillars of butterflies in the family Lycaenidae.

Prof. Pierce is interested in how parasitic and mutualistic life histories can influence the evolutionary trajectories of each partner.



Jean-Francois Bertrand

Robert M. Woollacott
Professor of Biology
Curator of Marine Invertebrates

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





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

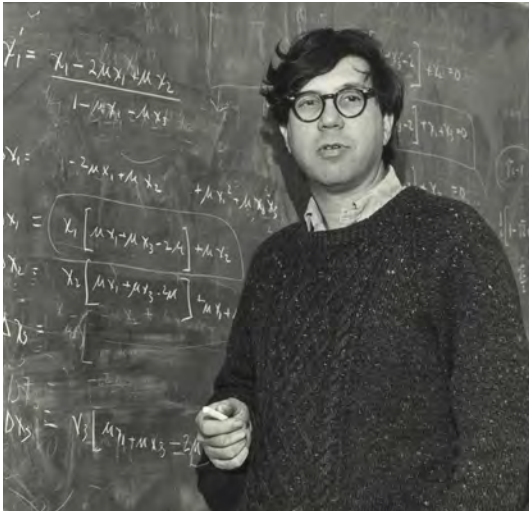
Prof. Crompton, former Curator of Mammalogy, was the Director of the MCZ from 1970 to 1982 and the former Director of the Peabody Museum of Natural History, Yale University, and the South African Museum, Capetown. His primary research interests are the origin and evolution of mammals, functional anatomy, neural control and evolution of feeding in recent and fossil vertebrates. Prof. Crompton received two Guggenheim fellowships for his research on vertebrate paleontology and functional morphology and in 2011 received the Romer-Simpson Medal from the Society of Vertebrate Paleontology.



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.

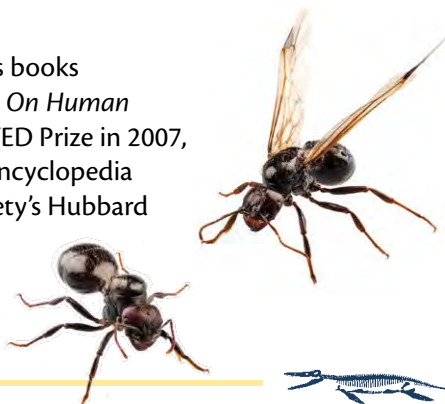
Prof. Lewontin's current research involves computer simulation and evaluation of statistical tests for selection. Among his many books are *The Genetic Basis of Evolutionary Change*; *Biology as Ideology: The Doctrine of DNA*; *Human Diversity*; and *The Triple Helix: Gene Organism and Environment*.



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

Prof. Wilson is considered the founder of sociobiology and evolutionary psychology and has developed the basis of modern biodiversity conservation. He has received many of the world's leading prizes in recognition of his research and environmental activism.

He was awarded two Pulitzer Prizes for his books *The Ants* (1990, with Bert Hölldobler) and *On Human Nature* (1978). Prof. Wilson received the TED Prize in 2007, where he articulated the concept of the Encyclopedia of Life, and the National Geographic Society's Hubbard Medal in 2013.



Organismic and Evolutionary Biology

OEB 10: Foundations of Biological Diversity (undergraduate)

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

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

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

Gonzalo Giribet

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

OEB 57: Animal Behavior (undergraduate)

Naomi E. Pierce (and Bence P. Olveczky)

A review of the behavior of animals under natural conditions, with emphasis on both mechanistic and evolutionary approaches.

OEB 118: Biological Oceanography

James J. McCarthy

Examines the ocean as an ecological system, with focus on environmental-organismal interactions that regulate plankton production and transfer to higher trophic levels.

OEB 51: Biology and Evolution of Invertebrate Animals

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





FRSEMR 41u: Museums

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



Brian Farrell

OEB 141: Biogeography

Gonzalo Giribet

Biogeography aims to explain distributions of organisms through historical and ecological factors. This course focuses on the history of biogeographic research, developments in the area of historical biogeography, and ecological processes that affect distributions of whole clades.

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

Naomi E. Pierce (and Michael R. Canfield)

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

OEB 173: Comparative Biomechanics (undergraduate and graduate)

Andrew A. Biewener (and Stacey A. Combes)

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

OEB 181: Systematics (undergraduate and graduate)

Gonzalo Giribet

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

OEB 234: Topics in Marine Biology (graduate)

Robert M. Woollacott

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

General Education

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

Robert M. Woollacott, James J. McCarthy

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

Graduate Courses of Reading and Research

OEB 307: Biomechanics, Physiology and Musculoskeletal Biology

Andrew A. Biewener

OEB 310: Metazoan Systematics

Gonzalo Giribet

OEB 320: Biomechanics and Evolution of Vertebrates

George V. Lauder

OEB 325: Marine Biology

Robert M. Woollacott

OEB 334: Behavioral Ecology

Naomi E. Pierce

OEB 341: Coevolution

Brian D. Farrell

OEB 345: Biological Oceanography

James J. McCarthy

OEB 355: Evolutionary Developmental Biology

James Hanken

OEB 370: Mammalian Evolutionary Genetics

Hopi E. Hoekstra



OEB 155r: Biology of Insects



Gonzalo Giribet

OEB 51: Biology and Evolution of Invertebrate Animals

Freshman Seminar

FRSEMR 22t: Why We Animals Sing

Brian D. Farrell

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

FRSEMR 41u: Museums

James Hanken

Traces the history of museums from their beginnings to the modern institutions of today, considering issues in conservation, finances, exhibit design, regulations and ethics, and their role in contemporary society.



MCZ History



In the summer of 1858, the landscape painter, writer and woodsman William James Stillman organized a month-long expedition to Follensby Pond in the remote wilderness region of upstate New York.

This momentous gathering of several of America's most prominent intellectuals (and Stillman himself) is memorialized in *The Philosophers' Camp in the Adirondacks*, which today hangs in the reading room of the [Concord Free Public Library](#).

Swiss-born naturalist Louis Agassiz, who would found the Museum of Comparative Zoology the following year, dominates a small group of men in the left foreground. The group also includes the anatomist Jeffries Wyman, who would soon serve on the Museum's governing board, the MCZ Faculty.

Philosopher Ralph Waldo Emerson, who would write a poem about his experiences, stands alone in the center of the painting. Poet Henry Wadsworth Longfellow declined an invitation to come along on the trip, where he was sure "somebody will be shot."

Agassiz's exploits, widely chronicled following his return, included his discovery of a new species of freshwater sponge. This and other accounts spurred tremendous interest in exploration of the Adirondacks and of American wilderness in general.

Environmental Science and Public Policy

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

James J. McCarthy (and Jennifer Leaning)

Explores the consequences of population flight due to war, drought and famine in which climate change is a contributing factor, relating to the extent and permanence of environmental destruction wrought by these crises, people's attachment to their homes and ecosystems, the circumstances of departure, the destinations of refuge and the possibilities for return.

Life Sciences

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

Hopi E. Hoekstra (and Maryellen Ruvolo, Kevin C. Eggan, Pardis Sabeti)

Demonstrates how genetics and evolution are intimately related using an integrated approach, explaining the patterns of genetic variation we see in nature and how genomics can be used to analyze variation.

LIFESCI 2: Evolutionary Human Physiology and Anatomy (undergraduate)

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

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

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

Brian D. Farrell

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



MCZ RESEARCH MAKING HEADLINES

Masters of the Underwater Universe

Intense commercial whaling during the 19th and 20th centuries caused an estimated 66–90% reduction in the worldwide population of great whales—among them the right, gray, blue, humpback and sperm whales—altering the composition of marine life and even the functioning of the ocean.

Tens of millions of whales were killed for the goods their bodies supplied, but a new study by **James J. McCarthy**, 2014 OEB/MCZ Hrdy Fellow **Joe Roman** and colleagues indicates that recovered whale populations can provide crucial ecosystem services and economic benefits that far outweigh any past commercial value.

Instead of competing with fishermen, whales support fisheries by making the ocean a more productive place. By diving and surfacing, whales enhance the upward movement of deep water rich in nutrients and microorganisms, and deliver additional nutrients to surface waters by releasing fecal plumes and urine at or near the surface, called the "whale pump."

Take to the Trees

When closely related species compete for resources like food or habitat, evolutionary changes are expected to occur as they diverge and take advantage of separate niches. Originally proposed in 1956 by **Edward O. Wilson** and William L. Brown, this core principle in ecology and evolution, called "character displacement," was once thought to unfold on timescales too long to observe directly, and well-documented cases are rare.

Yoel Stuart, a former member of the Losos lab, **Jonathan B. Losos**, **R. Graham Reynolds** and colleagues describe such evolutionary changes in the green anole (*Anolis carolinensis*), the only native species of anole in North America. In the early 1990s, researchers introduced the brown anole (*Anolis sagrei*) to three small islands in Florida's Intracoastal Waterway that were once the exclusive territory of the green anole.

The iron and nitrogen supplied by the whale pump promotes the growth of plankton and krill, critical food sources for larger marine animals. And when migrating, whales transport these resources to their lower-latitude, relatively nutrient-poor calving grounds. Even in death, "whale falls" provide food and habitat for numerous species.

Whales also transport carbon from the atmosphere to the deep ocean, helping to minimize climate change. If restored to pre-whaling levels, whale populations could extract carbon from the atmosphere via enhanced phytoplankton blooms and whale falls in amounts comparable to some hypothetical climate engineering projects intended to mitigate climate change.

[Roman J, Estes JA, Morissette L, Smith C, Costa D, McCarthy J, Nation JB, Nicol S, Pershing A, Smetacek V \(2014\) Whales as marine ecosystem engineers. *Front Ecol Environ* 12:377-385](#)

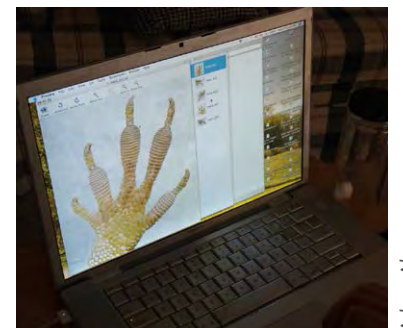


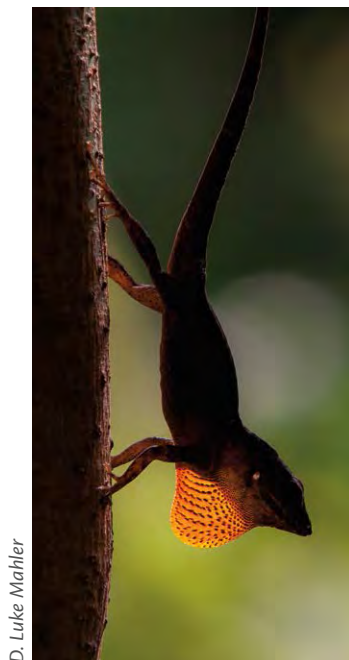
The two species of lizards are very similar in their tendency to live close to the ground, but once the brown anoles arrived, the green anoles began to move higher into the trees.

The researchers show that, in response, over 15 years or 20 generations, the green anole developed larger toe pads with stickier scales for better climbing, demonstrating that when competition is strong enough, evolutionary changes can occur rapidly.

The research may be useful in understanding how species respond to human-caused habitat fragmentation, climate change and invasive species.

[Stuart YE, Campbell TS, Hohenlohe PA, Reynolds RG, Revell LJ, Losos JB \(2014\) Rapid evolution of a native species following invasion by a congener. *Science* 346:463-466](#)





D. Luke Mahler

Trading Places

Theoretically, smaller, more isolated islands will have fewer species, and larger, less isolated islands will be richer in their diversity of species. **Edward O. Wilson** and Robert MacArthur outlined this theory of island biogeography in the 1960s, but testing it has been elusive due to the challenges of manipulating island biodiversity on a large geographic and long timescale. It turns out that in the Anthropocene, or Age of Humans, we have already done it.

Jonathan B. Losos, former MCZ graduate student **D. Luke Mahler** and colleagues used anoles—small lizards with numerous species that are ubiquitous in the Caribbean—to test the theory, but with a twist. Historically, anoles could rarely travel over large distances of water by themselves, so isolated islands were much less likely to be colonized by anoles from other places. However, trade and travel between islands have allowed anoles to cast away on boats to reach new homes, weakening the negative relationship between distance and biodiversity.

The researchers analyzed trade patterns in the Caribbean and catalogued the



Félix Pharand-Deschênes/Globaia

occurrence of 18 species of anoles introduced to various islands. Economically isolated Cuba does not have any non-native species of anoles. However, places such as Trinidad and the Anguilla bank islands trade extensively with and host numerous visitors from other islands and nations, and they have a correspondingly high number of imported anole species, confirming that it is no longer geographic isolation, but economic isolation, that affects island diversity.

[Helmus MR, Mahler DL, Losos JB \(2014\) Island biogeography of the Anthropocene. *Nature* 513:543-546](#)

Loving the Sweet Life

The ability to perceive tastes—salty, sweet, sour, bitter and “umami,” or savory—drives the food preferences of humans and other vertebrates. However, some species have lost certain taste receptors. The majority of birds, for example, may be unable to sense sweetness. So how did the hummingbird evolve into a specialized nectar feeder?

This question so intrigued **Maude Baldwin**, a member of the lab of **Scott V. Edwards**, that she spent many years during her PhD searching for the answer. Her findings showed for the first time that hummingbirds evolved the ability to perceive nectar through their umami receptor, which may have facilitated the extensive diversification of the species.

Baldwin led an international team of researchers that cloned and tested taste receptor genes of chickens, hummingbirds and swifts, the hummingbird's closest living relative. In chickens and swifts, a receptor that responds strongly to amino acids—the umami

flavors—was repurposed in hummingbirds to respond to carbohydrates—the sweet flavors—and it took at least 19 mutations over more than 40 million years to evolve this capability.

But do these mutations drive hummingbird behavior? The researchers set up hummingbird feeders filled with water and nectar made of glucose, fructose, sucrose and synthetic sweeteners. While the hummingbirds avidly drank nectar made with natural sweeteners, they would quickly spit out pure water and most artificial sweeteners with an annoyed shake of their heads. They even responded positively to one non-caloric sweetener that the taste receptor recognized in the lab, thus providing the link between the gene and feeding behavior.

[Baldwin MW, Toda Y, Nakagita T, O'Connell MJ, Klasing KC, Misaka T, Edwards SV, Liberles SD \(2014\) Evolution of sweet taste perception in hummingbirds by transformation of the ancestral umami receptor. *Science* 345:929-933](#)



Maude Baldwin

The Mad Rush of Courtship

Few vertebrates can run on water. The largest of these, the western and Clark's grebes (*Aechmophorus occidentalis* and *A. clarkii*), rise up from the water and skim across the lake in a pair bonding display, called rushing. To find out how the birds accomplish this feat, **Glenna T. Clifton** and two field assistants spent a month at the grebe's mating grounds in southern Oregon. With mere seconds of warning, the team positioned high-speed video cameras and filmed more than 100 rushing displays. Eight videos were calibrated for 3-D analysis, and two showed the motion of the grebe's feet in detail for the first time.

The research by Clifton and **Andrew A. Biewener** determined that the feet were slapping the water at a blinding 13–20 strokes per second. During the slap, the toes of the large foot were outspread, but coming out of the water the toes were collapsed and the foot extracted sideways to reduce drag.

Inside the Head of a Frog

For more than 150 years, scientists have been attempting to understand how skull bones develop in vertebrate embryos. Evolutionary changes in skull form underlie every major adaptive transition in the history of vertebrates, and skull bones are used to determine the evolutionary relationships among species. The developmental process first described in birds, and later in mammals, has been found to be highly similar. But the developmental pattern for frogs, whose ancestors diverged early in the history of terrestrial vertebrates, has now been shown to be very different.

To investigate how the skulls of frogs and salamanders form, **James Hanken** and former Hanken lab members **Nadine Piekarski** and **Joshua Gross** focused on a small group of embryonic cells—the neural crest—that give rise to a host of traits characteristic of vertebrates, including

Using models of grebe feet, Clifton estimated that the slapping motion generated 30–55% of the hydrodynamic force required to keep the bird, which can weigh up to four pounds, above water. The rest of the force is likely generated underwater, but verification will require the challenging undertaking of underwater filming.

In addition to informing the understanding of evolutionary changes in hind limb anatomy linked to this remarkable performance, grebe hydrodynamics could serve as a model for amphibious robots and inform the design of commercial products like paddles.

[Clifton GT, Hedrick TL, Biewener AA \(2015\) Western and Clark's grebes use novel strategies for running on water. *J Exp Biol* 218:1235-1243](#)



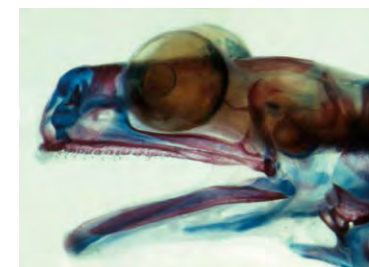
Barbara Scoles

pigment cells, sensory neurons and most cartilages and bones in the skull. To follow the development of these cells from embryo to tadpole to adult, the researchers had to find a new way to label the cells. Their innovative solution was to graft embryonic cells labeled with a fluorescent protein from

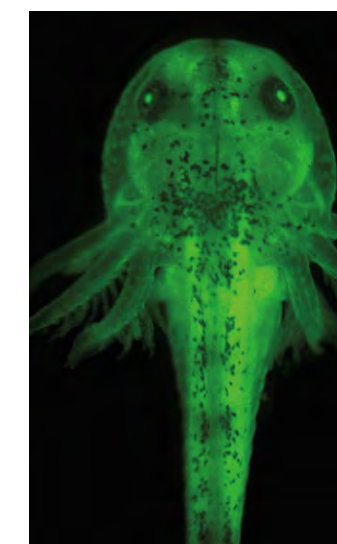
a jellyfish and see which bones in the mature animal glowed green under fluorescent light. They found that while the salamander skull developed along the same lines as other vertebrates, frogs unexpectedly had evolved a unique developmental pattern.

The work has potential applications in the study of human birth defects caused by neural crest cells or improper skull development.

[Piekarski N, Gross JB, Hanken J \(2014\) Evolutionary innovation and conservation in the embryonic derivation of the vertebrate skull. *Nat Commun* 5:5661](#)



James Hanken



Nadine Piekarski



HIGHLIGHTS FROM THE COLLECTIONS

Oversized Specimens Make Their Move



Jonathan Woodward

For numerous years, the very largest specimens of the MCZ collections—massive antlers, whale skulls and the like—have been housed in the attic of the MCZ building, and preparations to move these items to more suitable circumstances have been underway for some time. “Because of the size, shape and weight of this specimen material, it was determined that it should be housed in off-site storage,” says **Linda S. Ford**, Director of Collections Operations at the MCZ. “It was not part of the planning for the MCZ facilities in the Northwest Building.”

It was decided that most of the specimens in the attic, including much of the Mammalogy horn and antler collection,

could be temporarily placed on the MCZ building’s 5th floor in the area that was freed up by the Mammalogy and Ornithology collections’ move to the Northwest Building. This would improve the environmental conditions (temperature and relative humidity), reduce potential exposure to pests, and provide general protection from dust and debris while preparing for off-site collection storage.

When it came time to move, a number of the specimens were hand-carried or hoisted through an opening in the 5th-floor stairwell ceiling. However, removing the very largest specimen material from the attic—including an enormous moose antler rack, four whale skulls (blue, sperm and two fin), and additional skeletal parts from the blue whale, including the mandibles, or jaw bones—required much more elaborate and stronger rigging for hoisting.



Jonathan Woodward

On May 14, 2015, contractor O.B. Hill Riggers, subcontracted by ABC Moving, set out to extract these immense specimens. Using an 80-ton crane, two of the whale skulls were “drifted” out of the 5th-floor window on the courtyard side of the MCZ. The remaining skeletal material, including the other two whale skulls and mandibles, were lifted through the hatch on the north side of the building roof.

The moose antlers were placed in the temporary 5th-floor storage area. The whale skulls and skeletal material are being stored off site, awaiting the upgrade of the whale storage facility at the Concord Field Station.



Jonathan Woodward

Paleontology Collections Relocate to the Northwest Building

Invertebrate and Vertebrate Paleontology were the most recent collections to make the move to the Northwest Building.

The Invertebrate Paleontology collection is made up of over a million specimens. In November 2007, the staff started preparing for the move by cleaning and rehousing the specimens. Parts of the collection (mostly the fossil mollusk collections) were reorganized prior to the move. These activities were completed in January 2014. The move started in July 2014 and finished during October 2014.

The Vertebrate Paleontology collection, composed of around 100,000 larger and heavier specimens, started being prepared in February 2011. The cleaning and rehousing of those specimens was completed in August 2013, and they were moved between February and March 2015.

To prepare both collections, staff cleaned the specimens and any conservation issues, such as repair or treating pyrite disease or Bynesian decay, were addressed. For the more delicate specimens, boxes and drawers were lined with polyethylene foam as needed to provide additional support and stability.



Jessica Cundiff



Mark Renczkowski

“The MCZ has a character that will be greatly missed, but the Northwest Building space is much better overall for the collections,” says **Jessica Cundiff**, Curatorial Associate for Invertebrate and Vertebrate Paleontology. “The new prep space has many additional pieces of equipment—a dust collector, fume hood and rock saws—that will make our prep and repair work easier and safer.”

All specimens are now stored in metal cabinets that can be neatly labeled and locked for added security. The collection storage area is climate controlled, making

for a much better environment for specimens. Space for collection visitors is greatly improved with large tables to study specimens.

In addition to Cundiff, Invertebrate Paleontology staff members **Mark Renczkowski** and **Richard Knecht** were involved in the move efforts. Collections Operations staff included **Joe Martinez**, **Tsuyoshi Takahashi**, **Tatiana de Souza Varges** and **Victoria Wilke**. Interns **Britt Bowen**, **Abigail Parker**, **John Gallucci**, **Maggie Abe** and **Phil Lai** also provided assistance.

Renovations for the Ichthyology Collection

The Ichthyology collection work area was completely renovated in 2015. A new heating and air conditioning system was installed, along with new energy-efficient lighting. Shelving and work areas were designed to efficiently make use of space. The modernized area provides better support for the collection and its management.

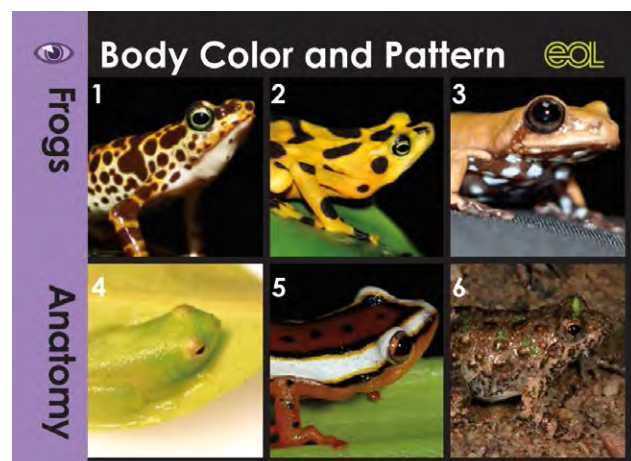


Karsten Hartel



PROJECTS & INITIATIVES

Encyclopedia of Life Learning + Education Group



The Encyclopedia of Life (eol.org) is a global effort to bring together species information in a free, trusted online resource. The MCZ and hundreds of other partners provide content on EOL. The Learning + Education Group, based at the MCZ, encourages development of innovative and effective uses of EOL content in educational settings.

In collaboration with EOL, **Breda Zimkus**, Cryogenic Collections Manager for Genetic Resources at the MCZ, developed a set of Frog Observer Cards, which encourage people to observe frogs in nature by focusing on the key traits and behaviors that make different frogs species unique. The cards are available at eol.org/info/disc_observer. Zimkus, a former EOL Rubenstein Fellow, also manages the African Amphibians Scratchpad, an online community-driven resource for information on the amphibians of Africa that serves content through EOL. africanamphibians.myspecies.info

EOL Places

EOL Places brings together information about species in the context of the places they inhabit. Along with content about local habitats and their species, tools, activities and games provide more opportunities for learning about biodiversity. The Okaloosa S.C.I.E.N.C.E. project is piloting EOL Places as part of a Department of Defense Education Activity grant to improve STEM education through outdoor activities and community partnerships. education.eol.org/ecosystems/ecoproj.php?proj_id=4.



EOL TraitBank Data in Google Knowledge Graphs

After four years of behind-the-scenes work, the collaboration between EOL and the Google Search Team has made it possible for EOL's [TraitBank](#) data to be used to improve the information about organisms that is shown in Google's Knowledge Graphs. Now when a search is performed on "koala," for example, data from EOL and other sources will be displayed on Google's search result page. MCZbase shares data with TraitBank, providing even greater exposure for MCZ data through this open science collaboration.

Grants

The Encyclopedia of Life Learning + Education Group is coordinating the broader impacts and educational outreach for two National Science Foundation grants.

For *Digitization PEN*, the MCZ is partnering with Southwest Collections of Arthropods Network to contribute expertise in the identification and digitization of ants from the Navajo Nation, and EOL will help develop a local field guide of these ant species.

For *ABI Development: Kurator*—developing software tools for scientific data digitization, sharing, integration and use—EOL Learning + Education will coordinate the production of outreach materials and instructional technologies for the grant.

Birds of the World

On September 20, 2014, *Birds of the World*, a permanent exhibition curated by the HMSC exhibits department and MCZ doctoral student **Maude Baldwin**, opened at the Harvard Museum of Natural History. With more than 10,000 species, birds are the most diverse land vertebrates on the planet, varying tremendously in appearance and size and thriving in every corner of the globe. The new gallery, located around the balcony of the Great Hall, captures this stunning diversity through 750 bird specimens representing more than 200 bird families worldwide. The birds on display were drawn from the MCZ Ornithology collection's 350,000 specimens. The exhibition is the result of months of cleaning and refurbishing mounted bird specimens to restore their iridescence, renovating antique cases and redesigning the exhibit displays.

Baldwin helped apply the latest findings on birds to organizing the displays, resulting in an exhibition that reflects the current understanding of avian evolution. The work also notes the scientific consensus that birds are descended from theropod dinosaurs—and in fact are the last living dinosaurs—and that other reptiles like crocodiles are their closest living relatives.

The exhibition was made possible by a donation given in memory of Melvin R. Seiden, Harvard AB 1952, LLB 1955.

Islands: Evolving in Isolation

Since Darwin's time, research on islands has played a pivotal role in advancing understanding of biodiversity and evolution. Through the years, MCZ faculty who have made important contributions to this study include former MCZ Directors Thomas Barbour and Ernst Mayr, Curator of Entomology Philip Darlington, **Edward O. Wilson**, and current faculty such as **Jonathan B. Losos**, **Scott V. Edwards**, **Brian D. Farrell** and **Gonzalo Giribet**. *Islands: Evolving in Isolation*, a new Harvard Museum of Natural History exhibition, illustrates the extraordinary diversity of island life and highlights the work of the scientists who have studied it.

Prof. Losos, who has spent much of his career exploring island evolution by working with *Anolis* lizards, was chief faculty advisor to the exhibition.



Melissa Aja



Kris Sribbe © 2015 President & Fellows of Harvard College



Melissa Aja

The theoretical underpinnings of island evolution are explained using a wide array of plant and animal specimens, including lizards, Galápagos tortoises, New Guinea birds of paradise, Malagasy lemurs, a Komodo dragon from the Indonesian islands, and a rare fossil cast of *Homo floresiensis*, a relative of modern humans.

The MCZ contributed specimens from multiple collections, including Ornithology, Mammalogy, Herpetology, Entomology, Invertebrate Zoology and Malacology. The exhibition highlights some of the latest research and discoveries made by Harvard scientists and features explanatory displays, videos of scientists discussing their work, and live displays of *Anolis* lizards, hissing cockroaches and carnivorous pitcher plants. Supported by the National Science Foundation and a generous gift from Dr. John Freedman, AB 1984, *Islands* will run through March 2017.

In conjunction with the exhibition, Prof. Losos gave a free public lecture entitled *Islands: Natural Laboratories of Evolution*, discussing the relevance of islands to our understanding of evolution and its processes.



Ernst Mayr Library Grant Projects



The Library is a partner on [Purposeful Gaming and BHL](#), an IMLS-funded project led by the Missouri Botanical Garden. The goal of *Purposeful Gaming* is to assess the feasibility of using crowdsourced gameplay as a means of improving the accuracy of both machine and human transcription of digitized texts. As a case study for the project, the Library uploaded digital scans of 3,470 handwritten pages by ornithologist William Brewster to two separate online tools designed for crowdsourced transcription of digitized manuscripts. Manuscripts are of particular interest to this project because accurate machine transcription of handwritten documents is nearly impossible.

The overall idea was to obtain two sets of transcription files for the same material. Gaming is then applied to reconcile differences between the two renditions, thus increasing the accuracy of the transcriptions. Tiltfactor, a game development laboratory at Dartmouth College, was contracted to develop two games for this project—Smorball and Beanstalk—which were launched publicly in June 2015. Smorball won an award for “Best Serious Game” at the Boston Festival of Indie Games in September 2015. The grant provided funding for the appointment of two part-time project assistants, **Patrick Randall** and **Elizabeth Meyer**.

Beginning in November 2015, EML will participate in a grant project with the New York Botanical Garden and the Missouri Botanical Garden. The two-year project is designed to significantly increase online access to biodiversity material from natural history literature collections, thus ensuring the widest possible audience.

Pforzheimer Fellow in the MCZ Archives

Deirdre Moore, a graduate student in Harvard’s History of Science Department, spent the summer of 2015 as a Pforzheimer Fellow in the Ernst Mayr Library, working with approximately 3,000 lantern slides of images from Harvard entomologists **Edward O. Wilson**, William Morton Wheeler (1865–1937), Charles T. Brues (1879–1955) and Frank M. Carpenter (1902–1994). Because of the research interests of the contributors, many of the images were of ants, fossil ants and illustrations of biogeography such as island landscapes.

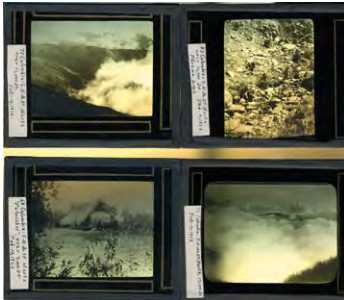
Under the direction of librarians **Robert Young** and **Joseph DeVeer**, Moore recorded data from 2,885 lantern slides, cleaned more than 1,000 slides and housed approximately 800 in numbered envelopes. For the scholarly context of the slides, Moore met with current Entomology staff, which led to the discovery of additional materials by entomologist Philip Darlington (1904–1983) from the “Banana Massacre” in Colombia during 1928–1929, some of the only surviving records of that era.

Biodiversity Heritage Library

During the 2014–2015 academic year, a total of 593 volumes (160,110 pages) were digitized for inclusion in the [Biodiversity Heritage Library](#). Since November 2007, EML has contributed 8,545 volumes of material that have been accessed more than 5.3 million times. Recent usage reports for Ernst Mayr Library materials in BHL reveal well over 100,000 downloads per month.



Kris Sribbe © 2015 President & Fellows of Harvard College



Deirdre Moore

MCZ GRANT RECIPIENTS ACADEMIC YEAR 2014–2015

Putnam Expedition Grants

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

Recipient	MCZ Department	Project Title	Amount
Felix Baier	Mammalogy	The genetic basis and evolution of territorial aggression in the deer mouse (<i>Peromyscus maniculatus</i>)	\$10,655
Nicole Bedford	Mammalogy	The adaptive significance of complex burrowing in the oldfield mouse <i>Peromyscus polionotus</i>	\$7,734
Rebecca S. Buckman	Invertebrate Zoology	Biogeography of Caribbean velvet worms (Phylum Onychophora)	\$6,506
Gonzalo Giribet	Invertebrate Zoology	Temperate rainforest Chilean soil invertebrates to elucidate Gondwanan biogeography	\$4,080
Emily R. Hager	Mammalogy	Adaptation to arboreality in deer mice (<i>Peromyscus maniculatus</i>)	\$8,991
Naomi E. Pierce	Entomology	Ant associated lycaenid butterflies of Kenyan <i>Acacias</i>	\$7,352
Stephanie E. Pierce	Vertebrate Paleontology	In the footsteps of A. S. Romer: Filling a 20 million year gap in tetrapod evolution	\$16,300
Robert G. Reynolds	Herpetology	A population genomics approach to resolving divergence, gene flow, and independent colonization of the Bahama Islands by <i>Anolis sagrei</i> , the Cuban Brown Anole	\$9,198
Christina P. Riehl	Ornithology	Evolutionary history of egg mimicry in the striped cuckoo	\$6,120
Martin Schwentner	Invertebrate Zoology	Enigmatic Crustacea from Belize to resolve crustacean-hexapod relationships (<i>Funds provided by the Fenner A. Chace Fund</i>)	\$3,730
Fabio Laurindo da Silva	Entomology	Understanding the ancient origins of South American biodiversity: A molecular perspective on the evolution and biogeography of non-biting midges (Diptera: Chironomidae)	\$5,200
Yung Wa Sin	Ornithology	Mate choice and major histocompatibility complex (MHC) genes in two species of North Pacific albatross (<i>Phoebastria immutabilis</i> and <i>P. nigripes</i>)	\$9,284
Gerard Talavera	Entomology	Phylogeography of the most cosmopolitan animal migrator: the butterfly, <i>Vanessa cardui</i>	\$8,698
		Total Awards	\$103,848



Alberto R. Puente-Rolon



Felix Baier



Kyle Turner



Gonzalo Giribet



Felix Baier



Gonzalo Giribet

Grants in Aid of Undergraduate Research (GUR)

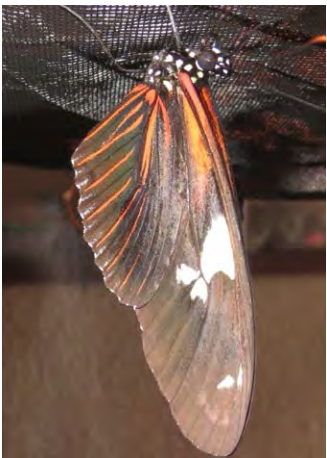
These grants support research by Harvard College undergraduates under faculty supervision. Priority is given to projects that utilize MCZ, Harvard University Herbaria (HUH) and Arnold Arboretum (AA) research collections, laboratories and facilities. Support for these grants comes from the MCZ's Myvanwy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



Sally Gee



Lucie Queste



Nathaniel Edelman



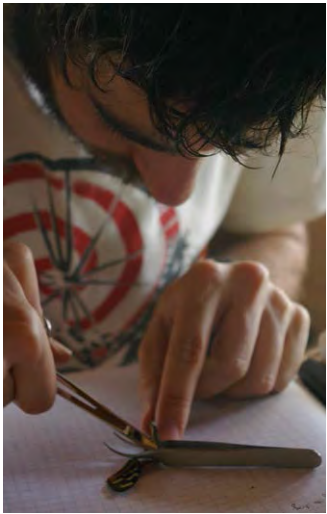
Rachel Moon



Christian Perez

Recipient	Faculty Sponsor/ Academic Dept.	Project Title	Amount
Hanna J. Barnes	Stephanie Pierce/ Organismic and Evolutionary Biology	Three-dimensional skeletal anatomy and limb joint mobility in the early tetrapod <i>Proterogyrinus</i>	\$1,725
Jarreth M. Caldwell	James Mallet/ Organismic and Evolutionary Biology	Pollen feeding in <i>Heliconius elevatus</i> and <i>H. pardalinus</i> : A potential mechanism for interspecies interactions	\$973
Stephanie N. Caty	Lauren O'Connell/ Organismic and Evolutionary Biology	Dressed to kill: Chemical ecology in the little devil frog	\$2,500
Stephanie N. Caty	Lauren O'Connell/ Organismic and Evolutionary Biology	Dressed to kill: Toxicity in the little devil poison frog	\$2,016
Christopher H. Chen	Robin Hopkins/ Organismic and Evolutionary Biology	Hybrid fitness, interspecific compatibility, and reinforcement in <i>Phlox</i>	\$700
Andrew D. Clark	Stacey Combes/ Organismic and Evolutionary Biology	Senior honors thesis on load lifting mud dauber wasps	\$1,500
Sally Gee	Elizabeth Wolkovich/ Organismic and Evolutionary Biology	Phenology and its relationship to plant functional traits of temperate trees in a changing climate	\$2,000
Elizabeth A. Karan	George Lauder/ Organismic and Evolutionary Biology	The evolution and structure of scales in damselfish (Pomacentridae)	\$600
Paige V. Kouba	Brian Farrell/ Organismic and Evolutionary Biology	Mosquito abundance in the Boston Harbor Islands	\$1,300
Fiona M. McAuley	Jonathan Losos/ Organismic and Evolutionary Biology	An exploration of thermal niche partitioning across four lizard species of the genus <i>Anolis</i> living on South Bimini	\$1,000
Jenna R. McGugan	Lauren O'Connell/ Organismic and Evolutionary Biology	Dietary contributions to chemical defences in the little devil frog, <i>Oophaga sylvatica</i>	\$1,000

Recipient	Faculty Sponsor/ Academic Dept.	Project Title	Amount
Rachel M. Moon	Jonathan Losos/ Organismic and Evolutionary Biology	Differences in morphology, ecology and escape behavior in female sex-limited polymorphic brown anole lizards (<i>Anolis sagrei</i>)	\$1,097
Ike O. Okonkwo	David Cox/ Neurobiology	Reverse engineering the visual system	\$1,000
Christian A. Perez	James Mallet/ Organismic and Evolutionary Biology	Mate preference in <i>Heliconius</i> butterflies: A potential underlying mechanism of sympatric speciation	\$600
Johnny L. Pulice	Kristen Bomblies/ Organismic and Evolutionary Biology	Genome scanning of <i>Chamerion angustifolium</i> for adaptation to whole-genome duplication	\$2,500
Michael W. Seward	David Haig/ Organismic and Evolutionary Biology	Nutrition interventions and healthy eating competitions at university dining halls	\$2,500
Alexander F. Weickhardt	George Lauder/ Organismic and Evolutionary Biology	Senior thesis project on the role of the dorsal fin in fishes	\$2,500
		Total Awards	\$25,511



Audrey Burns



Sally Gee

Robert G. Goelet Summer Research Awards

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

Recipient	MCZ Department	Project Title	Amount
Nathaniel Edelman	Mammalogy	The role of pheromones in speciation: Elucidating mechanisms of divergence in <i>Heleconius elevatus</i> and <i>H. pardalinus</i>	\$1,646
Nathaniel Edelman	Mammalogy	Characterizing the divergence of <i>H. pardalinus</i> and <i>H. elevatus</i> with respect to their post-zygotic isolation	\$5,778
		Total Awards	\$7,424



Michael Seward



Michael Seward



Ronald Mori



Ernst Mayr Travel Grants in Animal Systematics

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

Recipient	Institutional Affiliation	Project Title	Amount
David J. L. Agassiz	Natural History Museum, London	Taxonomic revision of Yponomeutidae (Lepidoptera) of Africa, also of Cybalomiinae (Lepidoptera: Pyraloidea, Crambidae) of sub-Saharan Africa	\$1,225
Mariana Raquel Chani-Posse	Natural History Museum of Denmark	Revision of type material of Philonthina Kirby and Hyptiomina Casey (Coleoptera: Staphylinidae) from the Neotropical region, and assessment of the distribution of <i>Holisus</i> Erichson in the Afrotropical region	\$1,500
Sandor Csoz	California Academy of Sciences	Taxonomic revision of the Malagasy <i>Nesomyrmex</i> fauna (Hymenoptera, Formicidae)	\$1,190
Itanna Oliveria Fernandes	National Museum of Natural History, Smithsonian Institution/ Instituto Nacional de Pesquisas da Amazônia	CAS Entomology general collection: Examination of <i>Anochetus</i> Mayr, 1861 (Hymenoptera: Formicidae: Ponerinae)	\$1,000
Roberto J. Guerrero	Universidad Central de Venezuela	Taxonomic revision of the ant genus <i>Tapinoma</i> Förster (Hymenoptera: Formicidae: Dolichoderinae) in the neotropical region	\$1,500
Jane Herrera Uria	National Museum of Natural History of Cuba	Taxonomic revision of <i>Priotrochatella</i> H. Fischer, 1893 from Isla de la Juventud, Cuba	\$1,500
Jesse T. Kelly	Auckland University of Technology	Systematics of the Octopoteuthidae Berry, 1912 (Cephalopoda: Oegopsida)	\$1,500
Siddharth Shrikant Kulkarni	Yashwantrao Chavan Institute of Science, Satara	Examination of specimens of genus <i>Latrodectus</i> (Araneae: Theridiidae) from the oriental region deposited at Senckenberg Museum, Frankfurt; MNHN, Paris and CAS, USA	\$1,500
Xiaoyan Li	Natural History Museum of Denmark	Systematics of the hyper-diverse rove beetle subtribe Paederina (Coleoptera: Staphylinidae: Paederinae)	\$1,500
Zachary E. Lieberman	College of Marin	A taxonomic revision of the cryptic plate-nosed ants of Africa (Formicidae: Proceratiinae: <i>Discothyrea</i> Roger)	\$1,500

Recipient	Institutional Affiliation	Project Title	Amount
Carlos Alberto Martínez Muñoz	Ecological Reserve "Mogotes de Jumagua," Villa Clara, Cuba	Review of <i>Scolopendra</i> types and Cuban scolopendromorphs at the MCZ	\$1,500
Sameer Mukund Padhye	Wildlife Information Liaison Development Society, India	Taxonomical re-assessment of Spinicaudata (Crustacea: Branchiopoda) with special reference to family Cyzicidae from Daday de Dees's Indian collection in the Muséum National d'Histoire, Paris	\$1,500
Kristene T. Parsons	Virginia Institute of Marine Science, College of William and Mary	Taxonomic review of <i>Gymnura micrura</i> (Myliobatiformes: Gymnuridae) with the description of a new species of Butterfly Ray from the western North Atlantic	\$1,204
Matthew M. Prebus	University of California, Davis	The ant genus <i>Temnothorax</i> : A revision of the <i>salvini</i> species group	\$1,390
Paula Fernanda Motta Rodrigues	University of São Paulo	Systematic and biogeography of Ecliminae Hall, 1969 (Diptera: Bombyliidae)	\$1,500
Michele Rossini	University of Urbino Carlo Bo, Italy; Federal University of Mato Grosso (Brazil)	Taxonomy, phylogeny and biogeography of the hirculus group of the American <i>Onthophagus</i> (Coleoptera: Scarabaeinae: Scarabaeinae)	\$1,500
Thiago Borges Semedo Fernandes	Universidade Federal de Mato Grosso, Cuibaba	Elucidating the taxonomic status of the spiny mice, genus <i>Neacomys</i> , Thomas, 1900 (Rodentia: Cricetidae) from eastern Amazonia, Brazil	\$1,500
Fabio Laurindo da Silva	Harvard University	Taxonomy and phylogenetic relationships of non-biting midges in the subfamily Tanypodinae (Diptera: Chironomidae)	\$1,500
Rodet Rodriguez Silva	Institute of Ecology and Systematics, Cuba	Revision of the Cuban freshwater fishes hosted in the MCZ at Harvard University	\$1,500
Thiago da Silva Moreira	The George Washington University	Systematics and phylogenetics of Neotropical Linyphiidae	\$1,000
Total Awards			\$28,009



Carlos Alberto Martínez Muñoz



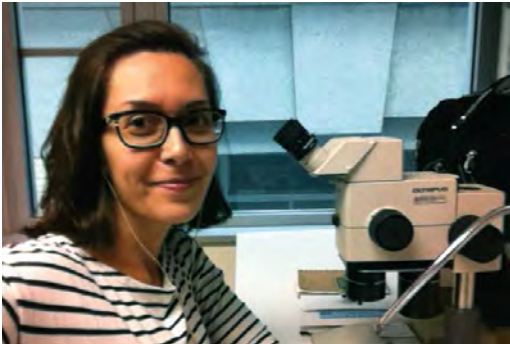
Rodet Rodriguez Silva



Tatiana Sepulveda



Siddharth Kulkarni & Jeremy Miller



Itanna O. Fernandes



Andrew Williston



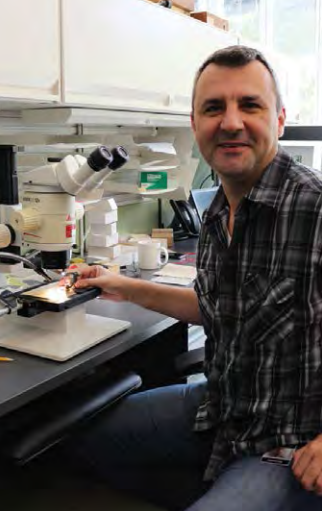
Matt Kohlmann



Allison Devlin



Roberto J. Guerrero, Smithsonian National Museum of Natural History



Sandor Csoz



Paula Fernanda Motta Rodrigues



AWARDS & RECOGNITION



Rose Lincoln

Scott V. Edwards

Emeritus

Richard Lewontin and Tomoko Ohta were awarded the Royal Swedish Academy of Sciences Crafoord Prize in Biosciences for their pioneering analysis and fundamental contributions to the understanding of genetic polymorphism.

Edward O. Wilson was awarded the Green Prize for Sustainable Literature, Pioneer Award, sponsored by the Santa Monica Public Library and the City of Santa Monica's Office of Sustainability and the Environment. His 2014 book, *The Meaning of Human Existence*, was a National Book Award Finalist.

Faculty

Scott V. Edwards was inducted into the U.S. National Academy of Sciences in recognition of his distinguished and continuing achievements in original research.

Gonzalo Giribet was elected a Corresponding Member of the Biological Sciences Section of the Institute of Catalan Studies, Catalanian Academy of Sciences. He gave the Presidential Lecture at the 3rd International Congress of Invertebrate Morphology at Humboldt University, Berlin, and the Peter Ax Lecture at the 107th Annual Meeting of the German Zoological Society, Göttingen.



James Hanken

James Hanken was Chief Guest at International Peradeniya University Research Sessions (iPURSE) at the University of Peradeniya, Sri Lanka.

Hopi E. Hoekstra received the Richard Lounsbery Award from the U.S. National Academy of Sciences for her work probing the molecular basis of how adaptation to novel selective pressures establishes and sustains diversity during evolution.

Staff

Ronnie Broadfoot, Ernst Mayr Librarian, and **Megan McHugh**, Human Resources Coordinator, each received a Dean's Distinction Award, which recognizes outstanding citizenship and exceptional contributions in support of the Faculty of Arts and Sciences' mission.

Postdoctoral Researchers

Andrés Bendesky was awarded a NIH K99 Pathway to Independence Award for his work on the genetics of social behavior.



Katrina Jones

Katrina Jones was awarded the Society of Vertebrate Paleontology Alfred Sherwood Romer Prize for best PhD dissertation talk.

Stefani Fortana



Molly Renfer

Paige Kouba

Ricardo Pérez-de la Fuente was awarded the X Edition Ramon Margalef secondary award for the best science paper derived from a PhD carried out at the University of Barcelona during the previous four years.

Mary Caswell (Cassie) Stoddard received the Cooper Ornithological Society Young Professional Award, the Jasper Loftus-Hills Young Investigator Award from the American Society of Naturalists, and the L'Oréal-UNESCO For Women in Science International Rising Talent Award.



Mary Caswell Stoddard

Graduate Students

Emily Hager and **Talia Moore** were awarded the Robert A. Chapman Memorial Fellowship.

Zachary Lewis received an honorable mention for the Brian K. Hall Award from the Canadian Society of Zoologists.

Undergraduates

Hanna Barnes received a Harvard College Research Program grant for her research on the skeletal anatomy of the early tetrapod *Proterogyrinus*.

Paige Kouba was awarded the Herchel Smith Harvard Undergraduate Research Program award for her research on mosquito abundance and diversity in the Boston metro area.

Graduating seniors **Young-Mi Kwon** and **Tess Linden** were awarded the Thomas T. Hoopes Prize for their outstanding senior theses: "The genetic basis of parental care in *Peromyscus*" (Kwon) and "The role of Agouti isoforms in the evolution of convergent pigmentation phenotypes in *Peromyscus* mice" (Linden).

Linden was also awarded Harvard's Trustman Traveling Fellowship to fund research on orchid-bee coevolution in Costa Rica. Kwon was also awarded a prestigious Herchel Smith Postgraduate Traveling Scholarship to study cancer genetics in Tasmanian devils at Cambridge University.



Carolyn Eng

Zachary Lewis

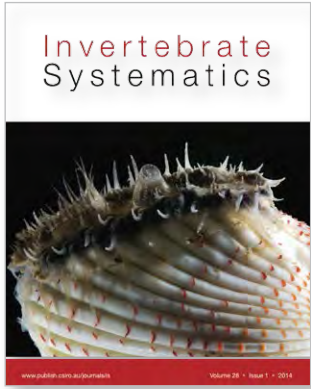


Lukas Raab

Tess Linden



MCZ PUBLICATIONS IN CALENDAR YEAR 2014



For the cover story, **Gonzalo Giribet, Vanessa L. González, Gisele Y. Kawauchi, Alejandra Guzmán, Erin McIntyre** and colleagues contributed “Investigating the Bivalve Tree of Life—an exemplar-based approach combining molecular and novel morphological characters.”



Gonzalo Giribet, Rosa Fernández and colleague published “Phylogenomic analysis of spiders reveals nonmonophyly of orb weavers.”

- **Andrade SCS**, Montenegro H, Strand M, Schwartz M, Kajihara H, Norenburg JL, Turbeville JM, Sundberg P, **Giribet G** (2014) A transcriptomic approach to ribbon worm systematics (Nemertea): resolving the Pilidiophora problem. *Mol Biol Evol* 31:3206-3215
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“Walk it off: Predictive power of appendicular characters toward inference of higher-level relationships in Laniatores (Arachnida: Opiliones)” by **Gonzalo Giribet** and colleagues was featured on the cover.



Gonzalo Giribet, Erin McIntyre and colleagues contributed “The first phylogenetic analysis of Palpigradi (Arachnida)—the most enigmatic arthropod order.”

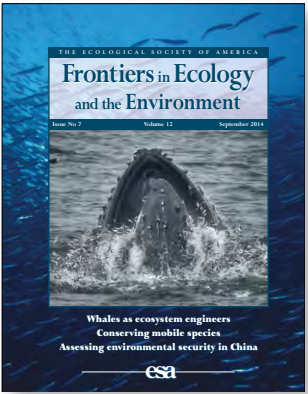


For the cover story, **Jonathan B. Losos, D. Luke Mahler** and colleagues published “Island biogeography of the Anthropocene.”

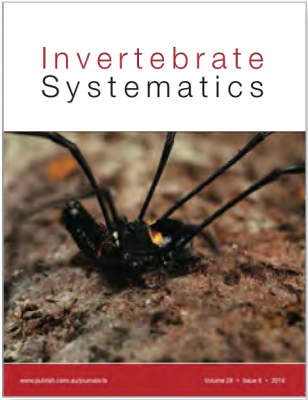




Research published by **Gonzalo Giribet** and colleagues, “The Global Invertebrate Genomics Alliance (GIGA): Developing community resources to study diverse invertebrate genomes,” was featured as the cover story.



“Whales as marine ecosystem engineers” by **James J. McCarthy**, **Joe Roman** and colleagues was featured on the cover.



Gonzalo Giribet, **Sebastián Vélaz** and **Rosa Fernández** published “A molecular phylogenetic approach to the New Zealand species of Enantiobuninae (Opiliones: Eupnoi: Neopilionidae).”

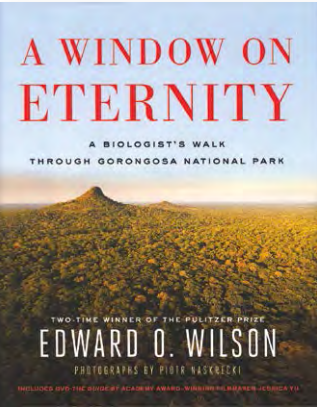
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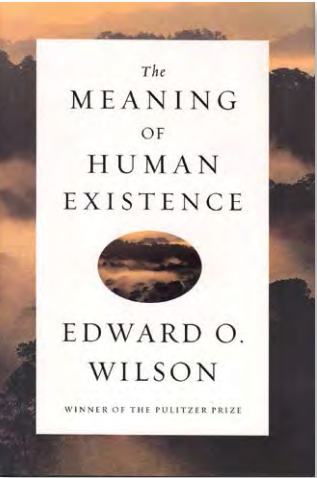
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A Window on Eternity by **Edward O. Wilson** describes and depicts one of the biologically richest places in Africa—and perhaps in the world—Gorongosa National Park in Mozambique.



In *The Meaning of Human Existence*, **Edward O. Wilson** examines what makes human beings supremely different from all other species.

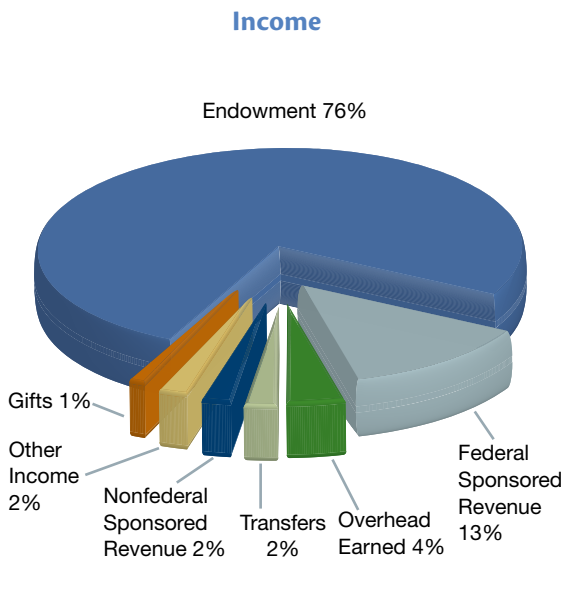


FINANCIAL DATA

These charts describe the income and expenses of the Museum of Comparative Zoology in fiscal year 2015.

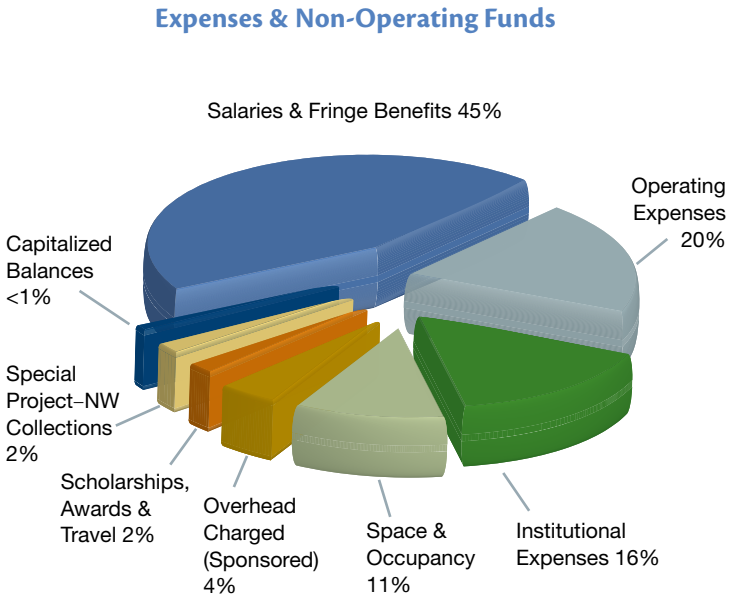
Endowment income funds much of the Museum’s activities, including acquisition and maintenance of collections, faculty and staff salaries, capital projects, facilities renovation and maintenance. Included in **Endowment** income is the annual distribution, revenue generated from assets purchased through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

and expenses (**Overhead Charged**). **Special Project–NW Collections** includes deployment of collections to the newly constructed space in the Northwest Building. Building expenses such as maintenance, facility improvements and utilities are captured in the **Space & Occupancy** category. **Operating Expenses** consist of equipment purchases, supplies, and consultant and conference fees, as well as annual subventions to the Department of Organismic and Evolutionary Biology (OEB) for administrative services. Support for MCZ-affiliated graduate students in OEB is included in **Scholarships, Awards & Travel**. **Institutional Expenses** are support for other University activities outside the MCZ, including FAS and University initiatives and general operating support to the Harvard Museum of Natural History.



Income

Endowment	\$14,585,748
Federal Sponsored Revenue	\$2,582,779
Overhead Earned	\$847,394
Transfers	\$426,151
Nonfederal Sponsored Revenue	\$350,679
Other Income	\$328,719
Gifts	\$121,820
Total	\$19,243,290



Expenses

Salaries & Fringe Benefits	\$8,630,113
Operating Expenses	\$3,698,538
Institutional Expenses	\$2,947,850
Space & Occupancy	\$2,135,514
Overhead Charged (Sponsored)	\$841,339
Scholarships, Awards & Travel	\$438,480
Special Project–NW Collections	\$293,718
Capitalized Balances	\$52,580
Total	\$19,038,132

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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.

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Mr. George Putnam III
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