Media Inquiries: Kendra Snyder, Department of Communications
212-496-3419; ksnyder@amnh.org
www.amnh.org

September 2020

U.S. NATIONAL SCIENCE FOUNDATION AWARDS THREE GRANTS TO MUSEUM SCIENTISTS

PROJECTS WILL FOCUS ON THE IMPACTS OF BATS ON HUMAN HEALTH AND ECOSYSTEMS, DISCOVERING "OVEREXCITED PLANETS" NEAR OUR SUN, AND THE DEVELOPMENT OF NEW METHODS TO COLLECT DNA FROM HISTORICAL SPECIMENS

Scientists at the American Museum of Natural History have received three grants from the U.S. National Science Foundation (NSF) to conduct research in wide-ranging areas: bats and their bearings on ecosystems and human health; the search for new worlds lurking in our solar neighborhood; and the exploration and development of innovative ways to collect DNA from historical specimens up to 140 years old. The multi-year grants will advance the Museum's dual mission of science and education by helping researchers discover, interpret, and disseminate knowledge about the natural world.

Building global bridges to explore how bats impact ecosystems and human health

There are more than 1,400 living species of bats around the world, and they each play crucial roles in their ecosystems, including pest management, pollination, and forest regeneration. However, key aspects of bat biology, from the causes and consequences of population declines to their natural ability as hosts to tolerate virus infections by minimizing damage from pathogens—a trait that may provide clues to solutions to deal with the COVID-19 crisis—remain poorly understood.

To coordinate and drive bat research forward, NSF is funding the establishment of the Global Union of Bat Diversity Networks (GBatNet)—a group of 14 pre-existing bat research networks with a shared vision to address pressing questions in bat biology related to ecosystems and human health. This "network of networks" creates new avenues for

global research exchange through coordination of joint research, education, and outreach and brings together experts in paleontology, evolution, morphology, ecology, virology, genomics, and conservation.

"The goal is to better coordinate research and conservation on a global scale, but also to foster communication of accurate science about bats to the public," said Nancy Simmons, curator and chair of the Museum's Department of Mammalogy and one of three principal investigators for the project. "GBatNet will fill key knowledge gaps and create an international structure to accelerate discoveries across disciplines and borders."

The roughly $1.67 million grant, awarded by NSF's Accelerating Research through International Network-to-Network Collaborations program, is shared among three institutions — the Museum, Stony Brook University, and Texas Tech University. Activities will include annual meetings and interdisciplinary synthesis sessions, the development of public outreach materials, professional development of the next generation of bat scientists in integrative research, and the integration of existing datasets to create interdisciplinary tools and protocols. One of GBatNet's primary goals will be to build and test predictive models of species vulnerability to ongoing habitat change, emerging infectious diseases, and climate change.

Finding new worlds through the power of citizen science

Since 2017, citizen scientists have flagged more than 1,500 potential new worlds in our solar neighborhood using their eyes, an internet connection, and a platform co-founded by the Museum and funded by NASA called Backyard Worlds: Planet 9. The project's more than 150,000 participants sift through images captured by NASA's Wide-field Infrared Survey Explorer (WISE) mission, searching for previously unknown objects lurking in the outer reaches of our solar system and in neighboring interstellar space. The Backyard Worlds science team has confirmed a number of these discoveries as brown dwarfs, objects spread throughout the Milky Way that are more massive than planets but lighter than stars and highly relevant to studies about star and planet formation. A roughly $457,000 Astronomy and Astrophysics Grant from NSF will help Backyard Worlds researchers follow up on the backlog of candidate brown dwarfs identified by volunteers.

"When we first started Backyard Worlds, we recognized the potential of WISE as a discovery engine for nearby brown dwarfs, but I don't think any of us anticipated just how active this citizen-science-fueled tool could be," said Jackie Faherty, a senior scientist at the Museum and a principal investigator on the project. "These volunteers have revealed objects that professional scientists may never have found, and they are doing so at an incredibly quick rate."

The award is collaborative between the Museum, the University of California San Diego, and the University of Arizona and will support investigations of high-priority brown dwarf candidates using ground-based telescopes including Magellan, Gemini, Keck, and others. The grant will also support the development of high-school-level educational materials that will be incorporated into Museum programs and then made publicly available through ZooTeach, a companion website to Zooniverse, which hosts the Backyard Worlds platform.

Unlocking the incredible potential for museum specimens to yield DNA

Discoveries made by Museum scientists don't just happen in the field; they often occur in the shelves of the collection or even among items on public display. These traditional museum collection specimens—a pinned insect, the "skin" of a bird, a lizard kept in alcohol, or the skeleton of a bat, for example—were once considered poor sources of DNA. But thanks to recent advances in technology, they offer potential as a vast biological resource for historical DNA (hDNA) that could provide an unparalleled record of biodiversity over the last 200 years. In particular, the rise of high-throughput sequencing platforms (using short DNA fragments) provides a more efficient means of sampling the hDNA genome. However, hDNA's potential has hardly been explored, with current "home brew" procedures for DNA extraction often relying on approaches tested on few specimens and optimized for specific projects. Consequently, scientists still have a poor understanding about how DNA degrades with time and across different museum specimen types. To develop new protocols for hDNA extraction and bioinformatic processing using diverse museum specimens, the Museum has received an $800,000 grant from NSF's Division of Biological Infrastructure.

The principal investigators on the grant—Chris Raxworthy, a curator in the Department of Herpetology, and Brian Smith, an associate curator in the Department of Ornithology—will lead the sampling of amphibians (microhylids), reptiles (chameleons), and birds (lorikeets), ranging in age from 1-140 years and preserved with various techniques, which are now archived in the Museum's rich historical collections.

"The goal of this work is to establish the optimal methods for obtaining hDNA from a specimen, whether it's a chameleon that was collected 30 years ago in Madagascar and frozen or fixed in the field, or a parrot dry skin that's been in the Museum's research collection for the last 140 years," Raxworthy said. "This project has the potential to increase by more than 100 fold the availability of historical DNA samples to scientists. It also allows the genetics and epigenetics of extinct species and populations to be studied and provides exciting new opportunities to determine how genetic diversity has changed during the Anthropocene."

"We are only at the beginning of unlocking the vast amount of information available in the millions of specimens stored in museums," Smith said. "The development of new and more rigorous approaches for studying hDNA will be critically important to the research community."

ABOUT THE AMERICAN MUSEUM OF NATURAL HISTORY (AMNH)

The American Museum of Natural History, founded in 1869 and currently celebrating its 150th anniversary, is one of the world's preeminent scientific, educational, and cultural institutions. The Museum encompasses more than 40 permanent exhibition halls, including those in the Rose Center for Earth and Space, as well as galleries for temporary exhibitions. The Museum's approximately 200 scientists draw on a world-class research collection of more than 34 million artifacts and specimens, some of which are billions of years old, and on one of the largest natural history libraries in the world. Through its Richard Gilder Graduate School, the Museum grants the Ph.D. degree in Comparative Biology and the Master of Arts in Teaching (MAT) degree, the only such free-standing, degree-granting programs at any museum in the United States. The Museum's website, digital videos, and apps for mobile devices bring its collections, exhibitions, and educational programs to millions around the world. Visit **amnh.org** for more information.

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