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Testimony of Dr. Kirk Johnson
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Introduction

Thank you, Mr. Chairman and distinguished members of the Subcommittee. It is an honor to appear before the Subcommittee to discuss scientific research, collections and the public impact of the Smithsonian's National Museum of Natural History (NMNH). My name is Kirk Johnson and I have served as Sant Director at the National Museum of Natural History since October 2012.

The Smithsonian's National Museum of Natural History houses most of the founding collections of the Smithsonian Institution. Over the last 167 years, these collections have grown to include more than 127 million objects, specimens, and artifacts, and have become the largest and most comprehensive sample of the Earth's diversity. These collections are an irreplaceable scientific tool that is used by more than 11,000 scientists each year. With nearly 8 million visitors in 2013 alone, NMNH is also the most popular natural history museum in the world.

Visitors of all ages come to the Museum from across the nation and around the world because they are curious about the natural world and because they want to see things that can only be seen in a museum of this size and scope. They come to see the dazzling Hope Diamond and to be in the presence of the real Jurassic Park. They come to understand meteorites, to learn how gemstones form, to discover the causes of earthquakes and tsunamis, to see live rainforest butterflies, to understand the deep history of humanity, and to share engaging and exciting learning experiences with family and friends. More is on the way as a spectacular *Tyrannosaurus rex* (T. rex) fossil from Montana will be transported to the Museum this year to anchor our new National Fossil Hall.

In the past, most of our visitors have been unaware that our exhibitions and public programs are just the tip of the iceberg and that there is a vast scientific research enterprise operating behind the scenes. In order to make our experts and their work more accessible to students, parents and teachers, we have just opened a new 10,000-square-foot learning center that we call *Q?rius* (pronounced "curious"). Seven years in the making, *Q?rius* is both a place and an experience, a new way for teens– and their families and educators – to connect science with everyday life. In *Q?rius*, the full range of our science and collections will be directly accessible to our huge public audience in a way that is interactive and hands-on. Students and teachers outside our nation's

capital will have easy access to much of what we offer through a menu of online and digital outreach options.

This Museum belongs to each and every American, and stands as a vital resource for scientists and a window into the natural world for millions of people each year. Nurturing and expanding the work and educational reach of the National Museum of Natural History is an investment in our nation's future.

We thank the Chairman and this Committee for their steadfast interest and support. I now wish to provide the committee with background on the Museum, discuss recent accomplishments and address some of the issues and challenges we will face in the future.

Scientific Research and Collections

Science is the foundation of the National Museum of Natural History and, in many respects, of the Smithsonian Institution, itself. The Museum currently supports collection-based research in three thematic areas: the formation and evolution of the Earth and similar planets; the discovery and understanding of life's diversity; and the study of human diversity and cultural change.

NMNH is organized into seven departments: anthropology, botany, entomology, mineral sciences, invertebrate zoology, paleobiology, and vertebrate zoology. We have on staff 84 scientists—including the largest concentration of biodiversity scientists on Earth. Our scientists travel to ocean depths, the peaks of the Andes, Africa's Rift Valley, the rainforests of South America, and the deserts of Central Asia, and of course, to every area of our own nation. They are routinely evaluated by their peers as world experts in their field. Four members of the National Academy of Sciences are currently on the NMNH staff. These scholars and approximately 200 postdoctoral or resident researchers, produce, on average, 600-700 scholarly publications per year. Over the Museum's history, our scientists have published more than 40,000 books and articles and, in so doing, have made a profound contribution of our collective understanding of the natural world.

NMNH scientists collaborate with universities and research centers in every state in the nation and conduct research in more than 80 countries around the world. Scientists from around the world visit the NMNH to access our collections and scholars. Last year we hosted more than 11,000 distinct research visitors to our collections, for a total of 25-30,000 visitor days. They come here in such great numbers because our scientists and collections are a unique scientific resource. In addition to hosting scholars that come to Washington to research our collections, we also travel these resources. At any given time, over two million NMNH objects are on loan to national and international research organizations. As a result of these activities, Smithsonian natural history collections are cited in more than 1,200 (non-Smithsonian authored) scientific publications annually.

In addition to their basic research, our scientists also train the next generation of scientists. In just the last fiscal year, NMNH training reached 743 academic appointments, 374 citizen scientist volunteers, 465 interns, and 254 research students and postdoctoral researchers.

The 1846 legislation that created the Smithsonian Institution identified the U.S. National Museum (as the NMNH was originally known) as the repository for natural history specimens belonging to the United States:

> "All collections of rocks, minerals, soils, fossils, and objects of natural history, archaeology, and ethnology, made by the National Ocean Survey, the United States Geological Survey, or by any other parties for the Government of the United States, when no longer needed for investigations in progress shall be deposited in the National Museum" (20 U.S.C. § 59).

That role of steward of the U.S collections has been emphasized by legislation, and evidenced by the steady growth and diversification of the collections. The Smithsonian is honored to ensure these precious holdings and shared vital research infrastructure are preserved and strengthened for the benefit of both our country and the global scientific research enterprise.

We work in partnership with several federal bureaus to advance the impact of federally-funded science. Affiliated U.S. government agencies contribute immeasurably to the Museum's strength as a research center and depend heavily on our collections in conducting research. Several of them house their collections and scientific staff at the NMNH. These include the Department of Interior (the Fish and Wildlife Service and the U.S. Geological Survey), the Department of Agriculture (the Systematic Entomology Laboratory), the Department of Commerce (the National Marine Fisheries Service Systematics Laboratory), the National Oceanic and Atmospheric Administration, and the Department of Defense (Walter Reed Biosystematics Unit). Some 50 professionals from other federal agencies work full time at NMNH because our science and collections are vital to their applied missions.

Our interagency collaboration also extends to ensure a systematic approach to safeguarding scientific collections under the stewardship of the federal government. As recognized by the America COMPETES Act of 2010, the proper management, documentation, preservation, and accessibility of collections are critical to the nation's research and education infrastructure. The preservation and management of Federal scientific collections is recognized as part of the long-term infrastructure needs and responsibilities of Federal scientific agencies. The Museum serves as a leader in the Federal community by the excellent progress we have made and the professional standards we establish in collections management to ensure all scientific, cultural and historical collections are preserved and remain accessible for current and future generations. We prioritize our collection care efforts using four key collection metrics (condition, information content, importance, and outreach potential) and use this approach to continually improve the quality of the collection. Taken together, these efforts have produced the largest, most comprehensive natural history collection in the world.

Collection-based research plays a vital role in addressing contemporary challenges. NMNH scientists and their colleagues worldwide seek the puzzle pieces that will form detailed pictures of vital topics such as evolutionary relationships of organisms, biodiversity loss and global change. The collections' relevance to science and society continues to grow and evolve as new technologies are applied to their study and analysis.

For our presentation to Subcommittee we have brought a few objects and the scientists who study them as examples of how collection-based scientific research is relevant to the concerns of society today.

1. Bird-strikes and airplanes: The research of Dr. Carla Dove

   When US Airways Flight 1549 landed in the Hudson River on January 15, 2009, the world became even more aware of the hazards that birds can cause to flight safety. What many people did not realize was that for more than 50 years researchers at the National Museum of Natural History have been working behind the scenes to provide data to the Federal Aviation Administration (FAA), the U.S. Air Force and Navy, and to engine manufacturers such as General Electric and Pratt & Whitney, regarding the species identifications and weights of birds that are struck by aircraft. Knowing the natural history of problematic species will help reduce the damaging costs of bird-strikes on airfield environments and improve aviation safety.

   Currently, the FAA reports nearly $500 million in damages annually from bird-strikes and last year alone the United States Air Force suffered three Class A bird-strikes (incidents that resulted in loss of life or more than $2 million in damage).

   So, when Captain Chesley "Sully" Sullenberger made his emergency landing into the Hudson River on that cold January day, highly trained researchers at the Smithsonian were ready to investigate. The first feathers pulled from the engines were hand-carried to the Museum by United States Department of Agriculture colleagues. Scientists at the Museum's Feather Identification Lab used DNA barcoding methods and stable hydrogen isotope analysis to identify the species as Canada Goose, and determined that the birds were from a migratory population rather than resident birds.

   This information highlights the need to focus future research on bird migration patterns while maintaining the current wildlife management strategies on airfields. Museum scientists have identified the following issues and concerns:

   - Since 1988, civil aviation reports 231 people have been killed as a result of bird strikes, with more than 220 aircraft destroyed.
   - United States Air Force reports over 4,500 bird-strikes each year
   - Large birds such as Canada Geese, Bald Eagles, White Pelicans, Black Vultures, cause the most damage and are increasing in population numbers
   - Since the Hudson River event, the Smithsonian's Feather Identification Lab has experienced a 146% increase in identification case-work from civil aviation alone.
   - FAA does not require bird-strike reporting, or that remains be identified. We estimate that only about 25% of the strikes are linked to the type of bird that caused them.

2. Meteorites and Fireballs: The research of Dr. Tim McCoy

   The explosion of the Chelyabinsk meteorite over Russia on February 15, 2013 was marked by a spectacular fireball recorded by dashboard cameras. The sonic boom burst windows on the ground and injured hundreds of people. The meteorite that produced this fell as thousands of stones, the largest of which was only recently recovered from a lake bottom and weighs nearly half a ton. Smithsonian scientists acquired samples of the meteorite and continue to

study these and similar stones to understand their remarkable history from the birth of the Solar System 4.5 billion years ago to the danger that they pose to society today.

3. Three-Dimensional Printing and Fossil Whales: The research of Dr. Nick Pyenson.

   This scale 3D print shows the skeleton of a 7 million year old whale. Smithsonian and Chilean scientists scanned the original skeleton only days before the site where it was found was bulldozed to expand the Pan-American Highway. The three-dimensional data now provides an exact record of the skeleton, as it was originally found, for future generations to study. This technique allowed for construction to proceed without the loss of a scientifically important discovery.

4. A new species of mammal discovered in 2013: The research of Dr. Kristofer Helgen

   The olinguito (*Bassaricyon neblina*) is the smallest member of the raccoon family and the first new species of carnivore discovered in the Americas in 35 years. Curator Kristofer Helgen and his team used data from overlooked museum specimens to describe this new mammal and to find and study it in the wild in the Andes Mountains. The discovery of the olinguito has drawn global attention to the Andes' endangered cloud forest habitats, illuminates the fundamental scientific importance of museum collections, and shows how much of the biological world remains to be explored by scientists.

Exhibitions, Education, and Outreach

Science will inform solutions to many of the environmental, health and economic challenges of our time. Yet America faces a deficit of scientific understanding. In a 2009 international assessment of scientific literacy, American high school students ranked behind their peers from 12 other developed nations. Only 1% of our 12th graders are performing at an advanced level in science. In fact, most are failing to reach the proficient level in science, as determined by the National Assessment of Educational Progress.

As the most visited natural history museum in the world, we have the opportunity and responsibility to ignite the minds of the next generation of STEM (Science, Technology, Engineering, and Mathematics) professionals; and inspire lifetime learners to discover the science behind current environmental issues that affect our daily lives.

We presently welcome 8 million annual visitors – and many millions more online. A recent visitor survey revealed that 84 percent of our visitors are visitors to Washington, D. C. New information and social media technologies enable us to reach broader audiences, and online information now accompanies all major exhibitions. As a result, the number of online visits to the Museum's websites and social media followers continues to increase and we are able to reach an even broader audience. We also collaborate with the Smithsonian Channel, Smithsonian Magazine, and other media outlets to introduce our collections and experts into homes across the country and the world.

From the sea creatures in the Sant Ocean Hall to the iconic Hope Diamond in the Janet Annenberg Hooker Hall of Geology, Gems and Minerals, the Museum combines cultural artifacts and specimens with engaging stories and innovative technology to connect visitors to

stories of the natural world and its peoples. Our exhibitions invite visitors to ask questions and to explore answers using evidence, objects and interactive experiences. Responsive to our rapidly changing world, our exhibitions showcase topical science by our own researchers and our many partners. The exhibitions provoke discovery and inquiry, and encourage an appreciation of the natural and cultural processes that shape our world.

Anchoring the Museum are exhibitions that delve into the science of such complex and far-reaching topics as the history and dynamics of Earth and other planets; the evolution, diversity, and interdependence of life; and human evolution, diversity and culture. The Sant Ocean Hall communicates the critical message that the ocean is a global ecosystem essential to all life on our planet, including our own. In the David H. Koch Hall of Human Origins, visitors can walk through six million years of humans' evolutionary history and explore how dramatic climate change drove evolution of the characteristics that make us human. Visitors can get to know more than 60 of our mammal relatives in the Kenneth E. Behring Family Hall of Mammals.

We are just beginning a complete renovation of our National Fossil Hall, where the popular dinosaur fossils are housed. It is one of the Museum's most ambitious projects yet and the resulting exhibition will leverage our understanding of the Earth's past to inform our choices about its future. A centerpiece of the new National Fossil Hall will be a spectacular *Tyrannosaurus rex* (T. rex) skeleton from Montana, that will be transported to the Museum in April 2014. The T.rex is on long-term loan to the Museum from the U. S. Army Corps of Engineers.

We also host a series of temporary exhibits. Most recently, the Museum partnered with National Human Genome Research Institute at the National Institutes of Health (NIH) to create the exhibition, *Genome: Unlocking Life's Code*. The remarkable collaboration between NIH and the Smithsonian marked two important milestones: 60 years since Watson and Crick's discovery of the DNA double-helix and 10 years since the completion of the first human genome sequence. It builds on the strengths of both institutions to engage visitors many aspects of genomics: how genomes impact society, health, and the natural world. An experiential science learning laboratory in the exhibition–the Genome Zone–staffed by trained volunteers, features activities for all ages including opportunities to isolate one's DNA, and engaging sessions with scientists. The exhibition and its engaging education programs continue to be an enormous success, and venues around the country are now being identified to host the exhibit when it closes at the Smithsonian in September.

Through the exceptional content of our educational programs and exhibitions, we are creating experiences for our visitors of all ages. They are experiencing how relevant science is to them and how relevant they are to science.

Last month, we opened *Q?rius* (pronounced "curious"), a new 10,000 square feet learning center. With a name chosen to inspire curiosity and excitement, *Q?rius* is a first-of-its-kind interactive and experimental environment that brings the Museum's science, scientists, and collections onto the floor, and invites visitors to be an active and contributing part of this dynamic and engaging community. The following is a sample of *Q?rius* experiences.

Smithsonian Science Now, is a series of live webcasts that features Smithsonian experts and real-world science. Viewers see how these experts use tools and technology in their work, and

how the science is connected to their lives. Targeted to the classroom, each 25-minute interactive webcast introduces students to core science concepts through the lens of Smithsonian research and experts, providing students with positive STEM role models and a connection to science in their lives. A package of classroom activities, lessons, readings and other related resources will are accessible online, free of charge, to support each webcast program.

Earlier, you had the opportunity to meet Dr. Nick Pyenson and learned how he uses modern digitization techniques to study fossil whales. Imagine a wide-eyed middle school student having a similar experience, able to ask questions and participate in authentic science along with Dr. Pyenson. This Thursday, January 16, students will have that chance when Dr. Pyenson will be the featured expert on a *Smithsonian Science Now* live webcast. I invite you to listen in through the website qrius.si.edu or at Smithsonian Science Now Fossil Whales Webcast. Next month, on Thursday, February 6, Dr. Carla Dove will be the featured expert to discuss her feather identification work to combat aircraft bird strikes. Each month *Smithsonian Science Now* will introduce you to one of the Museum's talented scientists.

Scientist-led programs offer opportunities in *Q?rius* to interact directly with scientists about their specialties, recent discoveries, or a topic in the news. Educator-led programs are facilitated experiences with fragile specimens or advanced topics to which participants can relate.

Since its inception in 2010, the Youth Engagement through Science program (YES!) has connected local youth with Smithsonian collections, experts, and training to inspire them to pursue science, technology, engineering, and mathematics (STEM) careers. The award-winning internship program provides youth from communities traditionally underrepresented in science careers with the resources needed to help them to achieve their ultimate goal of attending college. During six weeks in the summer, YES! students work side-by-side with Smithsonian researchers and educators. In early fall, interns rejoin us for a ten-week college preparatory program.

Self-guided activities are based on or inspired by research that Museum scientists are currently doing. Visitors use scientific equipment, such as microscopes, along with objects and digital resources to participate in solving problems or investigate ways to find answers to their own questions. In the *Reefs Unleashed* activity, for example, teens explore how scientists are inventing new technologies to identify the number and variation of species living in coral reefs, and how DNA analysis reveals lots of new information about previously unknown species.

Partnerships with many world-class science organizations ensure that our visitors encounter educational programs on topics relevant to their daily lives. Several educator positions are jointly funded with other government agencies to promote public learning around ocean science and genomics. These educators create programs, experiences and resources for students, adults and family audiences across the country.

The Museum is a leader in utilizing new technologies to engage the public in science: on-line, and in exhibitions, educational initiatives and programming. As we continue to expand our scientific knowledge, the Museum employs the latest innovations to make our research and collections available to the public.

Strategic Plans and Priority Initiatives

Since 2003, the Museum has engaged in two strategic planning processes: *Understanding Our World (2004 – 2009)* and *Knowledge for a Sustainable Future (2010 – 2015).* These plans set clear priorities, goals and outcomes for the Museum that build on our legacy and help us prepare to meet the challenges of tomorrow and take advantage of future opportunities

In addition to continuing broad explorations of nature and culture, the Museum has committed itself to advancing six priority interdisciplinary initiatives in areas. These initiatives have special relevance and urgency to society, where the Museum has a comparative advantage, and where we are poised to make substantial progress over the next decade. Three of these priorities – the Ocean Initiative, the Human Origins Initiative, and the Encyclopedia of Life – were identified in the 2004–2009 plan and have become reality. The other three – the Global Genome Initiative, Recovering Voices, and Deep Time – were identified in the most recent planning process and are now vibrant functioning programs.

Designed to be long-term and transformational for the Museum, these priorities build on our strengths, integrate our core functions (research, collections stewardship, and outreach), and expand our partnerships within the Smithsonian and with external collaborators. These initiatives and our core work – exploring and interpreting nature and culture – are enabling us to become the hub of a global network of institutions committed to the exchange of ideas and knowledge; advance the application of new methods and technologies to study our collections and share our resources with people across the globe; and play a key role in the training of future generations of scientists and museum professionals. Both of these plans have been made available to subcommittee members and staff. We would welcome your questions or comments.

I have talked about the remarkable collections and the enormous potential they have to help us understand the world in which we live. Our large and capable scientific staff ensures that we will explore the full potential of our collections and tackle emerging research opportunities worldwide. I expressed my belief that our public programs enable us to serve a unique and leading role in advancing science literacy for all Americans. The choices we make today and the direction we take will have a significant impact on future generations. For these reasons and countless others, it is my sincere conviction that the National Museum of Natural History is a unique world treasure, and a continuing source of American pride.

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