Outside Witness Testimony in Support of FY 2025 Funding for the National Science Foundation

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Subcommittee on Commerce, Justice, Science and Related Agencies

The Natural Science Collections Alliance appreciates the opportunity to provide testimony in support of fiscal year (FY) 2025 appropriations for the National Science Foundation (NSF). We encourage Congress to provide the NSF with **at least $11.9 billion** in FY 2025.

The Natural Science Collections Alliance is a non-profit association that supports natural science collections, their human resources, the institutions that house them, and their research activities for the benefit of science and society. Our membership consists of institutions that are part of an international network of museums, botanical gardens, herbaria, universities, and other institutions that contain natural science collections and use them in research, exhibitions, academic and informal science education, and outreach activities.

Scientific collections, and the collections professionals and scientists who make, care for, and study these resources, are an important component of our nation's research infrastructure. These collections and their associated experts contribute to the expansion of our bioeconomy. Whether held at a museum, government managed laboratory or archive, or in a university science department, these scientific resources form a coordinated network of specimens, samples, and data (e.g. genetic, tissue, organism, and environmental) that are a unique and irreplaceable foundation from which scientists are studying and explaining past and present life on earth.

Natural science collections advance scientific research and education, and that informs actions to improve public health, agricultural productivity, natural resource management, biodiversity conservation, and American economic innovation and productivity. Current research involving natural science collections also contributes to the development of new cyberinfrastructure, data visualization tools, and improved data management practices. This work also ensures critical input into policy development and implementation by several U.S. government agencies. A few examples of how scientific collections have saved lives, enhanced food production, and advanced scientific discovery include:

- Scientists used museum specimens in U.S. collections to gather data on the distribution of the mosquito *Culex quadrofaciatus*, which is known to carry West Nile Virus and other pathogens. They then modeled the distribution under different scenarios of changing

climates to predict regions where the species may expand in the future. Predicting the spread of disease vectors such as these mosquitoes helps the health care community prepare for disease outbreaks and where they will happen.

- Researchers from Boston University documented Tau proteins in the brains of fluid preserved museum specimens of Downy Woodpecker. These proteins are also found in traumatic brain injuries in humans. Because of the life history traits of woodpeckers, the researchers argue these birds may have evolved a level of resistance to traumatic head injuries that could have implications for treatments for humans.
- Citrus bacterial canker disease wreaks havoc on fruit crops in Florida. Using plant specimens collected a century ago, scientists have analyzed the bacterium and traced its source. Knowledge of how the bacteria spreads allows scientists to develop effective control methods and to protect the U.S. citrus industry.
- When the 2001 anthrax attacks happened in the United States, specimens collected decades earlier allowed researchers from the Centers for Disease Control and Prevention to quickly identify the strain involved.

Scientific collections enable us to tell the story of life on Earth. There are more than 1,600 biological collections in the United States. These resources are the result of more than 200 years of scientific investigation, discovery, and inventory of living and fossil species. Scientists have collected and curated more than one billion specimens within those collections, many of which have now been digitized with continued funding from NSF and the resulting data stored in easily accessible online databases that contribute heavily to research.

The institutions that care for scientific collections are important research infrastructure that enable other scientists to study the basic data of life; conduct biological, geological, anthropological, and environmental research; and integrate research findings from across these diverse disciplines. Their professional staff members train future generations with the tools and expertise required to move science forward. In-house institutional staff expertise is vital to the development and deployment of this critical research infrastructure.

According to the U.S. Interagency Working Group on Scientific Collections (IWGSC), "scientific collections are essential to supporting agency missions and are thus vital to supporting the global research enterprise." A 2020 report by the IWGSC presented a framework for estimating and documenting the long-term benefits, both monetary and non-monetary, generated by federal institutional collections. More recently, a 2023 report from the IWGSC enumerated the many ways federal scientific collections have served the nation in diverse areas, including with the COVID-19 response and improving national health, climate change research and mitigation, ensuring the nation's food security, as well as environmental health and safety.

Additional recent reports have highlighted the value of mobilizing biodiversity specimens and data in spurring new scientific discoveries. In 2019, the Biodiversity Collections Network issued a community-informed call for the development of an Extended Specimen Network. The report, "Extending U.S. Biodiversity Collections to Promote Research and Education," outlined a national agenda that leverages digital data in biodiversity collections for new uses. This endeavor requires robust investments in our nation's scientific collections, whether they are owned by a

federal or state agency or are part of an educational institution or free-standing natural history museum or another research center.

A 2020 report by the National Academies, *"*Biological Collections: Ensuring Critical Research and Education for the 21st Century," argued that collections are a critical part of our nation's science and innovation infrastructure and a fundamental resource for understanding the natural world. The report's recommendations for establishing an action center for biological collections and requiring specimen management plans for research proposals generating new specimens underscore the importance of biodiversity specimen collections and have been supported by the CHIPS and Science Act. A recently published white paper, "Envisioning a Natural History Collections Action Center," summarizes the features and functions of an action center and underscores the essential role that collections play in medical science, human health, food security, pathogen-borne disease, biosecurity, a strong bioeconomy, mitigating the effects of climate change, and conserving ecological services for human use and subsistence. Such a center will provide leadership, support, and coordination for federal, non-federal, and private collections and enable transformative research to address grand societal challenges.

All of the above reports articulate a common vision for the future of biological collections and emphasize the need to broaden and deepen these collections and associated data to realize their potential to inform 21st century science. Because NSF is the only agency that supports research in all fields of science, it is ideally suited to lead a national effort to establish the action center and build the Extended Specimen Network, which will require the engagement of computer and information scientists, geoscientists, life and environmental scientists, and anthropologists.

Collections are a critical resource for advancing the knowledge needed to address current global challenges such as climate change, biodiversity loss, and pandemics. The COVID-19 crisis has illustrated how inextricably linked humans are to nature. Biological collections, their extended data, and the experts who build and study them are globally important for understanding where viruses such as SARS-CoV-2 exist and when they cross from their current hosts to humans.

The United Nation's Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services has warned that about one million species of plants and animals worldwide face extinction within the next few decades. This would not only be an unprecedented loss of global biodiversity but also a loss of valuable genetic diversity that has implications for human health and well-being. Robust investments must be made to support efforts to grow and digitize natural history collections and conduct critical collections-based science that can help prevent this loss.

The NSF plays a unique role in protecting and expanding access to our nation's scientific collections. It supports research that uses existing collections as well as studies that gather new natural history specimens. NSF's Directorates for Biological Sciences, Geosciences, and Social, Behavioral and Economic Sciences support research and student training opportunities in natural history collections. NSF is also an important supporter of national research infrastructure that houses natural history collections, such as living stock collections and field stations.

The NSF funds evolving work to digitize high priority specimen collections. The result of this effort is that irreplaceable biological specimens and their associated data are now accessible

through the Internet to researchers, educators, and the public. Nearly 140 million specimens are now online, with millions more awaiting digitization. Many of these specimen records also include high quality images of the specimens that facilitate high quality, detailed analyses. This project involves biologists, computer scientists, and engineers in multi-disciplinary teams who develop innovative imaging, robotics, and data storage and retrieval methods. Resulting new tools and approaches expedite the digitization process and contribute to the development of new products and services of value to other industries. Museum specimens and associated data also represent an extraordinary resource for teaching core concepts in science.

An example is the multi-institutional openVertebrate (oVert) project, which creates high-resolution 3D anatomical data for scientific specimens of amphibians, reptiles, fishes, mammals, and birds held in U.S. museums. Through its NSF-supported partner MorphoSource, an open-access online repository, these data have been downloaded more than 100,000 times and viewed over 1 million times by faculty, veterinarians, exhibit designers, K12 teachers, and artists resulting in more than 200 scientific publications. In addition, more than 2,000 undergraduate students have learned from these data and visualizations while studying zoology, veterinary science, art, and design.

In addition to supporting research, NSF's science, technology, engineering, and mathematics (STEM) education programs enhance the ability of museums, botanic gardens, zoos, and other research institutions to provide science learning opportunities for students. NSF's Advancing Informal STEM Learning program furthers our understanding of informal science education outside of traditional classrooms. The program makes important contributions to efforts to make STEM more inclusive of historically underrepresented groups.

Conclusion

Investments in NSF have always been in the national interest. Scientific collections contribute to improved public well-being and national economic security. It is not possible to replace this important documentation of our nation's heritage. Specimens collected decades or centuries ago are increasingly used to develop and validate models that explain how species, including viruses, parasites, and pathogens have dispersed around the world, as well as how and when they might infect humans now and in the future. NSF is the primary funding source that provides support to institutions that preserve at-risk scientific collections. These small grants help ensure these collections are not destroyed and their data lost.

We were encouraged by the passage of the CHIPS and Science Act, which recognized biological collections as a research priority and authorized critical increases in NSF's budget. However, we were disappointed by NSF's FY 2024 appropriation, which was 8% below its FY 2023 budget. This cut ignores the CHIPS and Science Act, which demonstrated bipartisan commitment to our nation's scientific and technological enterprise. We urge Congress to follow through on the promise of this historic law by funding NSF as close as possible to the authorized levels.

Please support funding of at least $11.9 billion for NSF in FY 2025. This aligns with the FY 2023 authorization for NSF in the CHIPs and Science Act. Thank you for your thoughtful consideration of this request.