UNDERSTANDING OUR FUTURE THROUGH ENTOMOLOGICAL COLLECTIONS

ESA Transition Document

OVERVIEW

Biological collections are foundational to U.S. research infrastructure, enabling scientists to understand our changing world, chart the evolution of infectious diseases, and develop solutions against invasive pests. However, collections are at risk due to underfunding and a shortage of scientists trained in collections-based research and management. To assure continued U.S. leadership in many scientific disciplines that use specimens held in U.S. collections, the Entomological Society of America (ESA) recommends initiating a workforce development program, expanding infrastructure support for biological collections, and establishing new grants to support collections-related innovations.

CHALLENGES

Biological collections are foundational for modern research, an irreplaceable historical educational tool, and a resource to support research as well as regulatory and policy decision-making. Specimens in collections allow scientists to understand how biodiversity has changed over time in relation to climate shifts, land-use change, and other environmental factors and predict future loss due to global change. Collections help to rapidly identify and track species that carry diseases or invasive agricultural pests capable of damage in the billions of dollars annually. Biological collections are necessary for understanding the basic biological processes that shape our world, including how diseases and parasites jump to new species and how organisms develop pesticide resistance.

U.S. support over many generations for the preparation, curation, maintenance, and management of biological collections is essential to maintain U.S. leadership in biological research. The U.S. maintains a significant percentage of global collections, cementing U.S. leadership across many scientific disciplines and enabling international collaborations with the best and the brightest from around the world. The costs to maintain biological collections are low when compared with the high return on investment realized via their benefit to public, environmental, and agricultural health. A failure to sustain this support will degrade the investment that has already been made and result in irreplaceable losses.

Public support for the maintenance of biological collections is currently provided through the Infrastructure Capacity for Biological Research (ICBR) program at the National Science Foundation. The program, which has a total funding of $5-6 million per year, also supports other biological infrastructure needs and is therefore insufficient to meet the demand for existing biological collections, let alone for specialized digitization projects that would enhance the reach and accessibility of these valuable repositories. Further, these limited funds cannot support training or salaries for managers, nor can they be used to train new managers.

Staff reductions have led to an insufficient number of taxonomists and other scientists trained in collections management, especially within the federal government, resulting in delayed responses to informational inquiries, loss of public diagnostic services, reduced access for research, longer loan processing times, and closing of selected or entire collections when staff are not available to support them. Digitization of collections mitigates some of these issues but does not solve them. There is also a lost opportunity to modernize the role of collections managers by providing them with the support and training in new analytical methodologies and technology that could help maximize the utility of collections. We are at a critical juncture. Failure to act now to build the next generation of scientists, including taxonomists trained in collections management, will result in a loss of accumulated knowledge and expertise as the current generation retires from the workforce or leaves through attrition.

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We are at a critical juncture. Failure to act now to build the next generation of scientists, including taxonomists trained in collections management, will result in a loss of accumulated knowledge and expertise as the current generation retires from the workforce or leaves through attrition. Further, if collections are not sufficiently maintained, prior investments in them are essentially lost. In the worst cases, these resources are literally irreplaceable due to extinction of source populations.

RECOMMENDATIONS

To strengthen U.S. support of biological collections, ESA offers the following recommendations:

Increase Infrastructure Support for Biological Collections. The NSF's ICBR program should be significantly increased beyond its current $5-6 million per year to support biological collections, improve facilities and infrastructure, and support expansion as needs and technology change. Increased funding should fund qualified, non-term-limited collection managers and staff to support existing collections. As new trainees graduate, a funding mechanism to fill the existing workforce deficit should be created.

Establish a Collections-Focused Workforce Development Program. Establish an NSF program under the Directorate for Biological Sciences (BIO) to support taxonomy and museum studies specifically focused on training the next generation of curatorial researchers and staff. This program will require support for graduate student and postdoctoral fellows, curriculum development, and faculty recruitment to incentivize and revitalize interest in this scientific discipline. The program should provide opportunities for scientists to obtain training or certification in collections management, integrating physical sample management with digital curation.

Establish Biological Collections-Focused Research Programs. To spur the development of new analytical methods and technological advances to generate novel evidence and knowledge through biological collections, we recommend the creation of the following research programs:

Extended Specimen Database: A new extramural research program, jointly supported by NSF BIO and Directorate for Geosciences (GEO), could focus on integrating physical samples and preparations with other digital data collected from biological specimens to include genetic, phenotypic, behavioral, and environmental data as well as location, field condition, and biotic interactions that would enhance the interpretation of data derived beyond the physical specimen alone. To date, this kind of information is often separated across multiple data platforms. This network would integrate existing platforms to enable scientific investigations and improve the understanding of interactions between biological organisms and their environment, resulting in greater virtual accessibility of collections and the data contained therein.

Innovative Analytical Techniques for Investigations of Biological Collections: The National Institute of Standards Technology (NIST) should develop a program focused on new approaches for non-destructive uses of biological collections and strategies to harvest big data (historical distributions, ecological data, and genetic and population insights) contained therein.

Integrate Digitization and AI to Push Frontiers of Surveillance and Detection: As biodiversity loss accelerates, monitoring populations using AI-based imaging and data collection tools can be useful to craft models and store data that may complement physical biological collections. NSF and the U.S. Department of Agriculture should jointly support research and development of new surveillance, detection, and data-collection tools. This could lead to the creation of new, less invasive or less disruptive research techniques for many functions, including studying biodiversity without needing to collect as may physical samples (and thus potentially risking collecting a rare or endangered species), identifying emerging invasive threats as ports of entry, and other as yet unidentified opportunities to support entomology. Further, such efforts may also create new opportunities for more rapid detection and early response to emerging invasive insect outbreaks or disease vectors.

The Entomological Society of America is the largest organization in the world serving the needs of entomologists and other insect scientists. ESA stands as a resource for policymakers and the general public who seek to understand the importance and diversity of earth's most diverse life form—insects. Learn more at www.entsoc.org.

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