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# Biodiversity Online: Toward a Network Integrated Biocollections Alliance

JAMES HANKEN

**T**he scientific infrastructure of the United States includes more than 1600 institutions with biological collections. These biocollections, which are growing daily, are the result of nearly 250 years of scientific investigation, discovery, and inventory of living and fossil species from this country and around the world. Their more than 1 billion specimens and associated metadata are maintained for use in research and education and to inform decisions that affect the environment, public health, food security, and commerce.

This monumental investment of human effort and financial resources in research, documentation, and analysis is of value to many fields beyond biology. Computer and information science, geology, environmental science, land management, K–12 education, and citizen science are among the fields that increasingly seek access to this vital resource.

A partnership of US biological collections known as the Network Integrated Biocollections Alliance (NIBA) is now implementing a plan to incorporate cutting-edge technologies into data analysis and the management and curation of biocollections. The technologies will include digital imaging, image recognition, and natural language processing, as well as other cyber-assisted techniques for putting specimen data online. NIBA encourages researchers who are able to contribute expertise to this grand and vital enterprise to step forward and assist the effort, which will facilitate research in a wide range of fields.

NIBA's origins go back to 2010, when the biocollections community, recognizing the enormous value of its resources for research, education, and society at large, coalesced to develop *A Strategic Plan for Establishing a Network*

*Integrated Biocollections Alliance* (<http://digbiocol.wordpress.com/brochure>). As it was envisioned, NIBA would be an “inclusive, vibrant partnership of US biological collections that collectively will document the nation's biodiversity resources and create a dynamic electronic resource that will serve the country's needs in answering critical questions about the environment, human health, biosecurity, commerce, and the biological sciences.” The *Strategic Plan* calls for an aggressive, coordinated, large-scale, and sustained effort to digitize the nation's biological collections in order to mobilize their data (including images) through the Internet. Its three key objectives are to digitize data from all US biological collections, large and small, and integrate these in a Web-accessible interface using shared standards and formats; to develop new Web interfaces, visualization and analysis tools, and data-mining and georeferencing techniques, then make them all routinely available to people who are using and improving NIBA resources; and to facilitate frequent and ongoing updates of online collections data. These updates would include the prompt addition of data from newly obtained specimens, achieved through the use of specialized tools and by training researchers, collections staff, and students to use a customized cyber-infrastructure.

Federal agencies and the scientific community have responded to NIBA's proposal by initiating several core activities that it had urged, but more is required. In fall 2012, the American Institute of Biological Sciences (AIBS), with support from the US National Science Foundation (NSF), convened a workshop of experts in biocollections, digitization, computer science, and other relevant fields to develop the

*Implementation Plan for the Network Integrated Biocollections Alliance* ([www.aibs.org/public-policy/biocollections.html](http://www.aibs.org/public-policy/biocollections.html)). The *Implementation Plan* explicitly identifies the remaining actions needed to fully realize NIBA's ideas as envisioned in the *Strategic Plan*, along with time lines and milestones. In addition to the expertise of workshop participants, experience gained in other international, national, and regional scientific or technical initiatives informed the development of the *Implementation Plan*. The organizers solicited comments from a diverse group of current and potential stakeholders. The *Implementation Plan* provides detailed recommendations for achieving six goals: (1) to establish an organizational and governance structure that will provide the national leadership and decisionmaking mechanism required to empower NIBA and to fully realize its *Strategic Plan*, (2) to advance the engineering of the US biocollections cyberinfrastructure, (3) to enhance the training of existing collections staff and to create the next generation of biodiversity information managers, (4) to increase support for and participation in NIBA by the research community and a broad spectrum of stakeholders, (5) to establish an enduring and sustainable knowledge base, and (6) to infuse specimen-based learning and exploration into formal and informal education.

## What has been done so far?

In response to recommendations in the *Strategic Plan*, the NSF in 2010 founded the Advancing Digitization of Biological Collections (ADBC) program. Through the ADBC program, the NSF is providing seed money to initiate a 10-year effort to fully digitize United States-based biocollections. The NSF has pledged to provide at least \$100

million over this period. The ADBC program seeks to spur the development of new informatics and engineering tools that resolve technical problems hindering the digitization of some collections so as to enable the work to be done rapidly and cost effectively. It also aims to build collaborative thematic collections networks that can address major research challenges by using biocollections specimens and data and to establish a central resource, or hub, to support and coordinate the work of such networks. Thus far, the NSF has funded the central resource, iDigBio (for Integrated Digitized Biocollections, based at the University of Florida and Florida State University) and 10 thematic collections networks. Together, these awards involve 153 collections-holding institutions, represented in all 50 states; they will digitize, unite, and serve data for more than 70 million specimens.

The NSF directly funds work only at nonfederal collections. Support for digitization efforts that target the many hundreds of collections owned by the federal government must instead come from the agencies responsible for those specimens and data. In this respect, the US Geological Survey will play a key role, especially through its recently launched program Biodiversity Information Serving Our Nation (BISON; <http://bison.usgs.ornl.gov>). BISON is expected to perform at least two important functions. First, it will serve as an integrated resource for biological occurrence data from the United States, by providing simultaneous access to data from both federal and nonfederal collections, regardless of who or what agency paid to digitize them. Second, it will link these data to emerging federal government activities under the rubric of EcoINFORMA (an informatics entity proposed in PCAST 2011) and thereby mobilize and integrate data for sustaining the nation's environmental capital. Both functions will significantly contribute to and advance NIBA.

Collaboration among federal agencies and between these agencies and nonfederal institutions promotes wise resource allocation and the maximal use of US biocollections for research,

education, and decisionmaking. Such activities also nicely complement the efforts by several other countries to digitize specimens held in their biocollections and make these data readily accessible online. Indeed, many such efforts are much further along than comparable activities in the United States; notable examples are the ALA (Atlas of Living Australia), Costa Rica's INBio (National Biodiversity Institute), and Mexico's CONABIO (National Commission for Knowledge and Use of Biodiversity). Equally important are corresponding efforts to achieve international integration and interoperability of these and other data platforms, including the GBIF (Global Biodiversity Information Facility) and the GPI (Global Plants Initiative).

#### Why NIBA? Why now?

Policymakers have come to recognize the scientific and societal benefits that emerge when researchers, educators, and other stakeholders have the ability to efficiently access information from and about biocollections. In 2005, President George W. Bush chartered the federal Interagency Working Group on Scientific Collections to evaluate and make recommendations about the needs of the federal government's scientific collections. President Barack Obama's administration has furthered this effort, including a directive issued by the Office of Science and Technology Policy (OSTP) that requires federal agencies to budget for science collections. Furthermore, through §104 of the America COMPETES Act Reauthorization of 2010 (Public Law 111-358), Congress directed OSTP to "improve the quality, organization, access, including online access, and long-term preservation of such collections for the benefit of the scientific enterprise" and to work with representatives of nongovernmental organizations and institutions that have a "stake in the preservation, maintenance, and accessibility of such collections." NIBA will advance these and related governmental initiatives. Indeed, the president's fiscal year 2014 budget request for the NSF, recognizing the importance

of biocollections for both basic and applied research, notes that its Directorate for Biological Sciences should use the strategic and implementation plans developed by the research community to inform program development and funding decisions. NIBA is one of several such programs being considered for further development.

The *Implementation Plan* reflects a coordinated and collaborative effort by the collections community to achieve NIBA's three key objectives, and it provides a solid, realistic, and effective framework for doing so. However, the campaign to digitize the nation's biocollections is not contingent solely on technology, organizational development, education, training, or professional engagement. Nor is it the sole responsibility of the collections-holding institutions, government entities, or commercial interests. Instead, it will require commitment from all stakeholders. Anyone seeking more information about NIBA is encouraged to read the full plans ([www.aibs.org/public-policy/news/scientists\\_call\\_for\\_greater\\_access\\_to\\_biodiversity\\_resources\\_data.html](http://www.aibs.org/public-policy/news/scientists_call_for_greater_access_to_biodiversity_resources_data.html)). With resources for a multi-dimensional strategic plan and prioritized parallel implementation activities, NIBA can deliver a national computing architecture for the widespread mobilization of specimen information and its deployment online for all to see and use. That transformation will leverage and provide a fitting reward for the huge historical contribution that US collections have made to documenting the nation's biological diversity.

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