

Collections are truly priceless

Last month, Duke University in North Carolina announced that it was shuttering its herbarium. The collection consists of nearly 1 million specimens representing the most comprehensive and historic set of plants from the southeastern United States. It also includes extensive holdings from other regions of the world, especially Mexico, Central America, and the West Indies. Duke plans to disperse these samples to other institutions for use or storage over the next 2 to 3 years, but this decision reflects a lack of awareness by academia that such collections are being leveraged as never before. With modern technologies spanning multiple fields of study, the holdings in herbaria and other natural history collections are not only facilitating a deeper and broader understanding of the past and present world but are also providing tools to meet both known and unforeseen challenges facing humanity. Science and society can hardly risk the loss of such an important resource.

Sadly, Duke is not the first world-class institution to withdraw support from, and cease the operation of, its natural history collections. In the late 1970s and early 1980s, Princeton and Stanford Universities did the same. Ostensibly, the decisions to close those collections were made to shift priority to research programs in molecular biology and biochemistry, which were considered closer to science's cutting edge of discovery and able to attract more external funding. Ironically, nearly half a century on, biological sciences departments at these institutions and comparable ones in China, Brazil, some regions in Africa, and in most of Western Europe are filled with world-class scholars who—knowingly or unknowingly—use herbaria, zoological collections, and their derivatives every day for transformative research published in the highest-impact journals.

Herbaria have long been a critical resource for ecological and evolutionary research but have recently become relevant to many more fields, including climate science, anthropology, genetics, computer science, chemistry, and medicine. Specimens are being mobilized to investigate plant-animal and plant-pathogen interactions, crop domestication, compounds with potential applications in agriculture and pharmaceuticals, and human migration over time and space. Advances in genome sequencing and machine learning are guiding

biodiversity monitoring efforts and revealing knowledge gaps where specimen sampling is needed.

The decision by Duke comes at a time when widespread awareness of and access to herbaria are growing in tandem. This is principally a result of the large-scale digitization of natural history collections, an endeavor that has been extensively supported by governmental agencies and philanthropic organizations worldwide. This innovation is arguably one of the greatest transformations in biodiversity science since DNA sequencing. In short, creation of the Global Metaherbarium—an open-access, global interlinked virtual resource—makes physical herbaria discoverable and is attracting new interest in the utility of these collections for sophisticated multiomic investigations (genomics, transcriptomics, metabolomics, proteomics, and microbiomics) and for research that connects science with the broader society.

Closure of the Duke Herbarium also points to changes needed in formally recognizing herbaria and other natural history collections in research initiatives and agendas. Collections increasingly have become the first line of genetic and genomic sampling for investigators who otherwise eschew conventional field work. Requests to destructively sample specimens are often central to rapidly expanding big data initiatives. These requests place

enormous demands on the institutions and staff who support collections but who largely go unrecognized for their crucial work. In turn, users of these collections, many of whom are not based at these institutions, benefit from grants and high-profile papers in which herbaria are only briefly acknowledged, if they are mentioned at all. Scientists who oversee collections should be fully funded partners in research initiatives. Institutions, herbarium curators, and support staff should be coauthors of studies, with contributions indicated through the Contributor Roles Taxonomy (CRediT) system, for example. Such recognition could help more directly measure the impact and influence of natural history collections on scholarly research.

Universities should support the priceless resources and heritage represented in natural history collections. They also should have the vision to provide for, and commit to, the long-term stewardship and robust intellectual environment for open inquiry and deep research that these collections provide across generations.

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