7-2020

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BioScience, Vol. 70, No. 7 (July 2020): 527. DOI.

Human Health, Interagency Coordination, and the Need for Biodiversity Data

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The importance of understanding the interconnectedness of individual humans and the environment has never been more urgent. The current global health crisis illustrates how interlinked human welfare is with the natural world. The health effects related to biodiversity extend far beyond pathogens like SARS-CoV-2 to agriculture and food security, wildlife and recreation, clean water access, veterinary medicine, and psychological well-being. This underscores the urgent need for coordination and collaboration among federal and nonfederal funding agencies using biodiversity data to resolve near- and long-term societal challenges.

The continued collection and growth of baseline biodiversity data are fundamental to understanding processes that unify—and possibly centralize—life science knowledge. Biodiversity data consist of factual information regarding the taxonomic identity, geoposition, and timeframe of a biological occurrence and often include information on morphology, genetics, and ecology. Housed in natural history museums and other research collections around the world, these data take many forms. Physical specimens offer a depth of scientific possibility that extends beyond the specimen itself—genomics, epigenetics, microbiome characterization, isotopic analysis, X-ray fluorescence spectrometry, and technologies yet to be imagined. When these enhanced metadata are interlinked and centralized with physical specimen data, their power is amplified.

Physical specimen collections and associated data curation are requirements for improving our understanding of how species interactions are changing. Series of specimens, collected over time, of transmitted pathogens and the hosts they might infect will help predict the risk for novel zoonotic diseases. In agricultural systems, specimens can inform economic and environmental studies. Crop scientists can use physical specimens to understand how pest genetics have changed in response to widespread pesticide use. Ecologically, specimen collections illustrate how land-use change and habitat fragmentation alter genetic and species diversity. Digitized specimen collections can inform preventative measures in agriculture and conservation. For example, occurrence records can be input into ecological niche models to predict how agricultural pest species might spread in the future or to identify conservation targets as species' ranges shift with climate change. Centralization of physical specimen data representing aquatic ecosystems enable monitoring of freshwater systems and the terrestrial areas that drain into them. Our limited knowledge of aquatic biodiversity impedes environmental health studies aimed at analyzing current conditions and observing change over time, in addition to limiting our understanding of important vectors and reservoirs of disease. Museum specimens are historic records that are used to identify environmentally sensitive species. Such assessments are based primarily on occurrence data associated with archived specimens in natural history collections.

Physical specimens representing the diversity of life on our planet have been collected for 150-plus years. These data are a resource for advancing biological understanding. Our ability to recognize and predict new interactions between diverse groups of organisms depends on comprehensive knowledge of global ecosystems and all of their components.

Over the last decade, massive advances in infrastructure, digitization, and organization of physical specimens and their associated data have transformed their use to address global societal challenges. We are still at the beginning of this development. More interagency coordination is required to ensure these data are aggregated and made available to all of the communities that depend on them. Increased support for infrastructure, coordination, and management of biodiversity data is required for these data to persist and to fulfill their practical purpose of sustaining human well-being.