Announcing Big-Bee: An initiative to promote understanding of bees through image and trait digitization

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Katja C. Seltmann, Julie Allen, Brian V. Brown, Adrian Carper, Michael S. Engel, Nico Franz, Edward Gilbert, Chris Grinter, Victor Gonzalez, Pam Horsley, Sangmi Lee, Crystal Maier, Istvan Miko, Paul Morris, Peter Obojsky, Naomi E. Pierce, Jorrit Poelen, Virginia L. Scott, Mark Smith, Elijah J. Talamas, Neil D. Tsutsui, & Erika Tucker

Cheadle Center for Biodiversity and Ecological Restoration, University of California Santa Barbara, Santa Barbara, USA, © Department of Biology, University of Nevada Reno, Reno, USA, | Natural History Museum of Los Angeles County, Los Angeles, © University of Colorado Boulder, Boulder, USA, # National History Museum, University of Kansas, Lawrence, USA, * Ecology and Evolutionary Biology, University of Kansas, Lawrence, USA, © Arizona State University, Tempe, USA, + California Academy of Sciences, San Francisco, USA, ✈ San Diego Natural History Museum, San Diego, USA, × Museum of Comparative Zoology, Harvard University, Cambridge, USA, ‹ University of New Hampshire, New Hampshire, USA, ‰ Essig Museum, University of California Berkeley, Berkeley, USA, ˄ Department of Organisms & Evolutionary Biology, Harvard University, Cambridge, USA, ˅ Ronin Institute for Independent Scholarships, Montclair, USA, ² Macroscopic Solutions, Tolland, USA, ³ Florida Department of Agriculture and Consumer Services, Gainesville, USA, ⁴ P Bug News, Ann Arbor, USA

Introduction

Bees are critical to sustaining a large proportion of global food production, as well as pollinating both wild and cultivated plants. They are decreasing in both numbers and diversity and our understanding of the factors driving these declines is limited, in part, because we lack sufficient data on the distribution of bee species to predict changes in their geographic range under climate change scenarios. Additionally lacking is adequate data on the behavioral and anatomical traits that may make bees either vulnerable or resilient to human-induced environmental changes. Fortunately, a wealth of associated attributes can be extracted from the specimens deposited in natural history collections.

Extending Anthophila Research Through Image and Trait Digitization (Big-Bee) is a newly funded US National Science Foundation Advancing Digitization of Biodiversity Collections project. Big-Bee will advance research on bee ecology and taxonomy through the creation and standardization of open datasets for taxonomic and computational analysis.

It will overcome challenges in bee identification and discovery by linking ecological and anatomical traits. The project will supply innovative methods for deep digitization of target taxa, including high-resolution imaging methods. These images will enable the scoring of life-history traits and will facilitate identification from digitized specimens. Big-Bee will further revolutionize processes of insect specimen digitization by enabling global bee data to be integrated and linked. The project will produce important partnerships between researchers, industry, and government agencies.

The Big-Bee network of participating institutions includes thirteen US institutions and partnerships with US government agencies. We will develop novel mechanisms for sharing image datasets and datasets of bee traits that will be available through an open, Symbiota-Light data portal called the Bee Library in addition, biotic interaction and species association data will be shared via Global Biotic Interactions (GBoI).

Objectives

Over the course of three years, we will create over one million high-resolution 2D and 3D images of bee specimens representing over 5,500 worldwide bee species, including most of the major pollinating species. We will also develop tools to measure bee traits from images and generate comprehensive bee trait and image datasets to measure changes through time.

Materials and Methods

Using the Macropod Pro 3D imaging system we will create over 1M images of the focal bee species (Table 1). These images include habitus details of morphological features (Fig. 3, C), 3D images (Fig. 2) and museum specimen label images (Fig. 3, A).

The Big-Bee project will engage the public in research through community science via crowdsourcing trait measurements and data transcription from images using Notes from Nature (NfN).

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Research

Although very early in the project we have significant results including the Notes from Nature (NfN) measurement tool under development (Fig. 4). With this tool, NfN users will be able to calibrate a ruler using the included scale bar before measuring the body size of a bee.

Evolution of pollen collecting hairs?

Understanding seasonality of bee parasitoids?

Verification of sex via counting antennal segments?

Interspecific variation in tongue length?

Conclusions

The Big-Bee project provides a unique opportunity to study bees using images. What would you like to investigate using the Big-Bee image dataset?

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http://big-bee.net

email: seltmann@ucsb.edu

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The full proposal can be found at: Seltmann, K. C. (2021). Extending Anthophila research features (Fig. 3, C), 3D images (Fig. 2) and museum specimen label images (Fig. 3, A).