THE NEW YORK BOTANICAL GARDEN

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International Plant Scientists Reach Agreement on Universal DNA Barcode Markers for World's Plants

Milestone Established by Multi-Institution Consortium for the Barcode of Life's Plant Working Group; Paves Way for Worldwide Tree Barcoding Initiative

An international team of 52 scientists from 25 different institutions working in 10 countries has concluded a four–year effort to agree on a standard "plant DNA barcode" to provide the foundation for the widespread use of DNA technologies to identify plants. This scientific tool will make an important contribution in areas as diverse as biodiversity conservation, sustainable development, and health care through wide-ranging applications ranging from intercepting illegal logging and trafficking in endangered plant species to assisting in a medical emergency by identifying toxic plant materials that have been ingested. According to a research report in *the Proceedings of the National Academy of Sciences*, to be published during the week of July 27, the contributing scientists recommend *rbcL* and *matK* as the optimal two-locus DNA barcode for land plants. The scientists are all part of the Consortium for the Barcode of Life's (CBoL) Plant Working Group. The recommendation paves the way for the barcoding of the trees of the world—or treeBOL—a major worldwide project sponsored by a grant from the Alfred B. Sloan Foundation to The New York Botanical Garden.

Dr. Damon Little, Cullman Curator in the Lewis B. and Dorothy Cullman Program for Molecular Systematics at The New York Botanical Garden and a co-principal investigator on treeBOL, stated: "A number of barcoding projects have amassed DNA samples in anticipation of this day. We can, at long last, move forward with sequencing now that a standard plant barcode has been agreed upon."

DNA Barcoding Allows Scientists to Reliably Identify Species

DNA barcoding, the use of a short standardized region of DNA for identifying species, has been used successfully to distinguish among animal species since 2003. A barcode library of approximately 60,000 animal species has been amassed already, based on the standard region selected in 2003. Botanical barcoding, however, has been more challenging. Although numerous strategies have been proposed, finding the right stretch of plant DNA has been difficult. Until now, no consensus has emerged among research groups as to which DNA region, or indeed how many regions, to use.

For the first time, the botanists involved in evaluating plant barcoding regions have pooled their data to agree on a standardized approach. This involved comparing the performance of the seven leading candidate DNA barcoding regions on a common set of samples. As a result of this research, two short stretches of DNA have been chosen to form the plant barcode (portions of the genes *rbcL* and *matK*) which will provide a universal framework for the routine use of sequence data to characterize plant biodiversity. By sequencing a standardized region, DNA barcoding provides a universal tool for species identification.

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The technique will work on minute amounts of tissue and can be used on fragments of plant material. Applications include identifying illegal trade in endangered species, identifying invasive organisms, poisonous species and fragmentary material in forensic investigations. Potentially, the main application will be assessment of the diversity of species in the world's biodiversity hotspots where a shortage of specialist skills hampers conservation efforts.

Dr. Peter Hollingsworth, Head of Genetics and Conservation at the Royal Botanic Garden Edinburgh, who has chaired the working group that selected the barcode genes, explained, "Identification is important. It is the link between a given plant and the accumulated information available for that species. It is not possible to know if a plant is common or rare, poisonous or edible, being traded legally or illegally, et cetera, unless it can be identified. Conservation prioritization, in particular, can be impeded by a lack of knowledge of what species grow where. But identifications can be difficult—there are a large number of plant species and some look very similar. Juvenile, non-flowering, or fragmentary materials are notoriously difficult to identify."

DNA barcoding is one way around the problem. The principle of the approach is to identify a stretch of DNA which is suitable for telling most species apart and to use this to build a massive and easily accessible database to provide a universal system for identifying the world's biodiversity.

Barcoding the Trees of the World

Agreement on an optimal plant DNA barcode is a critical step towards realizing treeBOL, a DNA barcode of life (BOL) initiative to barcode the world's approximately 100,000 species of trees. With funding from the Alfred P. Sloan Foundation, The New York Botanical Garden is coordinating treeBOL, which is managed centrally by Damon Little, Ph.D., Assistant Curator of Bioinformatics, in the Lewis B. and Dorothy Cullman Program for Molecular Systematics at The New York Botanical Garden. Several dozen researchers and partner institutions from around the world, divided into ten regional working groups, are collecting barcode data for the trees from their geographic region.

James S. Miller, Ph.D., Dean and Vice President for Science at The New York Botanical Garden, commented, "This innovative technology will significantly increase our capacity to accurately identify plants, particularly materials that are fragmentary, and it will have great application regulating the import of plants and timbers as well as confirming the identity of ingredients in foods and dietary supplements. The Alfred P. Sloan Foundation has shown great insight in encouraging and supporting this international collaborative effort to advance the development of this technology."

Dr. David Schindel, Executive Secretary of Washington, D.C.-based Consortium for the Barcode of Life (CBOL) which instigated the formation of the plant working group, stated, "The selection of standard barcode regions has been a slow and difficult process because of the complex nature of plant genetics. Dr. Hollingsworth and the Plant Working Group are to be congratulated for the careful and collaborative way in which they have approached their difficult task. Having an agreed upon barcode region will enable plant barcoding to accelerate rapidly. There are researchers around the world and diverse users of plant identification who are eager to get started."

TreeBOL is modeled on similar DNA barcoding projects already underway to document all the fish and birds of the world. Its scale, however, is quite different; while there are perhaps 10,000 different species of birds and up to 30,000 species of fish in the world, it is estimated that there are more than 100,000 species of trees.

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James S. Miller notes, “By initiating a long-term campaign to DNA barcode all tree species globally, The New York Botanical Garden is bringing together scientists around the world in a concerted effort to advance the field of plant DNA barcoding. Furthermore, the project will provide an invaluable scientific resource for research, conservation, and sustainable management of the trees of the world, a global asset essential to life on earth.”

TreeBOL is funded by the Alfred P. Sloan Foundation

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The New York Botanical Garden is an advocate for the plant kingdom. The Garden pursues its mission through its role as a museum of living plant collections arranged in gardens and landscapes across its National Historic Landmark site; through its comprehensive education programs in horticulture and plant science; and through the wide-ranging research programs of the International Plant Science Center. For more information, please call 718.817.8700 or visit our Web site at www.nybg.org.

The New York Botanical Garden is located on property owned in full by the City of New York, and its operation is made possible in part by public funds provided through the New York City Department of Cultural Affairs. A portion of the Garden’s general operating funds is provided by The New York City Council and The New York State Office of Parks, Recreation and Historic Preservation. The Bronx Borough President and Bronx elected representatives in the City Council and State Legislature provide leadership funding.

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