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International Researchers Produce Genetic Data for More Than 1,100 Plant Species, Providing Insights into One Billion Years of Evolution from Algae to Flowering Plants

NYBG Scientist, a Lead Investigator on the Project, Says the Research, Published Online Today by *Nature*, Could Help in the Search for New Medicines, Food Crops, and Biofuels



Two of the plant species included in the One Thousand Plant Transcriptomes Initiative (1KP) are *Dendrolycopodium obscurum* (left), a North American clubmoss, and *Paphiopedilum lowii* (right), a Southeast Asian orchid. Photos by Dr. Dennis Stevenson

Bronx, NY—Culminating nine years of field, herbarium, and laboratory research, an international consortium of nearly 200 plant scientists has compiled gene sequences for more than 1,100 plant species, a treasure trove of data that has a wide range of applications, from resolving questions about the evolution of plant life to potentially aiding in the hunt for new sources of medicine, food crops, and biofuels.

One of the principal scientists on the research project, called the One Thousand Plant Transcriptomes Initiative (1KP), was Dennis Stevenson, Ph.D., Vice President for Science and Cullman Senior Curator at The New York Botanical Garden (NYBG).

The project, whose findings were published online today by the British scientific journal *Nature*, examined the diversification of plant species, genes, and genomes across more than one billion years of evolution, dating back to the ancestors of flowering plants and green algae.

“Evolution is about problem-solving,” Dr. Stevenson said. “This project provides powerful data that will help us understand the mechanisms plants evolved to solve the essential problems of survival—such as how to store water, how to defend against disease and predators, and how to reproduce. It’s knowing the history of life.”

Dr. Stevenson said the 1,124 species in the study were strategically chosen to represent the broad diversity of plant life, which allows researchers to study similarities and differences in gene sequences to gain a better understanding of plant evolution and the relationships between species at different points on the tree of life.

“In the tree of life, everything is interrelated,” said Gane Ka-Shu Wong, Ph.D., lead investigator and professor in the University of Alberta’s Department of Biological Sciences. “And if we want to understand how the tree of life works, we need to examine the relationships between species. That’s where genetic sequencing comes in.”

The sequencing, which was done at the Beijing Genomics Institute (BGI) in Shenzhen, China, provides insights into the timing of genetic changes that led to the evolution of green algae, mosses, ferns, conifers and other cone-bearing plants, and flowering plants, which constitute the largest group of plants, with an estimated 370,000 species.

“Plant evolution has been punctuated with innovations and periods of rapid diversification,” said James Leebens-Mack, Ph.D., professor of plant biology at the University of Georgia and the co-lead investigator on the 1KP project. “In order to link what we know about gene and genome evolution to a growing understanding of gene function in flowering plant, moss, and algal organisms, we needed to generate new data to better reflect gene diversity among all green plant lineages.”

Apart from helping scientists learn more about the evolution of plant life, the 1KP sequencing data has the potential to help researchers discover relationships between known useful plants and other species that could yield new medicines, biofuels, and food crops, according to Dr. Stevenson. They could also help in the search for drought-resistant species, which are likely to become more important because of climate change.

Dr. Stevenson said NYBG was able to play a leading role in the project because of its comprehensive plant research facilities. The William and Lynda Steere Herbarium—the world’s second-largest collection of preserved plants, with 7.8 million specimens—provided information that he and other researchers used to determine where to collect living samples of the plants in the study and is now a repository for many of those samples after they were brought back from the field and preserved. Extraction of RNA and DNA from hundreds of samples took place at NYBG’s Pfizer Plant Research Laboratory for sequencing at BGI.

Dr. Stevenson collected plants for the study in the United States, Argentina, Australia, China, Italy, Panama, and Vietnam.

“This project integrates field work, herbarium research, and living collections with the latest in laboratory and information sciences as part of an international collaboration,” he said.

Other institutions involved in the project were the Royal Botanic Gardens, Kew; Royal Botanic Garden Edinburgh; Atlanta Botanical Garden; the Florida Museum of Natural History; Duke University; and the University of British Columbia Botanical Garden.

The paper, “One Thousand Plant Transcriptomes and the Phylogenomics of Green Plants,” is available online at <https://www.nature.com/articles/s41586-019-1693-2>

It will be published in the October 31, 2019, print edition of *Nature*.

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The New York Botanical Garden is a museum of plants, an educational institution, and a scientific research organization. Founded in 1891, the Botanical Garden is one of the world’s preeminent centers for studying plants at all levels, from the whole organism down to its DNA. Garden scientists conduct fundamental research on plants and fungi globally, as well as on the many relationships between plants and people. A National Historic Landmark, the Garden’s 250-acre site is one of the greatest botanical gardens in the world and the largest in any city in the United States, distinguished by the beauty of its diverse landscape and extensive collections and gardens, as well as by the scope and excellence of its programs in horticulture, education, and plant research and conservation. Learn more: nybg.org

The New York Botanical Garden, 2900 Southern Boulevard, Bronx, New York 10458

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