

The pace and scale of climate-induced changes, coupled with landscape modification resulting from agricultural development, urbanization and forestry practices, pose grave threats to plant diversity, to human well-being, and ultimately to the survival of all organisms. Plants are the foundation of ecosystem services on which we depend, regulating global and local climate, controlling erosion, purifying air and water, providing a viable habitat for all species, and comprising the basis of our food supply, medicines, and other valuable products. Although scientists consider many plant species to be seriously at risk of extinction in the near future, particularly those already rare or threatened in their current geographic ranges, efforts to safeguard plant diversity are impeded by a lack of basic information on key issues concerning climate change impacts on plants, including: 1) Which plant species are likely to experience broad-scale shifts in climatically suitable habitat? 2) To what extent are plant species able to germinate and grow in future climate scenarios? 3) Can plant species that are vulnerable to climate change be successfully grown outside their natural range for conservation purposes?

If botanical gardens and arboreta are to contribute timely strategies for conserving threatened plants, they will need a model that integrates the latest technological tools with innovative research methodologies to predict global change impacts on the plant diversity of their regions, identify the most at-risk species, and develop protocols to assist their survival. The project will develop and test a generalizable, easily replicable approach that integrates bioclimatic modeling and innovative research experiments to elucidate key questions concerning the impacts of climate change on plant diversity and to develop scientifically-based protocols to avert the loss of species. These tools and methodologies have never before been integrated into a comprehensive framework to evaluate climate change impacts on plant diversity and hasten the progress of conservation. The collaborative project proposed here builds upon the Missouri Botanical Garden's (MBG) expertise in bioinformatics analysis, a world-class botanical collection, the management and conservation of native biodiversity through MBG's Shaw Nature Reserve, and our long-term commitment to research projects with critically imperiled plant species in the lower Midwest. The project demonstrates the relevance of such expertise, and of botanical gardens' specimen collections, in addressing critical contemporary issues such as climate change. The specific goals of this project are to: 1) Assess the response of plant species from the Midwest to 6 possible climate change scenarios; 2) Rank species vulnerability to climate change using the Climate Change Vulnerability Index (CCVI) and identify priority species that are vulnerable to climate change; 3) Collect seed from natural populations of threatened species selected for research study; 4) Conduct seed research in growth chambers with threatened species to determine propagation protocols and the degree of adaptation to current and future climates; 5) Establish 'climate change plots' at Washington University's Tyson Research Center (TRC) and MBG's Shaw Nature Reserve (SNR) to determine whether threatened species are candidates for managed relocation.

The project will significantly accelerate plant conservation activities at botanical gardens and arboreta: it will demonstrate that their expertise and the knowledge contained in their collections, previously underutilized, have an indispensable role in confronting the threats posed by climate change; and it will provide a model that will enable them to apply their resources to assume this role. The project will have the following far-reaching impacts: 1) Demonstrate to botanical gardens and arboreta working in regional conservation a replicable model that assesses climate change impacts on plant diversity; 2) Advance climate change research through innovative, forward-thinking changes to and integration of existing methodologies and tools; 3) Enable botanical gardens to meet conservation targets of the Global Strategy for Plant Conservation (GSPC), such as conserving 60% of threatened plant species in *ex situ* collections; 4) Develop CCVI rankings for natural resource managers and the conservation community; 5) Provide leadership and scientific training to a post-doctoral fellow and graduate and undergraduate students in climate change research and botanical garden conservation programs; and 6) Enhance the understanding of climate change impacts on plant diversity within the research community and among the general public.