Assessing botanical capacity to address grand challenges
Summary of gaps identified and recommendations made

EDUCATION AND TRAINING

GAPS IDENTIFIED

Loss of botanical degree programs: In 1988, 72% of the nation's top 50 most funded universities offered advanced degree programs in botany. Today, more than half of these universities have eliminated their botany programs and many, if not all, related courses. Statistics from the U.S. Department of Education reveal that undergraduate degrees earned in botany are down 50% and advanced degrees earned in botany are down 41%. During the same time, undergraduate degrees awarded in general biology have increased 17% and advanced degrees earned in general biology have grown by 11%.

Decline in botanical course offerings: Nearly forty percent of the over 400 university faculty who completed the survey said botany courses in their department had been cut in the past 5-10 years. The courses eliminated tend to be from among those required for the 0430 (botanist) federal job code. A majority of faculty and graduate student respondents were dissatisfied with botany courses offered by their college or university.

Preparation for employment at federal agencies: Neither students or faculty were aware of the coursework requirements for employment as a federal botanist (24 credit hours in botany). Given course offerings at many academic institutions, it is likely that many students considering careers as federal botanists will graduate without meeting coursework requirements for federal hiring.

RECOMMENDATIONS MADE

Recommendation 1: Faculty and administration involved in college and university biology education should ensure plant science is appropriately incorporated in annual course offerings for undergraduate and graduate students to ensure they are employable both within and outside the academic sector. This includes offering courses that meet requirements for employment as a federal botanist (such as botany, plant anatomy, morphology, taxonomy and systematics, mycology, ethnobotany, and other plant-specific courses), and encouraging interdisciplinary research programs to train students in both basic research and applied science.

Recommendation 2: Faculty and administration at the nation's academic institutions should ensure plant science, including basic organismal expertise, is strongly represented within interdisciplinary departments, particularly as staff with botanical expertise retires in the coming decade. Accreditation bodies should develop recommendations and criteria for monitoring and evaluation to support adequate representation of botanical disciplines in biology departments and interdisciplinary study programs nationally.

Recommendation 3: Non-profit organizations play an increasingly critical role in filling gaps in botanical education and training. They contribute to course development and classroom education while providing amplification and practical experience, particularly for subjects that are most in demand for the nation's botanical workforce outside of academia. Because demand will likely only increase in this area, non-profit organizations should take strategic steps to increase their ability to fill this gap in capacity in this area. Leadership to recognize, support and sustain the ability of non-profit organizations to fill this role is needed from private foundations as well as academic and government sectors.

Recommendation 4: A full-time liaison position should be established between the Botanical Society of America and federal land management and research agencies to ensure botanical education and practical training needs for expert resource management are met. Similar to the current liaison position between the Bureau of Land Management and the Society for Range Management, this position would strengthen collaboration and workforce building through avenues such as quick-hire programs as well as the Office of Personnel Management's Student Educational Employment Program and Presidential Management Fellows Program.

Recommendation 5: Academic, government and private sectors should work collaboratively to strategically strengthen botanical education and training at all age levels. This includes curriculum development that recognizes the central role plants play in biological systems and human life, and better integration of plant science into biology standards and textbooks. Work through the STEM Education Coalition as well as organizations like the Botanical Society of America, the American Institute of Biological Sciences and the National Association of Biology Teachers is needed to build support for and better integration of plant science education and training in biology coursework.

COMMUNICATION AND OUTREACH

GAPS IDENTIFIED

Private sector: Respondents in this sector provide the greatest outreach to government agencies and private citizens, but more is needed. While 50% of respondents from this sector consulted with government agencies on botanical matters from 2007 - 2009, over 70% consulted with private citizens, and non-profit respondents gave on average 2.3 media interviews during the same timeframe.

Academic sector: While outreach within the academic sector is strong, there is a need for greater outreach to government agencies and private citizens: fewer than 37% of respondents reported consulting with government agencies on botanical matters, only 2.2% consulted with private citizens, and each respondent gave an average of 1.3 interviews to the media from 2007 - 2009.

RECOMMENDATIONS MADE

Recommendation 6: All sectors should work both individually and collaboratively to strategically increase outreach efforts to different audiences, and to monitor the effectiveness of this work. Action is needed to create appropriate materials and deliver information that increases the level of botanical literacy and appreciation among policy makers, other scientific disciplines, and the general public. The private sector should build on current outreach efforts to the government and general public, the government sector should ensure outreach efforts to the public effectively include plants as well as the wildlife that depends upon them, and the academic sector should make a commitment to increase outreach efforts beyond the academic sector.

RESEARCH AND MANAGEMENT

GAPS IDENTIFIED

Demand for research not being met: Survey respondents were unanimous in selecting invasive species control as the top management issue requiring additional research, yet very few faculty or graduate students reported undertaking research that was applicable to invasive species control.

Plants are being left out of climate change planning and action: Planning and policy actions within federal and state government agencies focused on climate change adaptation and mitigation are not incorporating botanical expertise. This is likely due at least in part to a false perception that plants are not being impacted by climate change, when in reality they will often be more impacted than the wildlife and people who depend upon them.

Private sector's valuable but under-supported role: businesses and non-profit organizations are beginning to fill key gaps in government and academic botanical capacity through cross-sector partnerships. Botanical services most commonly contributed to these partnerships match up with top needs for research and management, including invasive species identification and monitoring, botanical training, and rare species monitoring and conservation. Additional support is needed to ensure botanical capacity in the private sector is in place and able to help the nation address these current and future grand challenges.

Bureau of Land Management (BLM) — charged with managing biological resources on 40% of all public land, but employ just over one botanist per 4 million acres (equivalent to having one person responsible for all of Connecticut). Of the 95 BLM survey respondents, 97% said their agency did not have enough botanically trained staff to meet current needs.

US Geological Survey (USGS) — provides the science to guide management of nearly 400 million acres of public lands. All USGS survey respondents said their agency did not have enough botanically trained staff to meet current needs. A preliminary assessment of USGS scientists at science centers in the western U.S., where most public lands are located, shows that wildlife scientists outnumber botanical scientists by over 20 to 1.

RECOMMENDATIONS MADE

Recommendation 7: The significant impacts of climate change on plants, as well as the people, wildlife, and ecosystem services that are dependent upon plants for survival and well-being, should be recognized. Appropriate botanical expertise should be incorporated into climate change planning and policy efforts in all sectors to ensure appropriate proactive research efforts are initiated, and collaborative partnerships are encouraged to support effective, efficient, and economically defensible solutions. This includes ongoing work by the Department of Interior in developing and managing Climate Science Centers and Landscape Conservation Cooperatives, where botanical capacity is currently greatly underrepresented.

Recommendation 8: Public and private funding should be directed to help all sectors close key gaps identified in plant science research that are directly linked to top needs and applications identified by this survey. This includes identified research needs in invasive species control, climate change mitigation and adaptation, habitat restoration, and the preservation of ecosystem services.

Recommendation 9: The nation's five federal land management agencies* should increase the number of trained, full-time botanists on staff. *At minimum, each agency should have at least* (a) one full-time botanist working collaboratively at the national level to address critical climate change issues facing plants on public lands, and (b) one full-time botanist with appropriate training on staff at all regional, state, and field offices.

*Bureau of Land Management (BLM), Department of Defense (DOD), National Park Service (NPS) US Forest Service (USFS), and US Fish and Wildlife Service (USFWS), which are collectively responsible for managing nearly 1/3 of the nation's landmass.

Recommendation 10: The US Geological Survey, responsible for carrying out research to guide management of Department of Interior lands** should have *at least* five full-time botanists with a range of appropriate training on staff at each of its regional science centers.

**US Geological Survey (USGS) is the research arm of the BLM, NPS, and USFWS National Wildlife Refuge system, therefore charged with research on the native plant communities comprising almost 400 million acres of public lands.

Recommendation 11: Administrators and decision-makers at federal and state land management and research agencies should engage full-time staff botanists and work collaboratively with academic and private sector expert advisors in developing land-use plans, and in planning and implementing responses to key challenges (including climate change mitigation planning, habitat restoration and invasive species control strategies). This will lead to more successful, efficient, and economical outcomes.

Recommendation 12: Federal and state land management and research agencies should provide support for full-time staff botanists to identify and prioritize plant-related issues, and ensure these priorities are clearly and consistently communicated to the academic and private sector to allow for effective and efficient action. Once identified and communicated, management and funding decisions in the private and public sectors should ensure that capacity and resources are focused on the highest priority issues (such as invasive species) and/or taxa (such as those most critically threatened).

Recommendation 13: All federal land management and research agencies should ensure new hires have appropriate botanical training, and that monitoring and reporting mechanisms are in place to avoid a similar decay in botanical capacity in the future. Specifically, all new federal hires recommended here should be employed under the US Office of Personnel Management employment code 0430 (Botany), rather than the more general code of 0400 (Natural resource management / general biology), as it does not effectively capture required botanical expertise.

Recommendation 14: Cross-sector communication and partnership should be enhanced to pool existing resources, maximize efficiency, and more rapidly address and fill critical gaps in botanical capacity. Additional resources are needed to facilitate partnerships among government, academic, and private sectors, ensuring long-term sustainability of programs necessary for science-driven management of the nation's biological resources. The Plant Conservation Alliance provides an effective vehicle for multi-sector partnerships, and examples of programs built around public-private partnerships include the national Seeds of Success program and regional programs such as the New England Plant Conservation Program and the Georgia Plant Conservation Alliance.

Visit www.bgci.org/usa/bcap to download the full report

Project staff: Kayri Havens, Chicago Botanic Garden; Andrea Kramer, Botanic Gardens Conservation International U.S.; Barbara Zorn-Arnold, Chicago Botanic Garden

Advisory Board: Patricia DeAngelis, U.S. Fish and Wildlife Service; Kent Holsinger, University of Connecticut; Kathryn Kennedy, Center for Plant Conservation; Rachel Muir, US Geological Survey; Peggy Olwell, Bureau of Land Management; Kristina Schierenbeck, California State University, Chico; Larry Stritch, US Forest Service; Marsh Sundberg, Emporia State University

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