

Assessing botanical capacity to address grand challenges in the United States

Summary

Botanical capacity plays a fundamental role in solving the grand challenges of the next century, including climate change, sustainability, food security, preservation of ecosystem services, conservation of threatened species, and control of invasive species. Yet critical components of botanical education, research and management are lacking across government, academic, and private sectors. A recent nation-wide survey revealed severe shortages of botanists at government agencies, a wave of upcoming retirements, and an alarming decline in botanical degree programs and course offerings at the nation's colleges and universities. If botanical capacity continues to erode at its current rate, the nation's science, sustainability, and land management agenda will suffer, opportunities to economically and efficiently solve environmental challenges will be lost, and our public and private lands will continue to degrade.

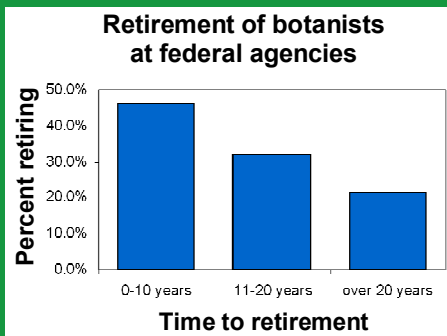
Botany is not optional

Plants are essential to life and central to the future of human well-being, the sustainable use and preservation of the world's resources, and scientific discovery. In addition to delivering ecosystem services necessary to human health – such as water purification, food and climate modulation – our plant landscapes provide habitat for myriad fish and wildlife species across the United States. This rich legacy of biodiversity is an invaluable component of American heritage.

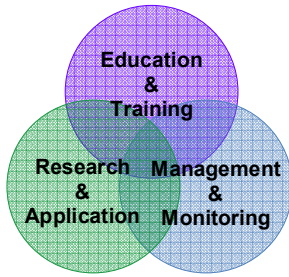
The nation's botanical sector plays a mission-critical role by studying, effectively managing, and guiding the sustainable use of the nation's plant resources. Botanical capacity therefore is a fundamental component of strategic planning and action to address today's grand challenges, particularly those surrounding climate change. Investments in this truly green sector will yield a high rate of return in environmental services and scientific advances while benefiting the health and well-being of American people and the nation's wildlife.

If we do not invest in botanical capacity now

- The United States will lose *nearly half of its workforce with botanical expertise* within the next decade. Without botanists, public lands and the nation's natural heritage cannot be efficiently or effectively managed.
- The United States will lack critical expertise needed to strategically plan and successfully implement projects to mitigate the effects of climate change on habitats, biological diversity, and ecosystem services. This will lead to significant and unnecessary costs while exposing the nation's natural heritage to dramatic losses.
- The United States will be unable to address critical challenges such as prevention and control of invasive species – adding to the billions of dollars already spent.
- The United States will continue to lose its international scientific competitive status.
- The United States will lose future opportunities to improve food security, cure disease, naturally sequester carbon and produce carbon-neutral biofuel.



Nearly 50% of federal botanists surveyed (N=147) will retire within 10 years.



BOTANICAL CAPACITY encompasses the human, scientific, technological, organizational, institutional and resource capabilities that support botanical **education, research and management**. Botanical capacity is necessary to guide the sustainable use and effective management of the nation’s critical life resources, as it provides a fundamental understanding of the processes that affect ecosystems, the natural and managed environment, wildlife, and human health and well-being. A lack of botanical capacity will severely compromise progress in solving the nation’s grand challenges.

Grand challenges requiring botanical capacity

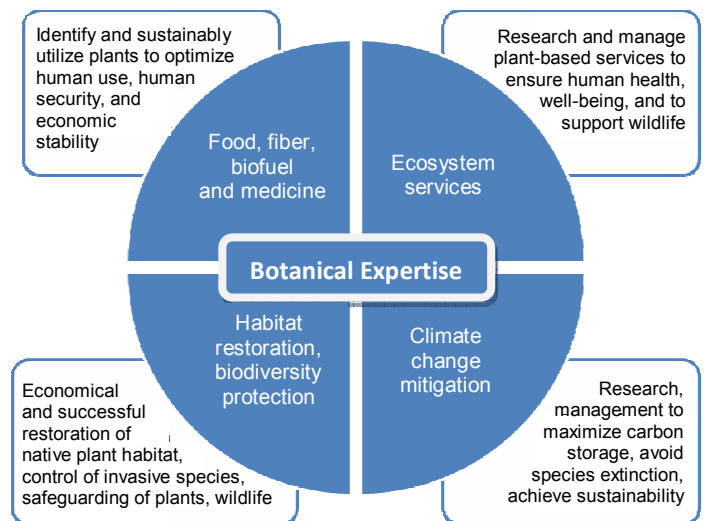
- Climate change
- Sustainability
- Preservation of ecosystem services
- Food security
- Invasive species control
- Habitat management and restoration
- Biodiversity conservation
- Carbon-neutral biofuel production

For more information on grand challenges, see President Obama’s Strategy for American Innovation, and reports from the National Research Council (2001—*Grand challenges in environmental sciences* and 2009—*A new biology for the 21st century*).

Botanical expertise: An urgent need

Despite the economic and environmental importance of botanical expertise in the United States (see figure at right), a comprehensive assessment of national botanical capacity had not been conducted until now. This project was initiated to evaluate critical gaps in botanical capacity across the government, academic and private (including NGO) sectors.

A survey targeting scientists, graduate students, administrators, and land managers involved in natural resource management, education and research across the United States was carried out in 2009. Results are summarized here and detailed in an accompanying report.



Identified: Current gaps in botanical capacity

Federal and state agencies currently lack the botanical capacity required to guide efficient and effective management of the nation’s most critical biological resources. Survey results document severe shortages of management and research staff with botanical degrees throughout all federal and state government agencies (see Table 1) with some of the most significant shortages found in agencies directly responsible for managing public lands.

Table 1: Summary of survey responses to the question “Do you think your agency has enough botanically trained staff to meet its current management/research needs?”.

Responses by sector	Response = No	Top job area with shortage
Federal Government Agencies	94% (N=358 ^a)	Botany
State Natural Heritage Programs	84% (N = 32 ^b)	Botany

Represents respondents from ^a twelve federal agencies and ^b twenty three states. See full report for details.

Identified: Current gaps in botanical capacity (CONTINUED)

Over half of all respondents from federal agencies indicated that individuals with botanical expertise are rarely, if ever, included in efforts to address topics like climate change effects on habitat, invasive plant and animal species, habitat monitoring, plant selection for restoration, or rare plant and animal species recovery. Investing in botanical capacity at government agencies will ensure that botanical expertise is available to inform these efforts, leading to more efficient management of the nation's biological resources and ultimately greater success and significant cost savings.

Evidence of current gaps in botanical capacity: research and management

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 plants in Connecticut). Of 105 BLM survey respondents, 94% 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 centers in the western US, where most public lands are located, shows that wildlife scientists outnumber botanical scientists by over 20 to 1.

Identified: Future shortfalls in botanical capacity

Already critically lacking, botanical expertise at federal agencies will continue to decline over the next 15 years as more than half of the current workforce retires. This decay in critical botanical infrastructure at government agencies is occurring in tandem with declines in botanical education and training opportunities at the nation's colleges and universities.

Survey respondents reported an inability to find appropriately trained botanists to fill currently open positions within government agencies, and they were generally dissatisfied with the botanical training of incoming employees. At the current rate of decline in botany programs at colleges and universities, and as agencies hire more botanists to fill current gaps in capacity and refill positions following retirement, there will not be an appropriately trained workforce to fill vacancies when they are needed most.

Evidence of future shortfalls in botanical capacity: education and training

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. Advanced degrees earned in botany are down 17% in the last decade, while biology degrees have grown by 60%

Decline in botanical course offerings: Nearly half 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. A majority of faculty and graduate student respondents were dissatisfied with botany courses offered by their college or university.

Recommendations to fill critical gaps in botanical capacity

- 1** 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* (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.
- 2** 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.
- 3** Administrators and decision-makers at federal land management and research agencies should ensure that full-time botanists are on-staff and directly involved in developing land-use plans, and in planning and implementing responses to key challenges (including climate change mitigation planning and invasive species control strategies). This will lead to more successful, efficient, and economical outcomes.
- 4** 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 430 (Botany), rather than the more general code of 400 (Natural resource management / general biology), as it does not effectively capture required botanical expertise.
- 5** 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 training needs are met. Similar to the current liaison position between the BLM and the Society for Range Management, this position would strengthen collaboration and workforce building through avenues such as quick-hire programs.
- 6** 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 an excellent example of how botanical capacity can be maximized through public-private partnerships comes from the national Seeds of Success program.

*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.

**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.

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