



## North American Botanic Garden Strategy for Alpine Plant Conservation

2019 North American Botanic Garden Strategy for  
Alpine Plant Conservation

*July 10th, 2019*

*Draft*

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## **Introduction**

The North American Botanic Garden Strategy for Alpine Plant Conservation (Alpine Strategy) is a blueprint for protecting alpine plants and ecosystems in the United States and Canada, focusing on the role of botanic gardens in this effort. The strategy uses two existing templates - The Global Strategy for Plant Conservation (GSPC), first approved at the Conference of the Parties (COP) to the Convention on Biological Diversity in 2002, and the North American Botanic Garden Strategy for Plant Conservation (North American Strategy) updated in 2016.

Plants that inhabit the alpine zone, defined as the treeless regions at the uppermost reaches of the mountains (Körner, 2003), are among the most vulnerable to climate change according to an assessment by the United Nations Intergovernmental Panel on Climate Change (IPCC) (Saunders, Montgomery, Easley and Spencer, 2008) and North America's alpine zone is no exception. According to the United States Geological Survey (USGS) temperatures have increased three times the global average over the past century in the higher elevations of the western U.S. and the Northern Rockies that contain North America's alpine habitat. Scientific observations have found that alpine species abundance, richness, and distribution are impacted by warming temperatures, resulting in altered patterns of alpine vegetation (Nagy, Grabherr & Thompson; Pauli, Gottfried & Grabheer, 2003; USGS). Research in the European Alps (ENSCONET 2007) has found alpine species to be on a rapid upward migration to cooler mountain summits and mountain flowers at most risk from extinction.

Alpine areas are also especially sensitive to environmental changes and impacts from mining, recreation, road building and livestock grazing (GMBA, 2006; Neely et al., 2009; Nagy, Grabherr & Thompson, 2003). According to the Institute for Arctic and Alpine Research (2017), the alpine ecosystem "is extremely sensitive to pollution and disturbance. Poor soils and a harsh climate leave little margin for tundra systems to restore themselves. Damage from erosion persists for centuries, and the extinction of any species affects many others".

The Alpine Strategy provides a framework for North American botanic gardens to address environmental and climate change challenges facing alpine ecosystems. It highlights the critical role that botanic gardens in North America play in research, conservation, and education and is intended to encourage more plant conservation organizations to contribute to the collective goal. Additionally, the Alpine Strategy fosters collaborative relationships among nations in North America, as plant conservation is often not as effective when separated by national boundaries (BGCI, 2016).

The Alpine Strategy is intended for use by not only botanic gardens, but natural history museums, universities, governments, native plant societies, and any other organization interested in preserving the natural heritage and ecological integrity of alpine zones in North America.

### History of Plant Conservation Efforts

The botanical community is increasingly working to conserve plants and their habitats around the world in the face of mounting plant extinctions. Today, one-third of all plants are threatened with extinction due to habitat loss, fragmentation, and degradation (GMBA; GSPC; Oldfield, 2010). Strategies to address this plant extinction crisis by the botanical community began at the international level with national and regional strategies soon joining global efforts.

*The Global Strategy for Plant Conservation, A Plan to Save the World's Plant Species* (GSPC) is the hallmark of global plant conservation strategies. It was adopted in 2002 by the Convention on Biological Diversity to bring both awareness and a framework for policy and action to address threats faced by plants worldwide. The GSPC provided concrete global goals and objectives for plant conservation while also encouraging individual nations to develop their strategies to support the overall protection effort. This emphasis resulted in the *North American Botanic Garden Strategy for Plant Conservation* in 2006, and updated in 2016, that laid the foundation for the protection of plants in North America.

Motivated by a strong passion for alpine plants and their stewardship, representatives of a diverse group of botanic gardens (Betty Ford Alpine Gardens, Denver Botanic Gardens, the Canadian Botanic Gardens, Botanic Gardens Conservation International, and the Memorial University of Newfoundland) and the United States Forest Service joined together in 2010 to specifically address the conservation of alpine plants in North America. The group began working on an alpine conservation strategy in 2010 and its completion is presently being led by Betty Ford Alpine Gardens and Denver Botanic Gardens.

Table 1. Comparison of the global, North American and alpine plant conservation strategies

<b>Alpine Strategy Mission</b> <i>To safeguard North American alpine plant diversity in a partnership of botanic gardens through stewardship, monitoring and education.</i>		<b>Alpine Strategy Vision</b> <i>Conservation and preservation of North American alpine plant species and their associated habitats.</i>	
<b>Global Strategy objectives</b>	<b>North American Strategy objectives</b>	<b>Alpine Strategy objectives</b>	
Understand and document plant diversity	Understand and document plant diversity	Understand and document alpine plant diversity	
Conserve plant diversity urgently and effectively	Conserve plant diversity	Conserve alpine plants and their habitats	
Use plant diversity sustainably and equitably	Use plant diversity sustainably		
Promote education and awareness about plant diversity, its role in	Promote public awareness of the importance of plant diversity and the wise use of resources	Promote awareness of the alpine ecosystem and plant diversity through education and outreach	

sustainable livelihoods and importance to all life on earth.		
Develop capacity and public engagement necessary to implement the Global Strategy.	Build capacity for conservation of plant diversity	Build capacity for the conservation of alpine plant species and associated habitats

The more specific emphasis on alpine habitats of the Alpine Strategy is considered within the broader frameworks of the GSPC and North American Strategy and is seen as complementary to their goals and objectives as shown in Table 1. The Alpine Strategy notably places a stronger emphasis on in-situ conservation as a higher priority for alpine species, supported by ex-situ efforts because of the anticipated impacts to natural habitat from climate change.

### References and related resources

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GMBA (Global Mountain Biodiversity Assessment)  
[http://www.gmba.unibe.ch/services/network\\_projects/](http://www.gmba.unibe.ch/services/network_projects/)

GSPC (Global Strategy for Plant Conservation) <https://www.bgci.org/policy/gspc/>

INSTAAR (Institute for Arctic and Alpine Research) <https://instaar.colorado.edu/>

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## **Summary of Objectives and Targets**

The Alpine Strategy has four objectives to meet its goals refined from the GSPC and North American Strategies:

1. Understand and document alpine plant diversity.
2. Conserve alpine plants and their habitats.
3. Promote awareness of the alpine ecosystem and plant diversity through education and outreach.
4. Build capacity for the conservation of alpine plant species and associated habitats.

Twelve targets have been identified to guide botanic gardens in meeting the objectives, summarized below.

<b>Objective 1. Understand and Document alpine plant diversity.</b>
<b>Target 1.</b> Develop a working map of all North American alpine areas by 2020.
<b>Target 2.</b> Create a list of all known alpine plants of North America that highlights alpine plants whose conservation status is ranked G1/T1 – G3/T3 by 2021.
<b>Target 3.</b> Assess land management designations for all North American alpine habitats.
<b>Target 4.</b> Expand floristic inventories and research on North American alpine plants to minimize gaps in knowledge.

**Objective 2. Conserve alpine plants and their habitats.**

**Target 5.** Protect 50 percent of the most Important Plant Areas (IPA's) for alpine plant conservation in North America by 2030.

**Target 6.** Conserve at least 25 percent of North American alpine flora *in situ* by 2025.

**Target 7.** Conserve 60 percent of threatened alpine plant species in North America *in situ* by 2030.

**Target 8.** Ensure that 60 percent of all identified alpine plant species in North America are placed in *ex situ* collections by 2035.

**Target 9.** Ensure that at least 75 percent of threatened North American alpine plant species are held in *ex situ* collections, and 10 percent are in recovery and/or restoration programs by 2030.

**Objective 3. Promote awareness of the alpine ecosystem and plant diversity through education and outreach.**

**Target 10.** Incorporate the irreplaceable value of the North American alpine ecosystem and plant diversity into educational and public awareness programs at botanic gardens.

**Objective 4. Build capacity for the conservation of alpine plant species and associated habitats.**

**Target 11.** Increase the number of trained professionals working on North American alpine plant conservation to address local, regional and national needs.

**Target 12.** Establish and strengthen networks, partnerships, associations and stakeholders for alpine conservation activities at regional, national and international levels.

**Targets for Botanic Gardens**

**∞ Objective 1. Document alpine plant diversity ∞**

**Target 1.** Develop a working map of all North American alpine areas by 2020.

A clear understanding of the distribution of North American alpine habitat is needed in order to protect alpine plant diversity. Using the definition of alpine as the treeless regions at the

uppermost reaches of the mountains (Körner, 2003), a map of alpine habitat in North America will be compiled using a GIS format. The map will include all areas that meet the narrow definition of alpine described here.

**Target 2. Create a list of all known alpine plants of North America and highlight alpine plants whose conservation status is ranked G1/T1 – G3/T3 by 2021.**

A definitive list of online flora providing the scientific names for 300,000 species of plants has been created as a result of the work done for the Global Strategy for Plant Conservation (GSPC). A compilation of all plants known to occur within designated and mapped alpine areas in North America will be constructed using the GSPC plant list as a starting point (An Online Flora of All Known Plants).

The list of alpine plants known to occur within North America will rely on expertise and knowledge from many participants using additional sources such as the Flora of North America, the PLANTS database administered by the U.S. Department of Agriculture and alpine specific resources such as Fowler et al. (2014). Online resources will include GLORIA (Global Observation Research Initiative in Alpine Environments), and the Rock Garden Plant Database. Online herbarium specimen databases collected in areas that align with mapped alpine habitats (Global Biodiversity Information Facility (GBIF); iDigBio) will also be used.

The compiled list for alpine plant species within North America will be compared to the NatureServe database to determine conservation ranks for all taxa. Those with a global rank of G1/T1 – G3/T3 will be highlighted.

**Target 3. Assess land management designations for all North American alpine plants and habitats.**

Land ownership and management status will be compiled for all Target 1 mapped areas of North America. Areas will be classified based on IUCN protection designations:

- Category Ia - Strict Nature Reserve
- Category Ib - Wilderness Area
- Category II - National Park
- Category III - Natural Monument or Feature
- Category IV - Habitat/Species Management Area
- Category V - Protected Landscape/Seascape
- Category VI - Protected Area with sustainable use of natural resources

Land management designations will be determined and ranked based on current land management agency definitions for habitat protection and security of designation.

**Target 4. Expand floristic inventories and research on North American alpine plants to minimize gaps in knowledge.**

Areas where alpine botanical diversity is under-studied or poorly understood will be identified based on Target 1 and Target 3 mapping. Those areas needing further documentation and greater knowledge of the flora with the potential to improve conservation will be prioritized. Floristic inventories will be conducted through collections to enhance knowledge of alpine plant diversity and distribution. Specimens will be deposited in herbaria of the region where plants are collected. Specimen data will be shared broadly on publicly accessible platforms such as Symbiota, iDigBio and GBIF.

## References and related resources

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<https://www.gloria.ac.at/species/vasculars>

GBIF (Global Biodiversity Information Facility). <https://www.gbif.org/>

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Symbiota. <http://symbiota.org/docs/>

World Flora On-line (WFO). <http://www.worldfloraonline.org/>

## ∞ Objective 2. Conserve alpine plants and their habitats ∞

### **Target 5. Protect 50 percent of the most Important Plant Areas (IPAs) for alpine plant conservation in North America by 2030.**

Protection of alpine plants will be increased by additional habitat conservation. Areas of high alpine diversity, particularly those with numerous occurrences of G1-G3 plants, will be highlighted as Important Plant Areas (IPAs). The Native Plant Conservation Campaign's IPAs Program and the Colorado Natural Heritage Program methodologies for IPA identification will be utilized in alpine areas of North America. Once North American alpine IPAs have been designated, they will be further ranked based on level of protection following the IUCN Protected Area Management Categories. Botanic gardens will work with land managers to protect at least 50 percent of these areas.

The broad goal is to maintain or improve the management of protected areas to achieve a favorable conservation status for alpine plant species. While only public land management organizations can control the level of protection on various parcels, botanic gardens can work to provide the agencies with robust, scientifically sound data on which to base management decisions. Success will involve collaboration among botanic gardens and public land management agencies.

### **Target 6. Conserve at least 25 percent of North American alpine flora *in situ* (in their native habitat) by 2025.**

Following the determination of IPAs identified in Target 5, 25 percent of North American alpine plants will be in protected areas. Areas that are designated as IPAs with low protection designation and areas with high alpine flora diversity not included in IPAs will be targeted for improved protection. Botanical gardens will conduct studies to further understand life history of species and floristic inventories that improve understanding of species distributions. These can lead to recommendations for fencing and road closures that enhance protection for individual species where appropriate. This can only be accomplished through collaborative efforts among botanic gardens and public land management agencies.

### **Target 7. Conserve 60 percent of threatened alpine plant species in North America *in situ* by 2030.**

60 percent of threatened alpine species (those with a G1-G3 rank) will be conserved in areas identified as protected by IUCN protection designations. Botanic gardens will commit to preventing alpine plant species extinction and habitat loss through in situ conservation activities. Botanic garden staff will endeavor to work collaboratively with land agencies to provide technical skills and botanical information.

**Target 8. Ensure that 60 percent of all identified alpine plant species in North America are placed in *ex situ* collections by 2035.**

60 percent of identified North American alpine plant species will be maintained in *ex-situ* collections of botanic gardens or seed banks as plants, living tissues or seeds, with appropriate genetic representation to support restoration and are managed according to science-based protocols.

*Ex-situ* conservation measures such as seed banking, cryopreservation and tissue culture are the most important methods to preserve alpine plant genetic material. Alpine species are particularly vulnerable to climate change and banking seed of these species will allow for studies to understand their ecological tolerance and potential for adaptation thus informing conservation and restoration programs. This target will require cooperation with public land management agencies as well as private land owners for collection permitting.

It is also important to develop carefully monitored living collections for a better understanding of propagation protocols and ecological requirements. Collections grown as living specimens in botanic gardens can also be valuable for raising public awareness and educational purposes.

Data on all these collections will be shared with the community through tools such as BGCI's *Plant Search* database.

**Target 9. Ensure that at least 75 percent of threatened North American alpine plant species are held in *ex-situ* collections, and 10 percent are in recovery and/or restoration programs by 2030.**

As noted in Target 8, *ex-situ* collections can take the form of plants, living tissues or seeds. Target 9 focuses on securing 75 percent of those with a G1-G3 rank in living and seed bank collections. A higher *ex-situ* collection target of 90 percent is planned for species with a greater risk of extirpation or extinction based on conservation assessment and threat. Seed banking is considered the highest priority for *ex-situ* conservation.

10 percent of threatened alpine plants will be placed in recovery and/or restoration programs following protocols such as those developed by the Center for Plant Conservation (CPC). These programs constitute rigorously tested science-based protocols for conservation and *in-situ* re-introduction.

## **References and related resources**

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### ∞ Objective 3. Promote awareness of the alpine ecosystem and plant diversity through education and outreach ∞

#### **Target 10. Incorporate the irreplaceable value of the North American alpine ecosystem and plant diversity into educational and public awareness programs at botanic gardens.**

Communication, education, and the raising of public awareness about the importance of alpine plant diversity are critical for the achievement of all targets of the Alpine Strategy. This target is understood to refer to both informal and formal education at all levels. Target audiences include botanic gardens' board members, staff, docents and volunteers as well as students, the general public, and policy-makers. Consideration should be given to developing specific indicators to monitor progress toward overall achievement of the target.

Botanic gardens have an important role in raising public awareness about plant biodiversity loss and its potential effects on the alpine ecosystem. Gardens have been shown to positively influence visitors' environmental attitudes (Williams et al., 2015), where they expect to receive accurate, unbiased information. Multiple informational techniques should be used to meet the knowledge, interests and needs of visitors for greatest impact (Weiler & Smith, 2009). Visitor

conversations with staff and docents is especially important for dispersal of sound scientific information.

It is not enough to just inform visitors about the need for alpine plant conservation (Blackmore & Oldfield, 2017) and the work being done by botanic gardens in this regard. Supplying pathways to be active in conservation projects is essential (Smith & Harvey-Brown, 2018). An educated and motivated citizen can discern the accuracy of publicly distributed information and provide valuable personal and financial support to conservation projects and organizations. Education and individual behavior are not sufficient to turn the tide on threats to alpine plant biodiversity and survival, however. Change must also occur at the legislative level. With education, environmental legislation can be proposed and supported by botanic gardens and citizens (Jensen & Wagoner, 2009) and, with their pressure, compel conservation actions by their legislators (Moss, Jensen & Gusset, 2017).

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## ☞ Objective 4: Build capacity for the conservation of alpine plant diversity ☞

**Target 11: Increase the number of trained professionals working on North American alpine plant conservation to address local, regional and national needs.**

Botany is an established science. However, there has been a decline in formal botanical education programs at all levels and in the number of professional government agency botanists, raising concern about the future study and fate of plants (Mason, 2017; Bidwell, 2013). A deficiency of educational programs and interest in botanical studies has led to a general lack of basic botany and plant identification skills in the current generation of scientists.

Botanic gardens must increase educational programs, fieldwork, and research in alpine plants to address the decline in botanical studies and shortage of botanists. These programs and collaborative efforts with universities will contribute to training future botanists whose work will be necessary to stem the growing loss of the world's plants and threats to botanical diversity.

**Target 12: Establish and strengthen networks, partnerships, associations and stakeholders for alpine conservation activities at regional, national and international levels.**

This Strategy urges botanic gardens to partner with institutions and appropriate stakeholders to strengthen plant conservation activities. Looking after North America's alpine plants and habitats is a shared responsibility of professional and amateur botanists and plant-lovers alike. Botanic gardens must take on the responsibility of championing diverse partnerships with governments, public agencies, academic institutions and individuals who all have a role to play in alpine plant conservation.

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