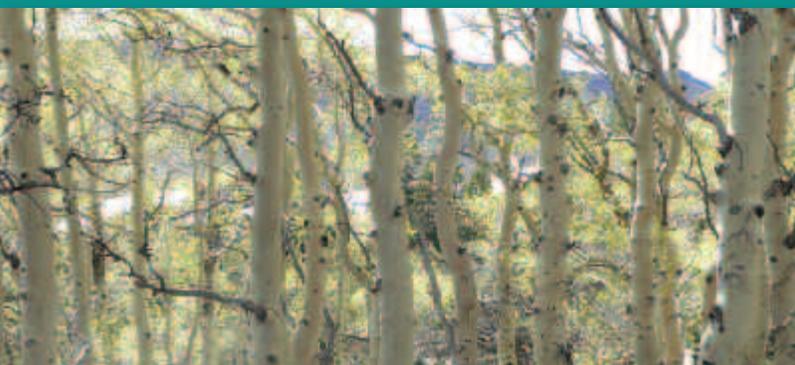


Conserving North America's Threatened Plants



Progress report on Target 8 of the
Global Strategy for Plant Conservation



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**Progress report on Target 8 of the
Global Strategy for Plant Conservation**

By Andrea Kramer, Abby Hird, Kirsty Shaw, Michael Dosmann, and Ray Mims

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Contents

Acknowledgements3
Foreword4
Executive Summary5
Chapter 1. The North American Flora6
1.1 North America's plant diversity .....	.7
1.2 Threats to North America's plant diversity .....	.7
1.3 Conservation status and protection of North America's plants .....	.8
1.3.1 Regional conservation status and national protection .....	.9
1.3.2 Global conservation status and protection .....	.10
1.4 Integrated plant conservation .....	.11
1.4.1 <i>In situ</i> conservation .....	.11
1.4.2 <i>Ex situ</i> collections and conservation applications .....	.12
1.4.3 Parameters of <i>ex situ</i> collections for conservation .....	.16
1.5 Global perspective and work on <i>ex situ</i> conservation .....	.18
1.5.1 Global Strategy for Plant Conservation, Target 8 .....	.18
Chapter 2. North American Collections Assessment .....	.19
2.1 Background .....	.19
2.2 Methodology .....	.19
2.2.1 Compiling lists of threatened North American taxa .....	.19
2.2.2 Data collection .....	.20
2.2.3 Gap analyses .....	.21
2.3 Results .....	.21
2.3.1 Participating institutions .....	.21
2.3.2 North American threatened taxa .....	.22
2.4 Conclusions and recommendations .....	.24
References .....	.28
Glossary .....	.29
Appendix 1: Participating institutions by country and collection type .....	.30
Appendix 2: Case study contributors .....	.32
Appendix 3: Status of North America's most threatened plants in <i>ex situ</i> collections .....	.33

Additional supplemental material at www.bgci.org/usa/MakeYourCollectionsCount.

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Botanic Gardens Conservation International U.S.
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Plant propagation facilities at El Charco del Ingeio Botanic Garden, Mexico. (K. Shaw)



BGCI

Plants for the Planet

BGCI U.S. works with BGCI's headquarters in the U.K. to link more than 800 botanic gardens and other partners in the United States and some 120 countries, forming the world's largest plant conservation network. Our mission is to "*mobilize botanic gardens and engage partners in securing plant diversity for the well-being of people and the planet.*" BGCI U.S. is a tax-exempt 501(c)(3) non-profit organization in the United States, and BGCI is a registered charity in the U.K.



**UNITED STATES
BOTANIC GARDEN**

Dating from 1820, the **United States Botanic Garden** is one of the oldest botanic gardens in North America. Operating under the jurisdiction of the Joint Committee on the Library, the Garden informs visitors about the importance and fundamental value of plants to the well-being of humans and our planet, and highlights the diversity of plants worldwide. The U.S. Botanic Garden is administered through the Architect of the Capitol as part of the Legislative Branch of the U.S. Government.



The **ARNOLD
ARBORETUM**
of HARVARD UNIVERSITY

The **Arnold Arboretum of Harvard University** is the oldest public arboretum in North America and one of the world's leading centers for the study of plants. Administered by the Office of the Provost of Harvard University and a link in Boston's Emerald Necklace of parks, the Arnold Arboretum is a unique blend of respected research institution and beloved public landscape. It provides and supports world-class research, horticulture, and education programs that foster the understanding, appreciation, and preservation of trees.

Additional funding provided by the Wallace Genetic Foundation.

Foreword

North America's wealth of plant diversity is increasingly threatened by habitat destruction, invasive species and climate change. While the *in situ* preservation of this diversity is the fundamental goal of plant conservation, the crucial and complementary role that *ex situ* conservation plays cannot be overstated. Well-documented, genetically diverse collections of living plant germplasm maintained away from natural populations provide a safety net for the survival of species threatened with extinction today and those that could become threatened in the future. Botanic gardens possess a unique capacity for *ex situ* conservation, made more powerful by their ability to incorporate research and education into integrated conservation programs. Their work, and the work of plant conservation organizations around the world, is helping to ensure long-term species survival in the wild.

The Global Strategy for Plant Conservation (GSPC), adopted in 2002 by the Convention on Biological Diversity, provides clear conservation targets for governments and the global plant conservation community. Target 8 of the GSPC set a goal of ensuring 60% of all threatened plants are included in *ex situ* collections by the end of 2010, as a safety net for the future. Good progress has been made toward achieving this Target via individual and collaborative efforts among the world's botanic gardens, seed banks and other plant conservation organizations and networks. However, BGCI's recent global report on progress toward Target 8 revealed that governments and conservation organizations have fallen well short of this



Hibiscus waimeae is an imperiled species found only on the island of Kauai, Hawaii. (USBG)

goal, with only 23% of globally threatened species known to be maintained in *ex situ* collections. Clearly there is much more work to do, and unfortunately the need only continues to rise.

At the 10th Conference of the Parties to the Convention on Biological Diversity, held in Japan in October 2010, countries voiced overwhelming support for the GSPC, and agreed to revise the Strategy and its targets for work through 2020. As a result, the new Target 8 now sets an updated goal of ensuring 75% of the world's threatened plants are maintained in *ex situ* collections by 2020, a significant challenge indeed toward which we must work urgently and effectively if we are to reach this objective. If North America is to achieve this Target, the North American botanical and plant conservation community must work more strategically and more collaboratively. It will be crucial to know not only what taxa are being effectively conserved in genetically diverse and representative collections, but also *what taxa are not being conserved*, so we can take actions to ensure none fall through the gaps. In renewing and revising the GSPC, the global community has given North America a second chance to achieve this important Target. If we fail there may not be a second chance for many of North America's unique plant species.

I am delighted to contribute the foreword for this important report, which was prepared as a result of a successful partnership between BGCI U.S., the United States Botanic Garden and the Arnold Arboretum of Harvard University, in collaboration with organizations across North America. In utilizing BGCI's online PlantSearch database and engaging more than 220 botanical institutions with living plant collections, tissue culture holdings and seed banks in the United States, Mexico and Canada, this project provides a much-needed first benchmark for North American progress toward Target 8. It points the way to where new collaboration is needed and sets a framework and a challenge for our future work in *ex situ* conservation efforts. I hope and trust that these results will motivate us all to do more, and provide a roadmap to assist us in ensuring that the remarkable and unique diversity of North America's wild plant species achieve the protection in our collections that so many of them desperately need.

Peter Wyse Jackson

President, Missouri Botanical Garden

Former Secretary General, BGCI

Chairman, Global Partnership for Plant Conservation

Executive Summary

North America's flora is diverse, globally unique, irreplaceable, and invaluable. This plant diversity underpins the ecosystem services that support wildlife diversity as well as human health and well-being, including the provisioning of clean air, water, food, medicine, clothing, and shelter. Unfortunately, this natural wealth is increasingly threatened by the compounding negative effects of habitat loss, invasive species, and climate change. Work to conserve North America's plants, and the ecosystem services they provide, requires an integrated blend of conservation actions. This includes: 1) *in situ* (on-site) conservation to ensure species are protected and able to thrive in their native habitat; and 2) *ex situ* (off-site) conservation to ensure genetically diverse and representative plant material is secured outside of native populations and accessible for research, education, and ultimately reintroduction of species to wild populations if and when needed.

These integrated conservation activities are included in the Global Strategy for Plant Conservation (GSPC), an international agreement adopted by the Parties to the Convention on Biological Diversity (CBD) in 2002 and updated in 2010. The GSPC provides guiding principles and 16 defined targets for global plant conservation actions through 2020. Among these is Target 8: '*75% of threatened plant species in accessible ex situ collections, preferably in the country of origin, and 20% of them included in recovery and restoration programs.*' Botanic Gardens Conservation International (BGCI) is a facilitating agency for the global implementation of Target 8, and recently published European and global assessment reports summarizing progress towards this Target. These reports identified 42% of Europe's threatened plants and only 23% of IUCN Red List species in global *ex situ* collections. In North America, botanical organizations across Canada, Mexico, and the United States make significant but largely unquantified contributions toward Target 8. This lack of information hinders strategic planning and collaborative action to conserve North America's flora. To remedy this, BGCI U.S. partnered with the United States Botanic Garden and the Arnold Arboretum of Harvard University to conduct the North American Collections Assessment and identify, for the first time, which threatened North American species are maintained in *ex situ* collections, and which are not.

We generated a consolidated list of threatened plants in North America and compared it with collections information maintained in BGCI's PlantSearch database, which contains taxa-level information on plants maintained in collections at botanical institutions around the world. Results indicate that, while some capacity for *ex situ* conservation is already in place, North America did not reach the 2010 Target 8 goal (*60% of threatened plant species in accessible collections*) and we have a considerable way to go to reach the updated 2020 GSPC Target 8 of 75%. Based upon data from 230 North American collections, we determined that 39% of the 9,496 North American threatened taxa are maintained in germplasm or living plant collections in North America. However, 45% of these collections are known from only one location, raising significant concerns about their conservation application and long-term viability.

Clearly, there is more work to do. These results are a first step in helping the botanical community prioritize the development of *ex situ* conservation collections for threatened taxa not yet in genetically diverse and representative collections. Additional surveying of institutions unable to participate in this assessment may identify threatened taxa not known to be in collections at this time. And, because our focus was at the taxonomic and not population level, next steps must include finer-grained analyses to understand the conservation value of existing collections. Given these results, we make 10 specific recommendations to North America's botanical community to advance conservation efforts and achieve the GSPC's Target 8 by the 2020 deadline: 1) expand capacity for integrated plant conservation; 2) strengthen networks for collaboration; 3) enhance collections management and curation; 4) share collections data; 5) enhance tools to facilitate data-sharing; 6) improve information on conservation status of threatened species; 7) prioritize the development of genetically diverse and secure collections; 8) use collections to advance research; 9) use collections to advance horticultural knowledge; and 10) use collections to support education and outreach. The tasks will not be easy, but are critical to halting the loss of biodiversity.

1. The North American Flora



Plants are not optional. They are essential to all life. Plants are also central to the future of human well-being, the sustainable management and preservation of natural resources, and scientific discovery^[1]. In addition to delivering ecosystem services necessary for human health – such as water purification, food, and climate modulation – plant diversity supports wildlife diversity. This rich legacy of biodiversity is an invaluable and irreplaceable component of North America’s heritage.

Northern forests cover much of Canada and the northern United States. (A. Kramer)



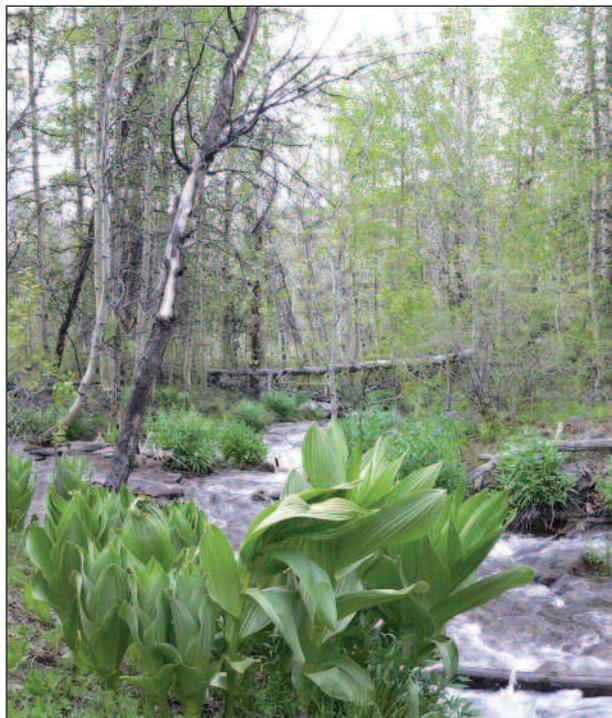
Quaking aspen (Populus tremuloides) is the most widely distributed tree in North America. (A. Kramer)

1.1 North America's plant diversity

North America's plant life is both diverse and globally unique.

The third largest continent in the world, North America (defined as Canada, Mexico, and the United States for the purposes of this report) encompasses nearly 15% of the planet's total land area. The continent contains a vast array of climates, terrain, and geological history characterized by 15 broad eco-regions ranging from arctic mountains and tundra in the far north to tropical forests in southern regions^[2] (see Figure 2.2). Together, Canada, Mexico, and the United States hold tremendous botanical diversity that is still being discovered^[3]. The United States and Canada contain some 20,000 plant species^[4], and while the full extent of Mexico's plant diversity is not yet known, it is estimated to include at least 22,000 species^[5].

Much of this unique plant diversity is found in North America's biodiversity hotspots. Coined in 1988 by ecologist Norman Myers, biodiversity hotspots are specific areas around the globe with especially high concentrations of endemic species that have experienced significant habitat loss^[6]. Out of a total of 25 global biodiversity hotspots worldwide, five are found within North America's political boundaries: California Floristic Province, Caribbean Islands, Madrean Pine-Oak Woodlands, Mesoamerica, and Polynesia-Micronesia (see Figure 2.2). Only 10-25% of original habitat remains in these North American hotspots, and the unique and abundant plant species contained within them face serious threats to their survival^[7].



Eco-regions encompass a vast array of habitats and plant diversity in North America. Shown on this page: Two very different sites located in the North American Deserts Ecological Region. (A. Kramer)



1.2 Threats to North America's plant diversity

During the last 200 years, much of the natural habitat in North America's diverse and biologically rich ecosystems has been destroyed or degraded. For example, grasslands are one of North America's most endangered ecosystems with less than 10% of original habitat remaining^[8]. Major drivers of biodiversity loss for the 21st century include habitat change, invasive alien species (including plants, animals, pests, and pathogens), climate change, and overexploitation of species^[9]. Studies show consistent increases in these threats in North America as well as globally, and provide irrefutable evidence of the need to prioritize conservation work^[9].

Habitat loss, change, and fragmentation

Destruction of natural areas to support farming, ranching, resource extraction, and human settlement has fragmented ecosystems and caused decline in biological diversity, water quality and quantity, climate stability, and other vital ecosystem services. Approximately one-third of North America's land area has been converted to agriculture, and almost 5% has been converted for human settlement^[6]. Urban and suburban sprawl is projected to continue in the coming decades, leading to further loss and fragmentation of native habitat in addition to agricultural land. With only 16% of native habitat in federally protected areas, North America faces major land use challenges and social conflict in light of increasing deforestation, urbanization, and projected changes in local climate and primary productivity^[6]. These challenges make the preservation of remaining intact natural habitat and the restoration of degraded or destroyed habitat high conservation priorities.

Invasive alien species

Biological invasions worldwide are soaring at the highest rates ever recorded, costing 5% of the global economy, or \$1.4 trillion annually^[10]. The United States currently spends more than \$25 billion every year controlling invasive plant species^[11], with costs likely rising over the coming decades. There are more than 3,300 nonnative plant species occurring in self-sustaining populations in natural areas in the U.S. today: 16 invasive plant species alone infest an estimated 125 million acres^[12]. Although many initial invasions were due to intentional movement of species, recent globalization has unintentionally accelerated the spread of plants, animals, and pathogens outside of their natural range^[9]. Marked declines of native plant populations due to invasive alien species encroachment have been documented, and now pose a serious threat to conservation of threatened and common species in the wild^[9].

Climate change

Climate change is projected to be among the leading causes of biodiversity loss this century^[9]. Species distributions, numbers, and phenology will be affected by rapidly changing climates, especially for species with long life cycles or slow dispersal mechanisms. Species that rely upon other species for survival or reproduction, and species located in vulnerable habitats (e.g., alpine and island ecosystems) will also be under increasing threat^[13]. The effects of climate change are also predicted to encourage the spread of invasive species and diseases^[10]. These changes make conserving plants in the wild increasingly challenging, and elevate the important work of maintaining genetically diverse collections of species off-site as an insurance policy and source material for restoration if and when needed.

“Projected changes in climate during the 21st century are to be without precedent during at least the past 10,000 years and, combined with land use change and the spread of exotic or alien species, are likely to limit both the capability of species to migrate and the ability of species to persist in fragmented habitats.”^[9]

Overexploitation

Plants that provide construction material, medicinal products or have culinary, cultural, or ornamental value to humans are often unsustainably harvested in the wild, causing declines in natural



populations. While difficult to document and monitor, the market for these products is significant: the market for medicinal plants and their derivatives alone

The Montreal Biodome is working to bolster remaining populations of American ginseng (Case study 1, Appendix 2). (A. Nault)



*El Charco del Ingenio Botanic Garden ensures *Dasyliirion acrotriche* is sustainably harvested for use in ceremonial decorations (Case study 2, Appendix 2). (K. Shaw)*



is more than \$3 billion annually in North America^[14].

Organizations across North America are working to protect remaining populations and sustainably utilize sought-after plant species such as American ginseng (*Panax quinquefolius*) and cucharilla (*Dasyliirion acrotriche*) (Case studies 1 and 2, Appendix 2).

1.3 Conservation status and protection of North America's plants

Approximately one-third of all plant species around the world are threatened with extinction^[15], and the North American flora is no exception^[16]. Conservation status is assigned to threatened plant species by several organizations and at a number of geographic scales including international, national, state/provincial, and even local levels. While many species have received special conservation status, this does not necessarily translate to legal protection. Legal protection is often applied only at the national or state level, and only species that make it through a formal process are legally protected. For the purposes of this report we focus on the conservation status and protection of plants at national and international scales (Table 1.1), while recognizing the important role of conservation protection and action at more local levels^[17].

1.3.1 Regional conservation status and national protection

Conservation status: Canada and United States

All plants native to Canada and the United States are monitored by a network of state or provincial natural heritage programs, with the data maintained in a single database by the non-profit organization **NatureServe**. Working with state or province-level programs to carry out periodic assessments, NatureServe assigns each taxon with a conservation status rank from 1-5 at the global, national, and state/provincial levels based upon a series of criteria, including population trends, distribution, and threats^[18]. No legal protection is associated with various NatureServe conservation ranks; of the 1,747 taxa designated with the highest conservation status (1 - critically imperiled; Table 1.1) nearly 37% are federally protected in the United States and less than 1% are federally protected in Canada. For example, *Pedicularis furbishiae* is native to Canada and the United States, has a conservation status of 1 and is federally protected in Canada and the United States (Case study 3, Appendix 2). Other taxa like *Arctostaphylos densiflora*, native to the United States and also with a NatureServe conservation status of 1, are not federally protected.

United States

The Endangered Species Act (**ESA**) was signed into law in 1973 to protect endangered species from extinction by prohibiting actions that jeopardize their survival. Species receive protection under this Act only after a rigorous legal process; currently 796 plant taxa are protected under this Act^[19]. Once listed, the U.S. Fish and Wildlife Service (USFWS) is required to create a recovery plan to increase numbers and improve management for each species so it can ultimately be removed from the ESA list (see Box 1). However, many plants protected by the ESA do not yet have recovery plans, and research is often lacking to help guide recovery actions. Additionally, plants listed under the ESA are only protected from destruction or damage if they occur on federal lands, while animals are protected on all lands, public or private^[17].

Canada

The Committee on the Status of Endangered Wildlife in Canada (COSEWIC)^[20] assesses the conservation status of plant and animal species that may be at risk of extinction in Canada. COSEWIC meets biannually to update this list. The Species at Risk Act (**SARA**), implemented in 2003, takes COSEWIC status into consideration when updating Canada's list of legally protected threatened species. Once a species is legally protected by SARA, measures to protect and recover natural populations are put in place. There are 205 vascular plant species listed under this Act^[21], which are legally protected but only on federal land. Many of these species are globally secure but have a small number of threatened populations in Canada (e.g., the plant is found in southern Canada and has many stable populations in the United States). For example, *Liparis liliifolia* was once found in southern Ontario and now listed as Extinct (E) by SARA, yet is secure in the United States (G5-NatureServe; see Table 1.1).

Box 1 An endangered species success story

After 23 years on the U.S. Endangered Species list, Robbins' cinquefoil (*Potentilla robbinsiana*) became the first plant to be delisted due to successful recovery efforts. This rare alpine plant, with a narrow distribution in the White Mountains of New Hampshire, was known from only one declining population when it was listed as Endangered in 1980. Following listing, the New England Wild Flower Society, U.S. Forest Service, U.S. Fish and Wildlife Service, State of New Hampshire, Center for Plant Conservation, and Appalachian Mountain Club worked collaboratively using *ex situ* and *in situ* conservation approaches to recover the species. Management actions *in situ* stabilized the last remaining population, and *ex situ* propagation and reintroduction work was successful in augmenting the existing population, and establishing new viable populations nearby. Today, the remaining populations continue to be monitored, and *ex situ* collections are maintained by the New England Wildflower Society as an ongoing insurance policy against extinction (Case study 4, Appendix 2).



Successful conservation allowed *Potentilla robbinsiana* to be delisted from the U.S. Endangered Species List. (D. Weihrauch)



The diminutive *Mammillaria hernandezii*, endemic to Mexico, is legally protected. (K. Shaw)

Mexico

The current national list of threatened plants in Mexico (**NOM**) was published by the Secretariat of the Environment and National Resources (SEMARNAT) in 2001. The NOM list was updated in 2010 but has not yet been published. It contains 976 plant species and subspecies^[22] known to be threatened in Mexico, of which 406 taxa listed as most threatened receive legal protection in Mexico. While many of the species on this list are endemic to Mexico, more than 9% are also found in the United States (and have been assigned a conservation status by NatureServe). Of these, more than 2% are also threatened in the United States (G/T1, 2 or 3 – NatureServe; Table 1.1), while 7% are threatened only in Mexico and considered secure in the United States (G4/T4 or 5 – NatureServe; Table 1.1).

1.3.2 Global conservation status and protection

IUCN Red List of Threatened Species

The International Union for Conservation of Nature and Natural Resources Red List (**IUCN Red List**) provides an international list

of globally threatened species that is generated following a scientifically rigorous approach for all species in order to accurately determine global risk of extinction. To produce this list, IUCN works with a Species Survival Commission and associated scientists and partners in nearly every country around the world. These scientists and conservation professionals likely hold the most complete scientific knowledge base on the biology and conservation status of taxa within their purview. As of 2010, the IUCN Red List included 13,383 vascular plant taxa, 9,418 of which are listed as threatened, and 526 of which have North American distributions^[23].

CITES

The Convention on International Trade in Endangered Species of Wild Fauna and Flora (**CITES**) is a governmental cooperation to regulate international commercial trade in animal and plant species and their derivative products. Aimed at preventing the overexploitation of wild populations, three CITES Appendices containing more than 30,000 animal and plant taxa govern movement of these materials across international borders^[24].

Table 1.1: Description of threat ranks for national and global threatened species lists (ranked from most to least threatened for each country or entity).

National Status	Rank	Details
Mexico: NOM ^[22]	E - Extinct	Probably extinct in the wild.
	Pr - Protected	Subject to special protection.
	A - Threatened	Threatened with extinction.
	P - At risk	At risk of extinction.
United States: ESA ^[19]	LE - Endangered	In danger of extinction throughout all or a significant portion of its range.
	LT - Threatened	Likely to become endangered within the foreseeable future.
Canada: SARA ^[21]	XT - Extirpated	No longer existing in the wild in Canada, but occurring elsewhere.
	E - Endangered	Facing imminent extirpation or extinction.
	T - Threatened	Likely to become endangered if limiting factors are not reversed.
	SC - Special Concern	May become threatened or endangered (biological characteristics and threats).
Global Status		
NatureServe ^[18] (Canada and United States)	G/TX - Extinct	Not located despite intensive searches and virtually no likelihood of rediscovery.
	G/TH - Historical	Missing; known from only historical occurrences but still some hope of rediscovery.
	G/T1 - Critically imperiled	At very high risk of extinction due to extreme rarity (often 5 or fewer populations), very steep declines, or other factors.
	G/T2 - Imperiled	At high risk of extinction due to very restricted range, very few populations (often 20 or fewer), steep declines, or other factors.
	G/T3 - Vulnerable	At moderate risk of extinction due to a restricted range, relatively few populations (often 80 or fewer), recent and widespread declines, or other factors.
	G/T4 - Apparently secure	Uncommon but not rare; some cause for long-term concern due to declines or other factors.
	G/T5 - Secure	Common; widespread and abundant.
IUCN RedList ^[23]	EX - Extinct	No reasonable doubt that the last individual has died following exhaustive surveys.
	EW - Extinct in the wild	Surviving in cultivation or as a naturalized population well outside past range.
	CR - Critically endangered	Facing extremely high risk of extinction in the wild.
	EN - Endangered	Facing a very high risk of extinction in the wild.
	VU - Vulnerable	Facing a high risk of extinction in the wild.

Box 2 Common species threatened by exotic pests

North America's native ash species (*Fraxinus* spp.) have significant ecological, economical, and cultural value, yet they are rapidly and unexpectedly being threatened with extinction. The cause is the emerald ash borer (EAB), an exotic insect pest native to Asia, probably brought to North America via wooden packing material transported to Michigan in the 1990s. Since its introduction, the EAB has substantially expanded its range, quickly decimating all native ash trees in its path. Tens of millions of ash trees in urban and native landscapes throughout central and eastern North America have been lost to the EAB, and the estimated 8 billion ash trees remaining are vulnerable.

With millions of dollars already invested in slowing the spread of the EAB, several response strategies have been developed to address short-term issues such as public awareness and monitoring the spread of EAB, as well as long-term questions such as genetic viability of remaining populations and the development of host-plant resistance. Before the introduction of EAB, most ash species in the United States were considered common and stable, and germplasm collections held outside of natural populations were all but nonexistent. It was not until

Natural ash stand lost to the emerald ash borer at Hidden Lake Gardens, Michigan. (A. Gapinski)

2007 that a coordinated effort to build genetically diverse *ex situ* germplasm collections was initiated to provide insurance against extinction for these species. This coordinated collection of germplasm from remaining wild ash populations is led by the National Plant Germplasm System (NPGS) of the USDA's Agricultural Research Service. Numerous partners in the United States and Canada are now working to create genetically diverse ash *ex situ* collections for future research, education, and conservation use before it is too late (Case study 7, Appendix 2).



1.4 Integrated plant conservation

Efforts to conserve North America's plants include an integrated mix of *in situ* (on-site) and *ex situ* (off-site) actions. *In situ* conservation efforts protect species in their native habitat, while *ex situ* efforts are focused on ensuring plant material is available for research, education, and ultimately reintroduction of species to wild populations if and when needed. Botanic gardens and other conservation organizations across North America play a vital role in plant conservation, integrating on- and off- site conservation methods that contribute to and help advance plant conservation.

1.4.1 *In situ* conservation

The most effective way to guarantee the long-term survival and evolution of plant species, and their associated ecological links, is to ensure plants are maintained in vigorous populations in

their native habitat – or *in situ* conservation. Today, an array of organizations and government agencies utilize *in situ*

Federally endangered Del Mar manzanita (Arctostaphylos glandulosa ssp. crassifolia) grows naturally in the San Diego Botanical Garden. (Case study 6, Appendix 2) (D. Ehrlinger)



conservation to maintain species diversity and to protect priority threatened species. In many cases this conservation work includes studying and protecting critical habitat, as well as undertaking management activities to support ecological processes and species survival^[25]. For example, staff at the Rancho Santa Ana Botanical Garden monitor and inventory Californian plant species through their Field Studies Program, which guides management strategies for critical habitat (Case study 5, Appendix 2).

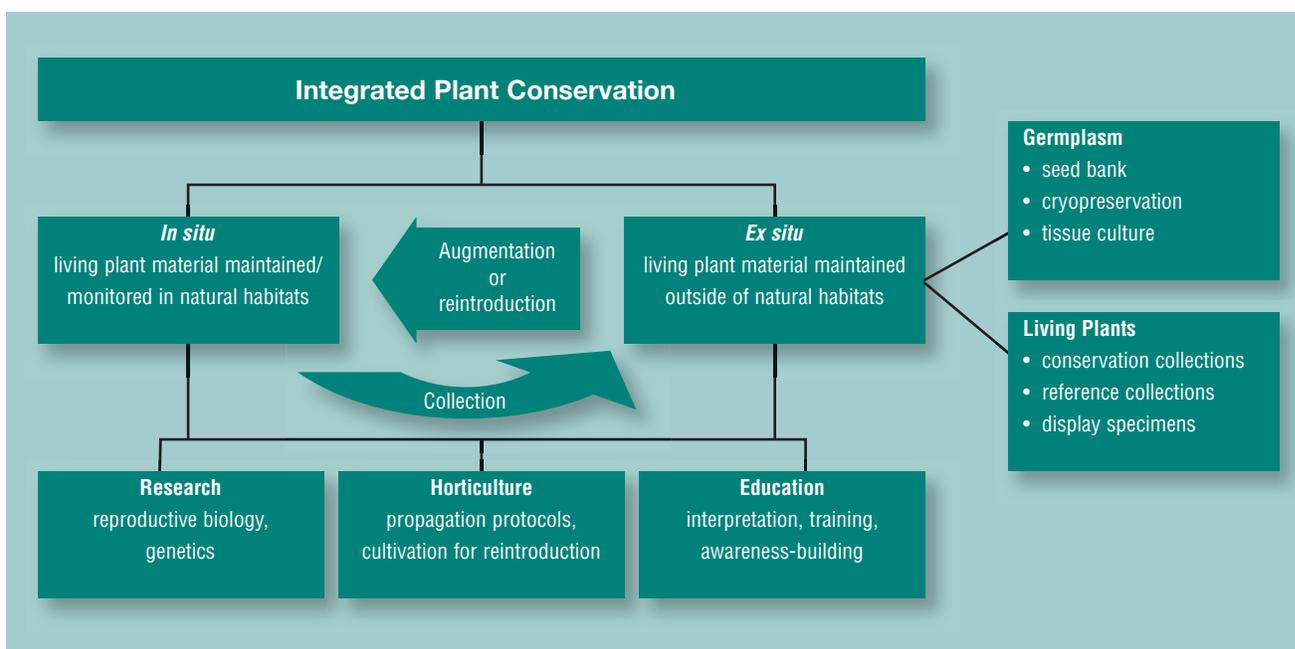
The growing threats of habitat loss, climate change, and the spread of invasive species means that *in situ* conservation is a necessary but increasingly inadequate means of conserving native plant diversity^[26]. Threatened as well as common species may be unpredictably threatened with extinction (Box 2), and as changing climates shift habitat and species distributions, protected areas that support rare species *in situ* today may no longer be suitable for those species in the future^[13]. Ideally, populations and protected areas will be robust enough to allow species adaptation via evolution and migration to avoid extinction. Restoration and reintroduction are important tools to help maintain healthy populations *in situ*, but because so many species are already in decline as a result of decades or even centuries of habitat fragmentation and degradation, many species may not be able to respond appropriately to avoid extinction. Examples include alpine species^[27] and other highly-specialized species such as serpentine endemics in California^[28]. This means *in situ* conservation work must be accelerated to



Denver Botanic Gardens works to conserve ESA listed taxa like *Gaura neomexicana* ssp. *coloradensis* (Case study 8, Appendix 2). (M. Goshorn)

help species cope with multiple unpredictable threats, and conservation-focused *ex situ* efforts must expand to secure the unique species and genetic diversity that underpin North America’s terrestrial ecosystems before they are lost. *Ex situ* collections of genetically diverse plant material, when combined with the research facilities, horticultural expertise, and public awareness (and corresponding political and financial support) maintained by botanic gardens and similar institutions, will make integrated conservation efforts more efficient and effective (Figure 1.2).

Figure 1.2: Integrated plant conservation is supported by the main activities at botanic gardens and related organizations.



1.4.2 *Ex situ* collections and conservation applications

Ex situ conservation preserves plant species outside of their natural habitat, providing a safety net for species whose survival in the wild is threatened. A range of organizations including botanic gardens, academic institutions, non-profit organizations, and government agencies maintain *ex situ* plant collections that directly or indirectly support *in situ* conservation (see Figure 1.2 and Boxes 3, 4, and 5). *Ex situ* collections that are well-documented and genetically diverse can directly support *in situ* conservation by providing seeds or plants needed to reintroduce extirpated populations^[29]. Other collections, when combined with expertise and facilities at botanic gardens, have indirect conservation application by providing opportunities to advance research, horticulture, and education.

“Botanic gardens and other ex situ facilities such as seed banks are among the most extensive yet underused plant conservation resources in the world.”^[26]

Reintroduction

When a species has been extirpated from its original habitat, scientifically based reintroduction efforts aim to reestablish new, self-sustaining populations in the same place. Since the mid-1980s, reintroduction has become an increasingly utilized plant conservation tool^[30]. For example, one-fourth of the plant species listed by the U.S. Endangered Species Act include reintroduction as a component of their recovery plan. However, the implementation of reintroduction projects is challenging, as they involve myriad factors that vary depending upon the species, site, and circumstances of the reintroduction^[30]. Even under the best circumstances reintroduction success is not guaranteed, as random events such as flooding or fire can easily decimate an otherwise healthy reintroduced population.

Reintroduction research to develop best practices is ongoing, and there is an urgent need to create *ex situ* collections before species begin to decline. Work to date has shown that viable and genetically diverse *ex situ* collections provide the best chances for reintroduction success^[31]. Without appropriate *ex situ* collections, reintroduction will not be an option.

Box 3 The Center for Plant Conservation Network

Since 1984, the Center for Plant Conservation (CPC) and its member network of 36 botanic gardens have worked to establish *ex situ* conservation resources, conduct *in situ* conservation, and where feasible prepare and initiate reintroduction for the rarest plants in the United States.

The cooperative CPC network maintains the National Collection of Endangered Plants, which contains genetically diverse and representative *ex situ* collections of more than 700 of America's most imperiled native plants. Live plant material is collected from nature following science-based, collaboratively developed CPC protocols designed to ensure a genetically-representative sample of populations for maximum conservation value. They are carefully maintained, preferably as seed (or when needed as tissue culture or cultivated plants) in CPC institutions and in the USDA National Center for Genetic Resources Preservation seed bank. Over the last 25 years, this network has banked nearly 22 million seeds destined for future reintroduction efforts. In 2009 the Center's National Collection contained material from 45% of endangered, threatened, and candidate species under the U.S. Endangered Species Act. Network institutions also conduct research on germination and clonal propagation as well as biology and ecology. Materials are carefully monitored so that imperiled plants can be more effectively grown and returned to natural habitats.

Many CPC institutions are also involved in *in situ* recovery and reintroduction, including on-the-ground fieldwork, data collection, habitat, and experimental reintroductions in appropriate secure habitat. In 2009 CPC initiated an online international reintroduction registry^[32] to facilitate information sharing, archive important data in an accessible manner, and support development of improved guidance, approaches, and techniques for reintroduction. The registry currently includes 122 reintroduction projects from North America. Data from the registry were used as the basis for a symposium in 2009 that synthesized trends, challenges, and best practices in reintroduction. The proceedings of this symposium will be published in 2011, and will include an update of the *CPC Guidelines for Preparing a Rare Plant Reintroduction*^[30]. Researchers and managers are encouraged to continue to register their reintroduction projects within the registry, whether considered successful or not, to enable monitoring of progress and best practices (Case study 9, Appendix 2).

Box 4 An integrated approach to conserve Florida's scrub lupine

Florida's scrub lupine (*Lupinus aridorum*) is a rare species found in habitat that has largely been cleared for housing developments and orange groves. Prior to 2002, 45 populations of scrub lupine had been recorded, but by 2009 only eight remained. Continuing habitat losses threaten this species with extinction. Working with numerous government, academic and non-profit partners including the Center for Plant Conservation, Bok Tower Gardens has successfully used an integrated conservation approach to conserve scrub lupine. Research efforts have doubled germination rates and produced nearly 100% seedling survival. Tissue culture studies have helped produce plants from populations with little or no seed production. Rescues of plants from areas being developed have helped preserve genetic diversity that would otherwise be lost. *Ex situ* seed collections now contain germplasm from all remaining populations, and include seed from some populations that have been extirpated. Educational presentations and materials have cultivated an awareness of scrub lupine in local communities, which resulted in several volunteers helping with conservation efforts for this species. As a result, Bok Tower Gardens has been able to introduce three new populations of scrub lupine onto protected land, increasing the number of populations to 13 by the end of 2010 (Case study 10, Appendix 2).



Bok Tower Gardens uses tissue culture propagation to safeguard remaining populations of *Lupinus aridorum*. (C. Peterson)

Box 5 Symbiotic reintroduction of a Mexican orchid

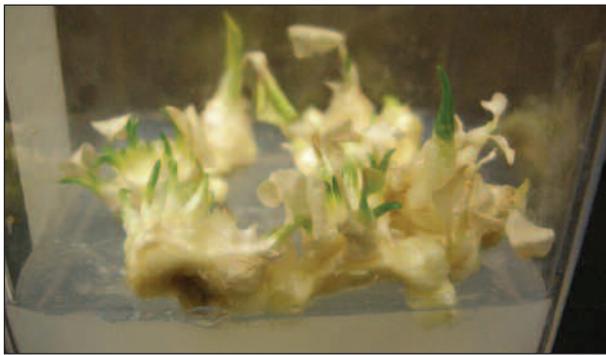
Orchidaceae is one of the world's most diverse plant families, but also among the most threatened due to habitat destruction and overcollection from the wild. A lack of effective conservation methods exacerbates their endangered status. Many orchids are also highly dependent on symbiotic (mycorrhizal) fungi for survival, meaning conservation practices need to extend beyond the plant to conserve associated fungi in order to be successful.

Twenty-five orchid species are native to the Pedregal Reserve of San Angel, located within the main National Autonomous University of Mexico (UNAM) campus. A number of symbiotic orchid reintroductions have been performed in the Reserve to illustrate the importance of mycorrhizal fungi in achieving successful long-term reintroduction projects. In 2000, 17 reintroduction sites for the rare *Bletia urbana* were selected within the Reserve, with 10 individuals planted at each site. The seeds came from a germplasm store collected from the Pedregal Reserve in 1984 and the individuals were propagated in a tissue



Bletia urbana in flower five years after successful reintroduction trials in Mexico's Pedregal Reserve. (M. Pilar Ortega)

culture laboratory at UNAM. The associated symbiotic fungi were isolated in 1999, and planting took place in 2000. The viability of the seeds 16 years after collection is a noteworthy example of the value of *ex situ* collections, and the results of the project show strong evidence for the success of symbiotic reintroductions. In 2005, the first flowering of a reintroduced individual was recorded and seeds were collected for propagation. Since this date, further individuals have flowered and produced seed with some populations now naturally reproducing (Case study 11, Appendix 2).



Student research at Southern Illinois University-Edwardsville helps conserve threatened native *Trillium* species (Case study 12, Appendix 2). (K. Barry)

Research

Ex situ collections can provide an accessible supply of plant material that facilitates research on species that otherwise may be difficult to access in the wild and/or which may have such low population numbers in the wild that research trials are not warranted. However, in order to maximize the research value of these collections they must be well-documented and appropriately curated^[33]. Collections can support both basic and applied research on topics like plant reproductive biology, molecular and evolutionary biology, ecology, as well as climate change^[34, 35]. The results of this research advance our understanding of plants and the natural world, and inform reintroduction and *in situ* conservation efforts to make them more successful.

Horticulture

Maintaining *ex situ* collections requires horticultural expertise and facilities to propagate plants (including seed germination as well as asexual propagation) and an understanding of biological characteristics unique to each species. Institutions maintaining *ex situ* collections have developed propagation techniques and

*Collaborative efforts to save the last known *Arctostaphylos franciscana* plant utilized the horticultural skills of the San Francisco Botanic Garden and UC Berkeley Botanic Garden (Case study 16, Appendix 2). (D. Kruse-Pickler)*



Ex situ work on the dawn redwood at the Dawes Arboretum supports research and conservation of this globally threatened Chinese species (Case study 13, Appendix 2). (G. Payton)



unique cultural care for thousands of taxa not available anywhere else. This information and expertise is often a critical component of reintroduction efforts. Botanic gardens are uniquely suited to develop and utilize this horticultural expertise to propagate plant material for reintroduction programs, and strong public outreach programs allow them to engage and involve a broader community in carrying out successful restoration or reintroduction projects (Case studies 14 and 15, Appendix 2).

Education

Many institutions involved in *ex situ* conservation also play a central role in public education and awareness-building by bringing visitors into contact with plants and information rarely



The Sherwood Fox Arboretum works with members of the Walpole Island First Nation to support threatened species conservation (Case study 18, Appendix 2). (J. Bowles)

The UNAM Botanic Garden produces Echeveria laui plants for reintroduction (Case study 15, Appendix 2). (K. Shaw)



seen elsewhere. BGC estimates that worldwide, more than 200 million people visit botanic gardens every year. Botanical institutions have a powerful voice both in their local communities as well as within local, state/provincial, and federal governments. *Ex situ* collections maintained by botanic gardens, if effectively interpreted and incorporated into programming, can play a critical education and outreach role beyond the plant conservation community, as well as a critical role in species protection. Efforts such as the Morton Arboretum's traveling educational exhibit on endangered trees (Case study 17, Appendix 2) can empower the botanical community to promote the importance of conserving threatened species to visitors. The news stories, research papers, and books produced by the conservation community also provide critical information about the importance of plants to people and the need for their conservation.

Conservation-focused internships, courses, and training opportunities that incorporate *ex situ* collections allow the botanical community to address plant conservation issues more effectively, as well as benefit society and culture. By developing relevancy between our lives and plants, people at every level of society can make day-to-day decisions to help decrease the loss of biodiversity.

1.4.3 Parameters of *ex situ* collections for conservation

Ex situ collections are found in widely varying circumstances which have significant implications for their application to conservation (Figure 1.2; Table 1.2). The direct or indirect conservation value of *ex situ* collections generally depends on three key factors: 1) the type of plant material collected; 2) the protocols used for collecting; and 3) the subsequent maintenance of viable germplasm.

1) The type of plant material held in *ex situ* collections

(including seeds, explants, and living plants) varies according to each species' reproductive biology, seed characteristics, and/or adaptability to *ex situ* conditions. For species with orthodox

seeds (able to be dried and stored at low temperatures for many years and still remain viable), *ex situ* collections maintained as seed banks provide the greatest direct conservation value at the lowest cost (Case study 19, Appendix 2). For species with recalcitrant seeds (not able to be dried and stored), tissue culture or

cryopreservation collections can also provide high direct conservation value but at a higher cost (Case study 20, Appendix 2; Box 6). Living plant collections can provide either direct or indirect conservation value, depending on how they are collected and maintained (see Table 1.2). The type of plant material held in *ex situ* collections at different institutions often depends on several factors including the organization's mission, availability of appropriate facilities, cultural conditions and climate, dedicated staff time and expertise, and financial support.

Collaboration among institutions can lead to more efficient and effective *ex situ* conservation action by pooling resources and connecting appropriate facilities, training, and other necessary support. In the United States, an example comes from the Seeds of Success (SOS) program, led by the Bureau of Land Management (BLM). This national native seed collection and banking program is the result of a public-private collaboration involving numerous federal agencies and private institutions (particularly botanic gardens; see Case study 21, Appendix 2) across the country. Since it began in 2001, this partnership has banked more than 10,000 collections of native seeds, safeguarding species against genetic erosion or even extinction, and providing new opportunities for research and production of the nation's native plants.



(M. Pence)

Box 6 Propagating Plants for Recovery

For many endangered species, traditional propagation by seed or cuttings can meet propagation needs, but for species with few or no seeds or few individuals, plant tissue culture can be used to supplement these methods. The Plant Research Division of the Center for Conservation and Research of Endangered Wildlife (CREW) at the Cincinnati Zoo & Botanical Garden focuses on developing and using tissue culture (*in vitro*) methods for propagating U.S. species of conservation concern. In collaboration with the Center for Plant Conservation and with support from grants from the Institute of Museum and Library Services (IMLS), CREW has developed *in vitro* propagation protocols for more than 40 of the nation's most imperiled species. In some cases, plants from these projects are already being directed into restoration projects. By partnering with botanic gardens, governmental agencies, and other non-profit organizations, the work at CREW is being integrated into conservation efforts for species recovery and demonstrating that tissue culture propagation can be an important tool for conservation and restoration.

A Resource for the Future

The CryoBioBank® (CBB) is a unique collection of frozen seeds, spores, and tissues for 150 species housed at CREW and stored in liquid nitrogen. The extremely low temperatures of liquid nitrogen provide stability for the tissues, maintaining them in a state of suspended animation for decades. Perhaps

one of the most important uses of the CBB is to preserve tissues from endangered species that produce few or no seeds or that produce recalcitrant seeds which cannot be stored in traditional seed banks. For these "exceptional" species, banking tissues such as shoot tips or embryos in liquid nitrogen can provide an alternative method for long-term germplasm storage. By partnering with collaborators in the field, multiple lines are collected and banked, thus helping to preserve the genetic diversity of a species. Tissue banking is more resource-intensive than seed banking but is valuable when seed banking is not an option, and can be used as part of an overall strategy for long-term *ex situ* conservation of rare plant species (Case study 20, Appendix 2).

Crotalaria avonensis (above) and *Arenaria cumberlandensis* are maintained at the Cincinnati Zoo & Botanical Garden's tissue culture and cryopreservation facilities. (M. Pence)



2) **The protocols used to acquire plant material for an *ex situ* collection** determine the potential conservation uses and impacts of that collection. In general, well-documented, wild-collected *ex situ* collections that capture as much genetic diversity of the species as possible will have the greatest conservation value. Organizations like the Center for Plant Conservation have developed protocols to guide the collection of plant material for genetically diverse and appropriate *ex situ* collections for direct use in reintroduction projects^[29]. These protocols often focus on *ex situ* seed collections, as this is the most effective way to capture and store genetic diversity off-site over the long-term for species with orthodox seeds.

Ex situ institutions such as botanic gardens often maintain collections of living plants represented by one or more specimens per species, and from sources that are of wild or non-wild (cultivated or unknown) origin. While only genetically diverse and representative collections are appropriate to directly support *in situ* conservation (e.g., reintroduction), living collections represented by only a few individuals from known sources serve important indirect conservation purposes, primarily through research, horticulture and education (see Section 1.4.2; Table 1.2). As collaborative efforts such as the North American Plant Collection Consortium (NAPCC) *Quercus* Multi-site Collection develop, there is potential for both large and small collections to combine efforts to develop well-documented collections of genetically diverse, wild-sourced plants that can directly and indirectly support conservation of threatened species (Case study 22, Appendix 2).

The collection of plant material for *ex situ* collections can impact the survival prospects of native populations if not carried out appropriately. Menges and colleagues^[36] showed that collecting 10% of the seeds produced in a wild population once out of every 10 years does not significantly increase extinction risk, even for more sensitive species. However, collecting even slightly more than this can severely decrease survival prospects for some species (particularly those that are already experiencing population declines). This means *ex situ*



The Lady Bird Johnson Wildflower Center's seed banking partnership with the Seeds of Success program has banked more than 500 species (Case study 21, Appendix 2). (C. Murrey)



*Montgomery Botanical Center conserves *Microcycas calocoma*, a critically endangered species endemic to a small area of Cuba (Case study 24, Appendix 2). (M. Calonje)*

collection efforts must be conducted carefully to ensure wild populations are not placed at additional risk. These findings highlight the importance of developing robust *ex situ* collections for species before their populations decline.

3) **The long-term maintenance of viable and genetically diverse plant material** plays a critical role in determining the ultimate conservation value of an *ex situ* collection. Without proper curatorial management, the conservation value of a collection, or the collection itself, can be entirely lost. Collections with the most direct conservation application are genetically diverse and representative of the species, and must be managed to ensure the material is genetically sound and available for research and conservation activities over the long-term^[37-39]. Many living collections today do not meet these standards due primarily to genetic issues such as having too little genetic diversity, being of unknown provenance, or losing genetic diversity via drift or adaptation to cultivation^[40] and hybridization^[41].

Ex situ collections management should minimize the risk of loss due to random events or natural disasters (such as staff changeover, theft, fire, disease, or other catastrophic loss) by ensuring that collections are maintained at more than one site. Additionally, curatorial oversight of living collections through time is crucial to maintaining associations between collection data (e.g., provenance) and specimens. By using the latest database and plant records technology, botanic gardens like the Francisco Javier Clavijero Botanic Garden in Mexico maintain critical links between specimens and collection data for broader conservation and research activities (Case study 23, Appendix 2).



The Arnold Arboretum and Atlanta Botanical Garden work with the Center for Plant Conservation to ensure living collections of *Torreya taxifolia* are backed up (Case study 25, Appendix 2). (M. Wenzel)

1.5 Global perspective and work on *ex situ* conservation

1.5.1 Global Strategy for Plant Conservation, Target 8

The Global Strategy for Plant Conservation (GSPC) was developed by the United Nations' Convention on Biological Diversity (CBD) to halt the current and continuing loss of plant diversity, and includes 16 outcome-oriented targets to be achieved by 2020. BGCI played a key role in the adoption of the GSPC in 2002 by the Parties to the CBD, recognizing the critical roles botanic gardens play in its successful

implementation. Since then, BGCI and botanic gardens around the world have made significant contributions to the GSPC, particularly through their work on *ex situ* conservation.

The GSPC's **Target 8** is of most relevance to *ex situ* conservation, calling for 'at least 60% of threatened plant species to be in accessible *ex situ* collections, preferably in the country of origin, and 10% of them to be in recovery and restoration programs' by 2010^[42] and 'at least 75% of threatened plant species in *ex situ* collections, preferably in the country of origin, and at least 20% available for recovery and restoration programs' by 2020^[43].

Until recently, we did not know how close we were to reaching Target 8 at a global level, as no comprehensive survey of *ex situ* collections had been conducted. Fortunately, work recently completed by BGCI^[44] shows that known global *ex situ* collections capture a minimum of only 23% of the world's threatened plants, falling well short of the 2010 Target. Significantly more strategic action is needed to achieve this recently updated target, and additional monitoring efforts such as the North American Collections Assessment will be vital in identifying the largest gaps in collections.

Table 1.2: Types of *ex situ* plant conservation and associated characteristics (adapted from^[31]).

Type of <i>ex situ</i> collection	Genetic Diversity	Longevity	Relative costs per individual	Relative Conservation Value	Notes
Seed bank	High (if proper protocols followed)	High (with proper storage)	Low (if facilities exist)	Reintroduction – High Research – High Education – Low	Seed storage is not possible for some species
Cryopreservation	High (if proper protocols followed)	High (with proper storage)	Intermediate (if facilities exist)	Reintroduction – High Research – High Education – Low	Techniques for many species not yet available
Tissue culture	High (if proper protocols followed)	Intermediate (with proper storage)	Intermediate (if facilities exist)	Reintroduction – High Research – High Education – Low	Techniques for many species not yet available
Conservation collection/Field gene bank	Intermediate	Short (species' generation length)	High	Reintroduction – Intermediate Research – High Education – High	Cultivation is the only option for some species, adaptation to cultivation and hybridization is a concern
Reference living collection	Low*	Short (species' generation length)	High	Reintroduction – Low* Research – Intermediate* Education – High	Source may be unknown, often one or few individuals, likely adaptation to cultivation
Display living collection	Low*	Short (species' generation length)	High	Reintroduction – Low* Research – Low* Education – High	Source often unknown, often one or few individuals, likely adaptation to cultivation

*May have higher genetic diversity or conservation and research value if material is wild-collected and maintained as multiple genetically diverse accessions, although adaptation to cultivation and hybridization is a concern.

2. North American Collections Assessment

2.1 Background

Ex situ conservation is a necessary component of *in situ* conservation efforts to preserve North America's plant diversity. Yet prior to this Assessment we did not know how many threatened North American species were safeguarded in collections, and how many were not. To remedy this deficiency, the key goals of this Assessment were to:

- 1) Compile available information on threatened plant species and subspecies in Canada, Mexico, and the United States into a single list to allow easy comparison with taxa held in *ex situ* collections.
- 2) Identify which globally threatened taxa native to North America are maintained in *ex situ* collections in North America, and which are not by increasing data content and quality in BGCI's PlantSearch database.
- 3) Connect North American plant collections with global plant collections (at the taxon level) via PlantSearch, allowing global reporting of progress toward Target 8 of the GSPC through 2020, and providing new opportunities for collaboration on research and conservation.
- 4) Provide recommendations for next steps that will allow the *ex situ* conservation community to achieve the GSPC Target 8 goal by 2020.

2.2 Methodology

2.2.1 Compiling lists of threatened North American taxa

A comprehensive and up-to-date list of species threatened with extinction is the first basic tool needed to assess how many threatened species are currently safeguarded in *ex situ* collections, and it is also the primary goal of Target 2 of the GSPC. Many government and private organizations monitor the threat status of species under their jurisdiction (see Section 1.3 and Table 1.1). Published threatened species lists provide critical information to help guide *ex situ* conservation efforts. However, no single comprehensive source of information on the conservation status of North American plant species was available prior to this Assessment. To remedy this, we harmonized three lists from different sources in order to compile a single list of globally threatened North American species:

- 1) **NatureServe List:** This is the most comprehensive source of global conservation status data on threatened species native to the United States or Canada^[18]. It contains 8,405 plant taxa with conservation status (five ranks, explained in Table 1.1).
- 2) **NOM List:** Mexico's national list of threatened plants is produced by the Secretariat of the Environment and National Resources^[22]. The currently published list dates from 2001, but an updated (2010) as-yet unpublished list was obtained from SEMARNAT for our analysis. It includes 976 taxa (four ranks, explained in Table 1.1).
- 3) **IUCN Red List:** This international list of globally threatened species contains 9,418 plant taxa with conservation status as of 2010^[23] (five ranks, explained in Table 1.1). Of these, only 526 taxa (6%) are identified as native to Canada, Mexico or the United States.

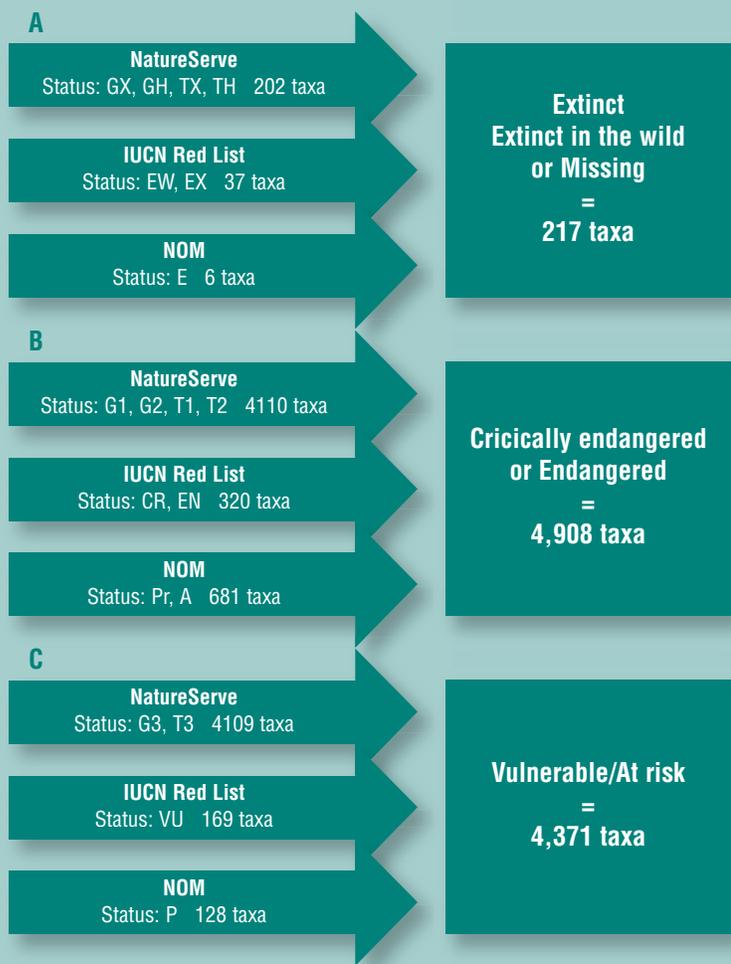
Of the 9,496 taxa on this integrated list, 75 taxa had conflicting status reports and needed adjustment for analysis. This included 69 taxa with a conservation status of protected (Pr), threatened (A) or at risk (P) on the NOM list and NatureServe ranks of secure (G4 or G5), which we excluded from the list based on the conclusion that they are nationally rather than globally threatened. In addition, six taxa had a vulnerable (VU) conservation status on the IUCN Red List but a G4 or G5 rank on the NatureServe list. In this case we accepted the IUCN Red List rank to ensure we did not inappropriately eliminate threatened taxa from our analyses.

We divided this single list into three categories to allow for more in-depth analysis of taxa that are Extinct, Endangered, or Vulnerable (Figure 2.1). The Extinct list included taxa that were considered completely extinct, extinct in the wild, or historical/missing but not extensively searched. We included Extinct as a category because some taxa identified in *ex situ* collections through this Assessment were listed as extinct on one list but not on another (e.g., *Melicope paniculata*).

Additional threatened species lists

To enable measurements of country-level progress toward Target 8, we utilized lists of threatened taxa specific to Canada^[21], Mexico^[22], and the United States^[19]. And because climate change is predicted to increase extinction threats for plants in specific habitat like alpine zones, we extracted a list of alpine and subalpine plants native to North America from Kartesz^[45]. This list was used as a first step to measure how well North American *ex situ* collections safeguard taxa that may be threatened in the future.

Figure 2.1: How three globally threatened species lists were compiled to create single Extinct (a), Endangered (b) and Vulnerable (c) taxa lists. See Table 1.1 for threat rank descriptions.



2.2.2 Data collection

BGCI launched PlantSearch, a free online database, in 2002 as a means for the international botanical community to easily measure basic, taxa-level progress toward Target 8 of the GSPC. PlantSearch allows institutions to upload a list of taxa maintained in their *ex situ* collections, and then compiles all uploaded lists into a single list of taxa, allowing for comparison with other lists of threatened species. Between 2002 and 2010 representation of North American institutions in this database grew slowly. Prior to April 2010, only 40 of the more than 700 gardens in North America had contributed to the database. These data were insufficient to carry out our rigorous collections Assessment. To encourage greater use of the database, we enhanced its usability, streamlined the upload process and improved the content and quality of information available to institutions that upload taxa lists (including new conservation status data from NatureServe and updated status data from the IUCN Red List). We also designed a project

website to encourage participation in this continent-wide Assessment where we explained the goals and benefits of the project, and translated all material into Spanish to facilitate participation by institutions in Mexico [46].

From April to September 2010, we actively solicited participation by institutions in Canada, Mexico, and the United States with living collections (defined as living plants, seed banks, tissue culture, and cryopreserved material) via listserves, newsletters, and posters at national meetings of collaborating organizations. Additionally, we contacted institutions known to maintain living collections in North America via email and telephone, and made individual site visits to many botanic gardens in Mexico [46].

Participating institutions were asked to:

- 1) Register online as a BGCI Garden Editor to obtain a username and password, allowing them to update information associated with their institution.
- 2) Create a simple spreadsheet listing the names of all taxa (regardless of source or nativity to North America) held in their collections.
- 3) Log-in to their institution's profile and upload their taxa list.
- 4) Wait 24 hours for PlantSearch to process the list (cross-referencing with the International Plant Names Index, or IPNI) and return a summary of accepted taxa, as well as information on the conservation status of each accepted taxon and the number of other institutions who report holding that taxon.

When necessary, BGCI U.S. staff assisted with formatting and uploading taxa lists for individual institutions.

On October 1, 2010, the *ex situ* collections data uploaded by participating institutions were compiled into a single list and classified as either **germplasm** (seed banks, cryopreserved collections, or tissue culture) or **living collections**. Germplasm collections on the list are largely collected for conservation purposes (i.e., documented, genetically diverse collections consisting of tens, hundreds or even thousands of individuals following protocols outlined in section 1.4) and maintained in *ex situ* facilities to maximize their longevity and conservation value. For the purposes of our analysis this also included clonal germplasm repositories maintained by the USDA Agriculture Research Service's National Plant Germplasm System (NPGS). Living collections are less uniform in genetic diversity and documentation, as the botanic gardens, zoos, and other organizations who maintain living plants often have widely different methods of obtaining plant material and different reasons for maintaining them. For example, a living collection may contain hundreds or thousands of species, but some species may only be represented by a single specimen from an unknown source, providing very little conservation or research value. However, other living collections may contain more plants that are collected from documented wild sources, providing greater potential research and conservation value.

2.2.3 Gap analyses

Threatened North American taxa

All taxa uploaded to PlantSearch (including species as well as subspecies and varieties, but excluding cultivars and forma) were categorized as represented in: 1) North American germplasm collections (including seed banks, cryopreserved, and tissue culture collections at individual institutions as well as networks); 2) North American living collections (including individual institutions and networks); 3) all North American collections (i.e., belonging to group 1, 2, or both); and 4) all global collections regardless of type.

These lists were examined separately and in combination with the three hierarchical lists of threatened taxa (explained in Figure 2.1). This allowed us to identify which North American threatened taxa – by conservation rank – are maintained in *ex situ* collections in North America, globally, and most importantly which are not. Synonymy was incorporated into gap analyses to ensure all taxa were appropriately counted, following Kartesz^[45] and data provided by NatureServe^[18].

Country-level threatened taxa

We conducted separate gap analyses for Canada, Mexico, and the United States to assess how much progress institutions

within each country have made in developing *ex situ* collections for the most threatened taxa within each country. To do this, we compared the lists of *ex situ* collections within each country to the respective national lists: 1) Canadian institutions and the list of species protected by Canada's Species At Risk Act^[21]; 2) Mexican institutions and the list of species protected by NOM-SEMARNAT^[22]; and 3) United States institutions and the list of species protected by the Endangered Species Act^[19].

Potentially threatened alpine taxa

We also compared our list of North American alpine taxa with known *ex situ* collections to identify how much of a safety net already exists for taxa that may be threatened by climate change.

2.3 Results

2.3.1 Participating institutions

Starting from a baseline of 40 North American institutions participating in PlantSearch as of April 2010, we registered a 575% increase in contributors by September 20, 2010. In all, 230 institutions participated in this Assessment, located in nearly all of the major ecoregions and biodiversity hotspots in North America (Figure 2.2; Table 2.1). This represents 31% of the 731

Figure 2.2: Participating institutions and other known botanic garden locations shown with ecological regions^[2] and biodiversity hotspots^[7] of North America.

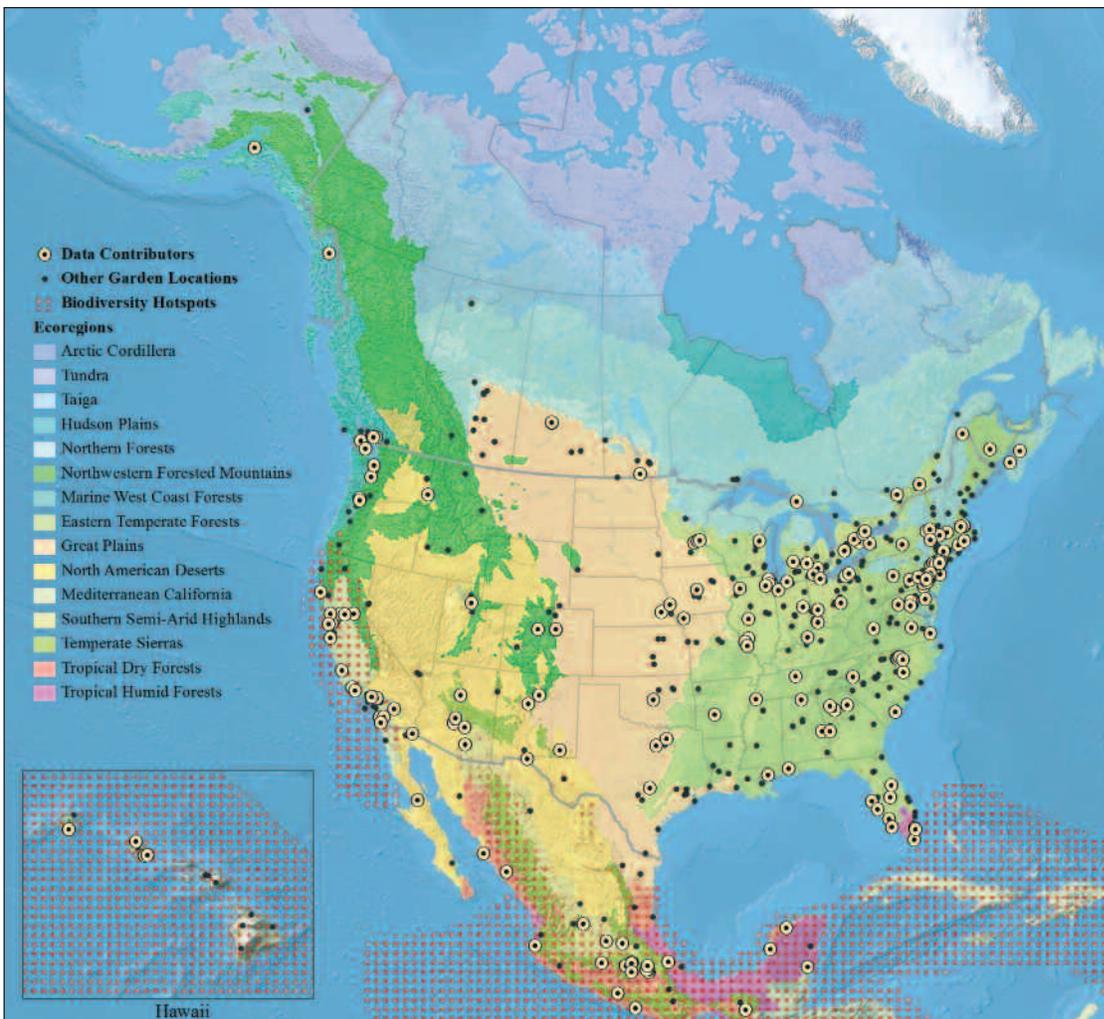


Table 2.1: Number of institutions contributing data by country and collection type. See Appendix 1 for additional details.

Country collections	Germplasm collections	Living collections	Total
Canada	2	23	25
Mexico	2	28	30
United States	19	156	175
Total	23	207	230

institutions known in BGCI's GardenSearch database for Canada, Mexico, and the United States as of September 2010. These additions translated to a nearly twofold increase in taxa listed in PlantSearch at North American institutions, from fewer than 36,000 taxa in April 2010 to more than 68,000 in October 2010.

2.3.2 North American threatened taxa

Extinct taxa

There are 217 native North American plant taxa that are now either extinct, extinct in the wild, or only known from historical collections. While 186 of these taxa are not known to be held in *ex situ* collections in North America or globally, 19 taxa are maintained in either seed banks, tissue culture, or cryopreservation facilities at five institutions on the continent, and an additional seven taxa are found in living collections at 65 North American botanic gardens and arboreta (Table 2.2; Figure 2.3). Globally, five additional native North American taxa that fall into the extinct category are found in living collections outside of North America. In total, this Assessment identified 31 extinct North American taxa maintained in the *ex situ* collections of 130 institutions around the world. It is possible that more taxa are maintained at additional institutions that did not participate in this Assessment; all institutions are encouraged to add or update their taxa lists in the PlantSearch database to ensure these taxa are able to be identified in future assessments.

Table 2.2: Percent of Extinct, Endangered, or Vulnerable North American taxa known to be maintained in participating North American and global institutions. Results are shown separately by collection type (Germplasm or Living collections) in North America, as well as for all collections in North America (Combined), and for all collections globally (Total). Many taxa are held in both germplasm and living collections, as reflected in the Combined column. See Figure 2.1 for details on Conservation Status.

Conservation Status (# known taxa)	Percent taxa in North American collections (# known institutions)			Global collections
	Germplasm	Living	Combined	Total
Extinct (217 taxa)	9% (5)	7% (65)	12% (70)	14% (130)
Endangered (4,908 taxa)	23% (20)	27% (168)	42% (188)	45% (436)
Vulnerable (4,371 taxa)	19% (21)	24% (183)	36% (204)	39% (448)
TOTAL (9,496 taxa)	21% (21)	25% (188)	39% (209)	42% (492)

Work on these taxa should focus on ensuring the remaining known plants are in secure locations and backed up elsewhere. In some cases research could be carried out to aid possible reintroduction efforts, if suitable habitat remains and if the threats which caused extinction in the wild have been removed. This includes research on the levels of genetic diversity remaining in *ex situ* collections. Work to establish multi-site breeding programs may be warranted for some species to ensure genetic diversity in the remaining *ex situ* populations is maximized while minimizing the possibility of inbreeding depression and adaptation to cultivation.

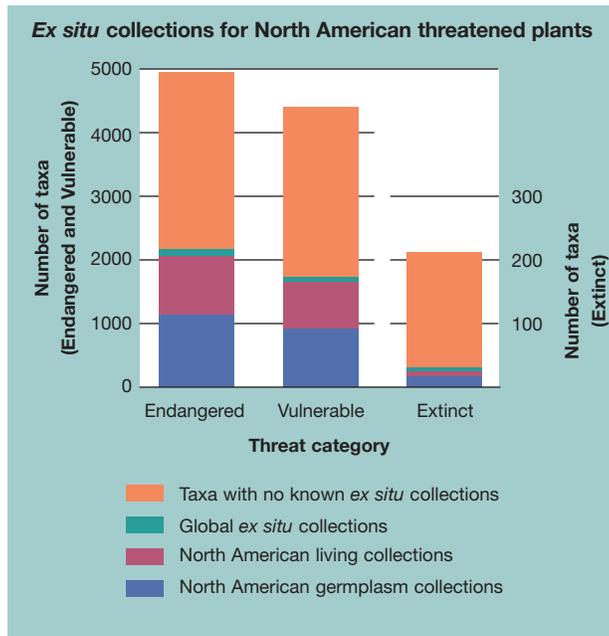
Additional work should focus on effectively using these collections in interpretation and education programs at public gardens, as they present unique opportunities to tell memorable and engaging stories about threatened plants and the need to save them through both *in situ* conservation and *ex situ* conservation.

Endangered taxa

Nearly one-quarter of the 4,908 native North American taxa that are either critically endangered or endangered are found in the germplasm collections of 20 participating institutions in North America (Table 2.2; Figure 2.3). An additional 964 taxa are also found in the living collections of 168 North American institutions. In total, 42% of these endangered taxa are held in *ex situ* collections of varying sizes and sources at 188 institutions in North America. This Assessment also identified an additional 132 taxa being held outside of North America in the collections of 248 institutions.

Additional work is needed to understand and build the size, scope, and genetic diversity of the 2,208 endangered taxa known to be maintained in an *ex situ* collection. It will also be important to ensure propagation protocols and other basic information about species biology is researched and documented from these collections in uniform and accessible ways. It is possible that a portion of the additional 2,700 endangered taxa for which we have no record in *ex situ* collections are maintained at North American institutions that did not participate in this Assessment. To fill this potential data gap, all institutions are encouraged to add or update their taxa lists in the PlantSearch database to ensure they are not missed in future assessments. However, most of these taxa likely are missing from *ex situ* collections, and it is therefore imperative that they are immediately targeted for appropriate preservation

Figure 2.3: North American threatened taxa in *ex situ* collections by threat category (see Figure 2.1). Note Endangered and Vulnerable taxa are reflected on the left vertical axis, and Extinct taxa on the right.



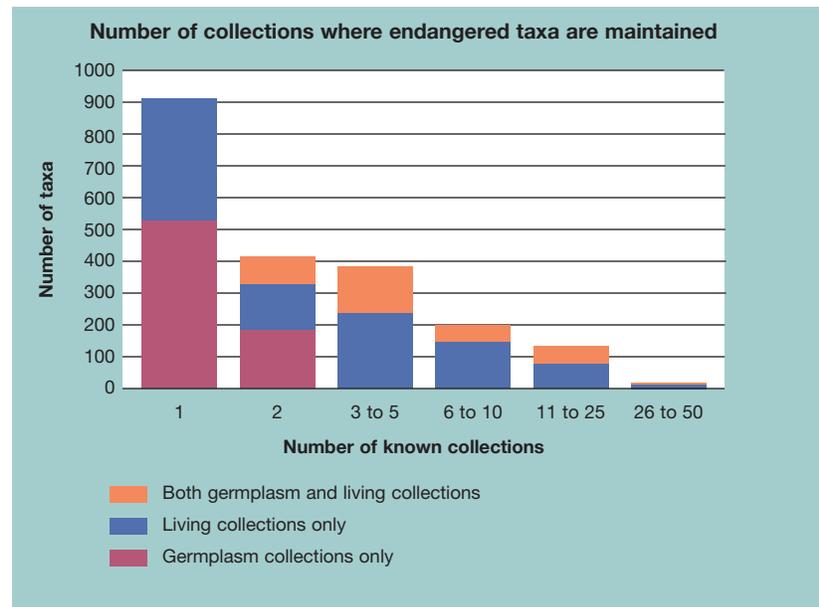
in *ex situ* collections while their population sizes are sufficiently high and before the possibility of extinction becomes a reality.

Nearly 45% of the endangered taxa held in *ex situ* collections are known from only one collection (Figure 2.4), suggesting that at least some taxa are not maintained in *ex situ* collections in sufficient numbers and replication to ensure genetic diversity. However, our data do not allow us to identify how many of these single collections represent genetically diverse and representative collections, and how many do not. We assume that the taxa held in germplasm collections contain more genetic diversity than living collections, as germplasm collections (particularly seed banks) by design are able to capture more genetic diversity. Many of the germplasm collections included in this Assessment are held as seed banks, and collected as part of the Seeds of Success program (led by the BLM), the USDA National Plant Germplasm System and the Center for Plant Conservation. Collections made as part of these programs follow well-defined protocols to ensure they capture appropriate levels of genetic diversity and are backed up at other locations to ensure long-term application for reintroduction use.

Vulnerable taxa

Of 4,371 taxa with a vulnerable status, 19% were identified in germplasm collections at 21 institutions in North America and 24% in living collections at 183 institutions in North America (Table 2.2; Figure 2.3). In total, 1,579 (36%) vulnerable taxa are maintained by 204 institutions in North America, with about a third of those held in germplasm collections also held in

Figure 2.4: Many *ex situ* collections of endangered taxa are known from only one or two collections.



living collections. In collections outside of North America, an additional 124 taxa are known from the living collections at an additional 244 institutions.

While less immediate than for endangered taxa, research needs to be conducted to determine how genetically diverse and representative the *ex situ* collections of these 1,703 taxa are. With these and other data in hand, work to make collections more robust over time can take place. For taxa that are not yet incorporated in *ex situ* collections (2,668 taxa) we will need to prioritize efforts to conserve them.

Country-level conservation

We found that rare taxa with legal protection are more likely to be maintained in an *ex situ* collection either within that country or globally than taxa that are not legally protected. Between 30% and 74% of federally protected species are found in collections in Canada, Mexico and the United States, and 60% to 77% are found in global collections (Table 2.3). This compares to only 45% of taxa with an endangered conservation status being held in *ex situ* collections globally (Table 2.2). The noticeable difference in collections representation indicated by our data may be due to differences in resourcing (e.g., institutions working with protected species are more likely to receive funding to develop *ex situ* collections) or awareness.

Our data also indicate different characteristics in the types of *ex situ* collections being utilized for the rarest taxa in each country. The United States has nearly three-quarters of its federally listed taxa in *ex situ* collection, and 65% of these taxa are found in genetically diverse germplasm collections. This is the result of over two decades of *ex situ* efforts on the nation's



Mammillaria rhodantha, threatened by over-collection in Mexico. (K. Shaw)

rarest taxa carried out by the Center for Plant Conservation and its member gardens. Canada and Mexico have fewer listed taxa in collections overall (30% and 37%, respectively), and for each country we were able to identify only 3% of these taxa maintained in germplasm collections. However, when global collections are included many more taxa (60-68%) are identified in *ex situ* collections.

Alpine taxa

Of the 3,230 native North American taxa located in subalpine or alpine habitat (and therefore threatened by climate change), 33% are maintained in germplasm collections by 18 institutions, and 36% are maintained in living collections at 165 institutions. In total, 50% of these taxa are maintained in *ex situ* collections in North America (19% are found in both living and germplasm collections) and an additional 7% of these North American alpine taxa are known from living collections outside of North America. While additional work is needed to

Table 2.3: Percent federally-protected taxa known to be maintained in Canada, the United States, Mexico, and Global collections, by collection type (Germplasm, Living, and Combined collections). Many taxa are held in both Germplasm and Living collections, as reflected in the Combined column.

Country and list providing conservation status and protection (# taxa)	Percent taxa held by in-country collections			Global collections
	Germplasm	Living	Combined	Total
Canada - Species at Risk (205)	3%	26%	30%	60%
United States - Endangered Species Act (796)	65%	39%	74%	77%
Mexico - NOM (976)	3%	36%	37%	68%

refine the North American alpine taxa list to include only taxa restricted to alpine habitat before any real conclusions can be reached, it appears that coordinated strategies to ensure alpine taxa are in *ex situ* collections have a solid base upon which to build. For example, a logical next step is to identify those endangered alpine taxa not in cultivation, and target them for collection efforts. Because of the predicted severe impacts of climate change, we need to incorporate taxa that may be threatened in the future into strategic *ex situ* collection planning. Work being carried out by NatureServe to determine the climate change vulnerability of plant species^[47] will help predict which species will be more at risk than others and may provide a useful guide for future *ex situ* efforts.

2.4 Conclusions and recommendations

This is the first time we have been able to answer the question: *Which North American threatened taxa are maintained in ex situ collections and which are not?* Results presented here, and recommendations made, are intended to spur conservation action and guide future collaborative work continent-wide. However, we acknowledge the limitations and caveats that come with an undertaking such as this, which involved tens of thousands of taxa and hundreds of collaborators.

Despite these limitations, results of this Assessment are unique and important. Future assessments, starting with this baseline, should be able to surmount many of these challenges to provide an increasingly comprehensive view of *ex situ* collections. Results of this and future assessments are necessary to support and guide strategic actions that help conserve the North American flora.

Challenges affecting the data presented in this report include:

1) **Institutional participation** – We made every effort to incorporate data from all institutions maintaining *ex situ* collections in Canada, Mexico and the United States, but did not have a 100% participation rate. Some institutions may not have been aware of the Assessment (e.g., our communications did not reach them), a small number chose not to participate, and many others indicated an interest but inability to participate (e.g., collections records were not electronically available or staffing/resources were insufficient at the time of our request). Additionally, although many resources were translated into Spanish, language barriers and lack of electronic plant records

were obstacles to participation for some institutions in Mexico^[46]. Therefore this Assessment should be considered a minimum accounting of North American *ex situ* collections, and a baseline for future work.

2) Collections information – The dynamic nature of living plant collections and ongoing *ex situ* efforts at botanic gardens and similar institutions make collection inventories a moving target. Further, staffing and resources for collections curation and management vary significantly among the 230 collections included in this Assessment, and taxa lists contributed were not always based on up-to-date inventories. Thus, depending on the type of curatorial error (undocumented losses or gains to a collection), our results may be inflated or deflated accordingly.

3) Synonymy – While this Assessment incorporated current nomenclature during data collection, existing collections of threatened species may have been missed if a participating institution submitted a synonym not recognized by either IPNI^[48] or Kartesz^[45].

4) Threatened species lists – Because there is no single comprehensive list of threatened taxa in North America, we compiled separate threatened species lists for the United States, Canada, and Mexico, which each utilized slightly different methods to assess conservation status. The results of our gap analyses were contingent upon these lists, so the accuracy of each threat rank and supporting data per taxon affected results.

5) Depth of analysis – This taxa-level Assessment provides important baseline information but is limited in that it does not quantify the genetic diversity and representative sampling of collections. Currently no technology exists to enable a more in-depth analysis at this scale.

North America did not meet the 2010 GSPC Target 8, but important conservation capacity is in place.

North America did not achieve the 2010 GSPC Target 8 (60% of threatened species in *ex situ* collections^[38]), as this Assessment identified only 39% of North American threatened taxa in North American *ex situ* collections. These results are above the global average (23%^[44]) and comparable to Europe (42%^[49]). Current capacity has been most effective in conserving North America's legally protected taxa, likely because there is greater awareness of these species, more potential resources are available for their conservation, and in many cases a mechanism for collaborative *ex situ* conservation is already in place. For example, in the United States 65% of the 796 species legally protected by the ESA are conserved in genetically diverse germplasm collections (Table 2.3), carried out by the Center for Plant Conservation and its 36 member botanic gardens.

Conservation capacity must be expanded to meet the new 2020 GSPC Target 8.

There are obvious limits to current conservation capacity, as only 42% of the 4,908 taxa ranked as endangered and 36% of the 4,371 taxa ranked as vulnerable are held in *ex situ* collections (Figure 2.3). Many of these collections are likely represented by only one or a few individual plants in living collections and therefore offer no direct conservation value (Figure 2.4). *Additional resources to expand current capacity are needed to meet the 2020 target of 75% of threatened species in ex situ collections*^[43].



Dasyliion acrotriche, a threatened plant native to central Mexico. (K. Shaw)

To advance conservation efforts and achieve the GSPC's Target 8 by the 2020 deadline, we make 10 specific recommendations to the North American botanical community.

Recommendation 1: Expand the capacity of institutions currently carrying out integrated conservation, and strategically build the resources and expertise in institutions not yet engaged in plant conservation.

Organizations with varying missions, resources, and expertise will be effective at advancing integrated plant conservation (reintroduction, research, horticulture, and education) in a variety of ways, and should seek to strategically build their capacity accordingly. Guidance on incorporating conservation into strategic planning and future action at individual institutions is available from the International Agenda for Botanic Gardens in Conservation^[50]. Examples of what individual institutions are doing and how they are measuring progress are found in Havens *et al.*^[51]. All institutions involved in integrated plant conservation are urged to record their resources and expertise in BGCI's online GardenSearch database^[52]. This allows institutions seeking specific expertise to identify potential collaborators, and provides essential baseline information on where conservation capacity is found.

Recommendation 2: Expand and strengthen networks to more effectively connect institutions carrying out integrated plant conservation.

Collaboration and communication are necessary components of integrated conservation because they build upon capacity already in place, maximize the use of limited resources, avoid duplication of effort, and provide a platform for data sharing and communication. For example, protocols, facilities, technology, and trainings developed through the Seeds of Success Program (led by the Bureau of Land Management), the Center for Plant Conservation network, and the National Plant Germplasm System have already guided the collection and banking of thousands of *ex situ* seed collections of native and threatened species. For living collections, collaborative efforts like the APGA's North American Plant Collections Consortium provide rigorous collections management standards and a platform for communication, data sharing, and training, and have the potential to more effectively integrate threatened species conservation into future collections planning and action. Other networks that facilitate communication and best practice sharing at the national, regional, and global levels come from the Canadian Botanical Conservation Network, the Asociación Mexicana de Jardines Botánicos, the American Public Gardens Association, the Plant Conservation Alliance (U.S.), and Botanic Gardens Conservation International.

Recommendation 3: Recognize the importance of collections management and enhance curatorial efforts at all institutions maintaining collections with conservation value.

The development of *ex situ* collections is a time- and resource-intensive process, and the conservation value associated with them depends not only on the type of collection (Table 1.2) but also the effectiveness of long-term curation efforts. The conservation or research value of a collection can easily be lost if key data (such as provenance information) is misplaced or if the genetic diversity or integrity of the collection is degraded (e.g., due to hybridization)^[33, 34, 41]. Resources are therefore needed to support and advance collections management standards and curatorial efforts within the botanical community over the long-term.

Recommendation 4: Share collections data to facilitate collaboration and conservation progress.

Data sharing via tools like BGCI's PlantSearch database^[53] is necessary for strategic and targeted collections development, and is the only way to measure collective conservation progress. Data sharing also allows institutions holding the same taxa to work together on interpretation, education, cultivation, research, and other programs to support species survival. For example, results of this Assessment identified one germplasm collection and 39 living collections that maintain *Neviusia alabamensis*. This species is imperiled (G2-NatureServe) but not legally protected. The few remaining *in situ* populations are threatened by invasive species as well as a lack of genetic diversity and natural recruitment, and appear to produce seed that is not viable^[18]. If *ex situ* collections for this species are genetically diverse and appropriate, and if research and horticultural practices can support it, these collections may be able to contribute to conservation work to augment remaining wild populations.

Recommendation 5: Enhance data-sharing tools to facilitate collaboration and monitor progress.

The ability to identify and synthesize accession-level information for collections of all threatened North American taxa will be required to fully gauge conservation value in future assessments. An example of the type of in-depth, accession-level assessment needed is demonstrated in a recent BGCI report on *ex situ* collections of red listed maples^[54]. The PlantSearch database allows taxa-level data sharing, and a growing number of institutions maintain individual, national, or regional databases that contain accession-level collections information. Linking PlantSearch with these accession-level databases available online will facilitate multi-institutional collaboration and allow future assessments to more effectively measure the conservation application of collections of threatened species.

A lack of comprehensive and up-to-date information on conservation status, synonymy, and distribution data for plant taxa native to North America limits *ex situ* conservation planning and action.

Recommendation 6: Improve information on the conservation status of threatened species.

Strategic *ex situ* conservation planning is hindered when comprehensive and up-to-date information on the conservation status and related synonym, nomenclatural, and distribution data is not available and easily accessible for potentially threatened taxa. Future conservation action will benefit from a universal approach to maintaining and sharing information on the current conservation status of North American taxa. This is the objective of the IUCN Red List process, and the goal of Target 2 of the GSPC ‘An assessment of the conservation status of all known plant species, as far as possible, to guide conservation action.’ A number of botanical institutions carrying out integrated plant conservation are contributing to this goal by monitoring populations *in situ* and ensuring information on changing population trends is shared with partners and in some cases applied directly to the IUCN Red List process.

Collections are only useful if they can be used! The results of this Assessment indicate that collections held in North American botanical institutions, in combination with the staff and facilities that support them, are providing key research, horticultural, and educational opportunities and information which would not otherwise exist. As collections and collaborations are enhanced to support plant conservation, it is important to remember that the ultimate goal of *ex situ* conservation is to directly support species survival in the wild.

Recommendation 7: Collaboratively prioritize and build genetically diverse, appropriate, secure, and viable collections to support conservation of North America’s threatened species.

With the results of this Assessment, we can begin to identify which collections contain appropriate genetic diversity and are sufficiently secure and viable to support *in situ* conservation work. We have also identified 5,815 currently threatened taxa not yet known in any *ex situ* collection, and many other taxa known in collections but likely with insufficient documentation and genetic diversity to be appropriate for direct conservation application. It is therefore critical to prioritize the development of new collections, and to work collaboratively to ensure resources are used efficiently and effectively. It will also be increasingly vital to include taxa predicted to be most affected by climate change and invasive species into planning and development of *ex situ* collections.

Recommendation 8: Ensure collections are able to advance research that supports conservation.

It is imperative that collections development and curation activities strengthen the research value of collections (i.e., ensuring they are of known provenance and represent the genetic diversity of a species). However, the current research value of existing *ex situ* collections is often underutilized and undervalued, largely due to a lack of awareness and accessibility across the botanical, conservation, and research communities. Fortunately, by participating in this Assessment, all 230 collections and the individuals who manage them are now connected to each other and online via the PlantSearch^[53] database. PlantSearch allows individuals maintaining species of interest to be instantly contacted by researchers or other institutions via PlantSearch’s blind email request system, and the institutions holding individual species have the option of responding or not. By continually striving to increase the utility and accessibility of *ex situ* collections of threatened species, research will be easier and more productive, and our knowledge of these species will be enhanced.

Recommendation 9: Advance horticultural knowledge to support plant conservation.

The institutions maintaining collections of threatened taxa likely hold the best or only information on how to grow these plants. This presents a tremendous opportunity for best horticultural practices to be utilized to make reintroduction work as successful as possible. However, unique propagation and cultivation information is currently not captured in consistent or accessible ways. Valuable knowledge and experience will undoubtedly be lost with employee turnover or technology shifts. A mechanism for gathering and sharing unique knowledge about the propagation and cultivation of the rarest taxa would ensure this priceless information is accessible to the botanic garden and conservation communities into the future.

Recommendation 10: Fully utilize collections to support conservation via education and outreach.

Botanical institutions have a powerful voice both in their local communities as well as within local, state/provincial, and federal governments. For example, more than 200 million people visit botanic gardens every year, and these institutions often provide the only plant-focused education programs available to students of any age. *Ex situ* collections maintained by botanic gardens, if effectively interpreted and incorporated into programming, can play a critical role in providing information about the importance of plants, the need for their conservation, and the actions people can take to help preserve North America’s plant diversity.

References

1. McCormick, S.J., and Tjian, R. (2010) A New Focus on Plant Sciences. *Science* 330, 1021.
2. CEC (1997) Ecological regions of North America: Towards a Common Perspective. Secretariat of the Commission for Environmental Cooperation.
3. Ertter, B. (2000) Floristic surprises in North America North of Mexico. *Annals of the Missouri Botanical Garden* 87, 81-109.
4. FNA (2010) Flora of North America North of Mexico. Flora of North America Association Available at www.fna.org.
5. Rzedowski, J. (1993) Diversity and origins of the phanerogamic flora of Mexico. In *Biological Diversity of Mexico, Origins and Distribution* (Ramamoorthy, T., et al., eds), 129-144, Oxford University Press.
6. Myers, N. (1988) Threatened biotas: "hot spots" in tropical forests. *Environmentalist* 8, 187-208.
7. CI (2007) Biodiversity Hotspots. Conservation International Available at www.biodiversityhotspots.org.
8. CEC (2008) The North American Mosaic. Secretariat of the Commission for Environmental Cooperation.
9. MEA (2005) *Millennium ecosystem assessment synthesis report*. Millennium Ecosystem Assessment.
10. Burgiel, S.W., and Muir, A.A. (2010) Invasive Species, Climate Change and Ecosystem-Based Adaptation: Addressing Multiple Drivers of Global Change. Global Invasive Species Programme (GISP).
11. Pimentel, D., et al. (2005) Update on the environmental and economic costs associated with alien-invasive species in the United States. *Ecological Economics* 52, 273-288.
12. Duncan, C.A., and Clark, J.K. (2005) Invasive plants of range and wildlands and their environmental, economic, and societal impacts. 222 pp., Report published by the Weed Science Society of America.
13. Hawkins, B.A., et al. (2008) Plants and climate change: Which future?, Botanic Gardens Conservation International, U.K.
14. TRAFFIC (1998) American ginseng: the root of North America's medicinal herb trade. TRAFFIC International.
15. Oldfield, S. (2010) Plant Conservation: Facing Tough Choices. *BioScience* 60, 778-779.
16. Master, L., et al. (2000) Vanishing assets. Conservation status of the U.S. species. In *Precious heritage: the status of biodiversity in the United States* (Stein, B.A., et al., eds), 93-118, Oxford University Press.
17. Stein, B.A., and Gravuer, K. (2008) Hidden in plain sight: The role of plants in State Wildlife Action Plans. NatureServe.
18. NatureServe (2010) NatureServe Explorer Online Database. (October 2009 edn), NatureServe.
19. USFWS (2010) Endangered Species Program. U.S. Fish and Wildlife Service. Available at www.fws.gov/endangered/.
20. COSEWIC (2010) Committee on the Status of Endangered Wildlife in Canada. Available at www.cosewic.gc.ca.
21. SARA (2010) Species at Risk Act. Government of Canada. Available at www.sararegistry.gc.ca.
22. SEMARNAT (2010) NOM-059-SEMARNAT-2010.
23. IUCN (2010) IUCN Red List version 2010.4.
24. UNEP-WCMC (2008) Checklist of CITES species. CITES Secretariat, Geneva, Switzerland, and UNEP-WCMC, Cambridge, U.K.
25. Garcia-Dominguez, E., and Kennedy, K. (2003) Benefits of Working with Natural Areas. *Public Garden* 18, 8-9.
26. Maunder, M., et al. (2004) *Ex situ* methods: A vital but underused set of conservation resources. In *Ex situ plant conservation: Supporting species survival in the wild* (Guerrant, E.O., et al., eds), 3-20, Island Press.
27. Trivedi, M.R., et al. (2008) Potential effects of climate change on plant communities in three montane nature reserves in Scotland, U.K. *Biological Conservation* 141, 1665-1675.
28. Loarie, S.R., et al. (2008) Climate change and the future of California's endemic flora. *PLoS ONE* 3, e2502.
29. Guerrant, E.O.J., et al. (2004) Revised genetic sampling guidelines for conservation collections of rare and endangered plants. In *Ex situ plant conservation: Supporting species survival in the wild* (Guerrant, E.O., et al., eds), 419-442, Island Press.
30. Falk, D.A., et al. (1996) *Restoring Diversity: Strategies for Reintroduction of Endangered Plants*. Island Press.
31. Guerrant, E.O., et al. (2004) *Ex situ plant conservation: Supporting species survival in the wild*. Island Press.
32. CPC (2010) International Reintroduction Registry. Available at www.centerforplantconservation.org/.
33. Hällfors, M., et al. (2010) Testing bioclimatic hypotheses with botanic garden collections - curatorial considerations. In *Proceedings of the 4th Global Botanic Gardens Congress*.
34. Dosmann, M. (2006) Research in the garden: Averting the collections crisis. *The Botanical Review* 72, 207-234.
35. Primack, R.B., and Miller-Rushing, A.J. (2009) The role of botanical gardens in climate change research. *New Phytologist* 182, 303-313.
36. Menges, E.S., et al. (2004) Effects of seed collection on extinction risk of perennial plants. In *Ex situ plant conservation: Supporting species survival in the wild* (Guerrant, E.O., et al., eds), 305-324, Island Press.
37. Falk, D.A., and Holsinger, K.E. (1991) *Genetics and conservation of rare plants*. Oxford University Press, USA.
38. Schaal, B., and Leverich, W. (2004) Population genetic issues in *ex situ* plant conservation. In *Ex situ plant conservation: Supporting species survival in the wild* (Guerrant, E.O., et al., eds), 267-285, Island Press.
39. Guerrant, E.O.J., and Fiedler, P.L. (2004) Accounting for sample decline during *ex situ* storage and reintroduction. In *Ex situ plant conservation: Supporting species survival in the wild* (Guerrant, E.O., et al., eds), 365-385, Island Press.
40. Ensslin, A., et al. Consequences of *ex situ* cultivation of plants: Genetic diversity, fitness and adaptation of the monocarpic *Cynoglossum officinale* L. in botanic gardens. *Biological Conservation* In Press, Corrected Proof.
41. Maunder, M., et al. (2004) Hybridization in *ex situ* plant collections: Conservation concerns, liabilities, and opportunities. In *Ex situ plant conservation: Supporting species survival in the wild* (Guerrant, E.O., et al., eds), 325-364, Island Press.
42. CBD (2002) Decision VI/9 Global Strategy for Plant Conservation.
43. CBD (2010) Global Strategy for Plant Conservation: Technical rationale, justification for updating and suggested milestones and indicators (UNEP/CBD/COP10/19). Conference of the Parties to the Convention on Biological Diversity.
44. Sharrock, S., et al. (2010) Saving plants, saving the planet: Botanic gardens and the implementation of GSPC Target 8. Botanic Gardens Conservation International, U.K.
45. Kartesz, J.T. (1999) A synonymized checklist of the vascular flora of the U.S., Canada, and Greenland. In *Synthesis of the North American Flora, Version 1.0* (2nd edition edn) (Kartesz, J.T., and Meacham, C.A., eds), North Carolina Botanical Garden.
46. Shaw, K.J. (2010) Conserving Mexico's Threatened Plants: Progress towards Target 8 of the Global Strategy for Plant Conservation. In *Faculty of Natural Science, Centre for Environmental Policy*, 140 pp., Imperial College, London.
47. NatureServe (2009) Predicting future change: a climate change vulnerability index. NatureServe.
48. IPNI (2010) The International Plant Names Index. Available at www.ipni.org.
49. Sharrock, S., and Jones, M. (2009) Conserving Europe's threatened plants: Progress towards Target 8 of the Global Strategy for Plant Conservation. Botanic Gardens Conservation International, U.K.
50. Wyse Jackson, P.S., and Sutherland, L.A. (2000) International Agenda for Botanic Gardens in Conservation. Botanic Gardens Conservation International, U.K.
51. Havens, K., et al. (2006) *Ex situ* plant conservation and beyond. *BioScience* 56, 525-531.
52. BGCI (2010) GardenSearch database. Botanic Gardens Conservation International, U.K. Available at www.bgci.org/garden_search.php.
53. BGCI (2010) PlantSearch database. Botanic Gardens Conservation International, U.K. Available at www.bgci.org/plant_search.php.
54. Gibbs, D. (2010) Global Survey of *ex situ* Maple Collections. Botanic Gardens Conservation International, U.K.

Glossary

Conservation collection/Field gene bank: Extensive collections of living plants from documented wild populations cultivated and curated to capture and maintain species and population-level genetic diversity and integrity for direct conservation or research application. Used as *ex situ* conservation method for species with recalcitrant seeds.

Cryopreservation: Use of liquid nitrogen to freeze seeds, pollen, or other plant tissue for long-term storage of viable plant material. Used as *ex situ* conservation method for species with recalcitrant seeds or species/populations with little viable seed production.

Direct conservation value: The potential application of an *ex situ* collection to directly benefit species survival in the wild through *in situ* efforts such as reintroduction or population augmentation. Well-documented and genetically diverse collections typically have high direct conservation value. Collections with only one or a few individuals with unknown origin, low representative genetic diversity, potential hybridization and/or adaptation to cultivation do not have direct conservation value.

Display living collection: Plants cultivated at botanic gardens or similar organizations for public enjoyment and appreciation, as well as for horticultural and educational purposes. Often represented by one or a few individuals with unknown origin, little genetic diversity, and possible hybridization and/or adaptation to cultivation.

Ex situ conservation: Long-term preservation of plant material outside the natural habitat for species whose survival in the wild is or will be threatened. Involves the development of genetically diverse and representative collections (germplasm or living plants) that can be stored long-term to provide a safety net against extinction and to support *in situ* conservation efforts.

Germplasm collection: Viable plant material preserved in seed banks, cryopreserved collections, or tissue culture; including the clonal germplasm repositories maintained by the USDA Agriculture Research Service's National Plant Germplasm System; largely collected for conservation purposes (i.e., documented, genetically diverse collections consisting of tens, hundreds or even thousands of individuals) and maintained in *ex situ* facilities to maximize their longevity and conservation value.

In situ conservation: Maintaining populations of plant species in their native habitat, where they are exposed to and affected by natural ecological and evolutionary processes.

Indirect conservation value: The potential application of an *ex situ* collection to indirectly benefit species survival in the wild through *ex situ* efforts such as research, horticulture, or education that contribute to greater understanding of threatened species and help guide more effective *in situ* conservation actions.

Living collection: Living plants maintained at botanic gardens and similar organizations for a variety of purposes including conservation, display, education, horticulture, and research; includes labeled specimens outdoors and under glass, as well as species documented in natural areas managed by the organization.

Orthodox seed: Seed that can survive desiccation (the removal of most or all water). This allows them to be stored under freezing temperatures and therefore increases their long-term viability in storage.

Recalcitrant seed: Seed that cannot survive desiccation, prohibiting storage under freezing conditions and resulting in relatively shorter storage longevity versus that of orthodox seed.

Reference living collection: Plants cultivated at botanic gardens or similar organizations as part of a large collection focused on taxonomic representation for research, horticulture, and education. For each taxon, reference living collections typically contain one or a few specimens from known sources, which typically represent a very small portion of that taxon's total genetic diversity.

Seed bank: Storage of seeds in low temperature and low moisture conditions. The method typically used for long-term storage of genetically diverse collections of orthodox seeds.

Tissue culture: Viable plant tissue maintained under slow growth conditions *in vitro*; aids propagation efforts to support reintroduction work, and can be used for relatively short-term storage of plant material.

Appendix 1: Participating institutions by country and collection type

Canada

Germplasm Collections -

National Tree Seed Centre; Plant Gene Resources of Canada

Living Collections -

Annapolis Royal Historic Gardens; Biodôme de Montréal - Botanical Garden; Cowichan Lake Research Station Arboretum; Dominion Arboretum; Dr. Sun Yat-Sen Classical Chinese Garden; Gardens of Fanshawe College and A.M. Cuddy Gardens; Great Lakes Forestry Centre Arboretum; Harriet Irving Botanical Gardens; Jardin Botanique de Montreal; Milner Gardens and Woodland; Morden Research Station; New Brunswick Botanical Garden; Niagara Parks Botanical Gardens and School of Horticulture; Patterson Park Botanical Garden; Riverview Horticultural Centre Society; Royal Botanical Gardens (Hamilton & Burlington); Royal Roads University Botanical Gardens; Sherwood Fox Arboretum; Toronto Botanical Garden; Toronto Zoo; University of British Columbia Botanical Garden; University of Guelph Arboretum; VanDusen Botanical Garden



Penstemon osterhoutii. (A. Kramer)

Mexico

Germplasm Collections -

FES Iztacala Banco de Semillas; Jardin Etnobotanico - Francisco Pelaez R. - Banco de Semillas

Living Collections -

Ecojardin del CIEco; Fundación Xochitla A.C.; Jardin Botánico - Ignacio Rodriguez Alconedo; Jardin Botánico 'Dr. Alfredo Barrera Marin'; Jardin Botánico Louise Wardle de Camacho; Jardin Botánico Benjamin F. Johnston; Jardin Botánico Culiacán; Jardín Botánico de Acapulco; Jardín Botánico de Ciceana; Jardin Botánico de Hampolol; Jardin Botánico de la Facultad de Estudios Superiores (FES); Jardin Botánico de la Universidad de Guerrero; Jardin Botánico de Plantas Medicinales de la Cruz-Badiano; Jardin Botánico del Instituto de Biología (UNAM); Jardin Botánico Dr. Faustino Miranda; Jardin Botánico Efraim Hernandez Xolocotzi; Jardin Botánico El Charco del Ingenio; Jardín Botánico Francisco Javier Clavijero; Jardin Botánico Jerzy Rzedowski Rotter; Jardin Botánico Jorge Victor Eller T. de la Universidad Autónoma de Guadalajara; Jardin Botánico Regional de Cadereyta Ing. Manuel Gonzalez de Cosío; Jardin Botánico Regional del Cicy; Jardin Botánico Rey Netzahualcoyotl; Jardin Botánico Tizatlan; Jardin Etnobotánico - Francisco Pelaez R; Jardin Etnobotánico y Museo de Medicina Tradicional y Herbolaria; Laboratorio Microcosmos Bioedáfico del Departamento de Edafología Instituto de Geología, UNAM; Vallarta Botanical Gardens A.C.



Trillium flexipes. (K. Barry)

United States

Germplasm Collections –

Berry Botanic Garden - Seed Bank; Seeds of Success program, led by the Bureau of Land Management (Network of collections); Bok Tower Gardens Conservation Program - Seed Bank; Boyce Thompson Arboretum Desert Legume Program - Seed Bank; Center for Plant Conservation (Network of collections); Chicago Botanic Garden - Dixon National Tallgrass Prairie Seed Bank; Cincinnati Zoo and Botanical Gardens - CREW tissue culture; Cincinnati Zoo and Botanical Gardens - CryoBioBank; Denver Botanic Gardens - Seed Bank; Desert Botanic Garden - Seed Bank; Harold L. Lyon Arboretum - Tissue Culture Laboratory; Harold L. Lyon Arboretum - CCRT Seed Conservation Laboratory; Missouri Botanic Garden - Seed Bank; National Plant Germplasm System - USDA-ARS-NGRL (Network of collections); National Tropical Botanical Garden - Seed Bank; New England Wild Flower Society - Seed Bank; North Carolina Botanical Garden - Seed Bank; Rancho Santa Ana Botanic Garden - Seed Bank; University of Washington Botanic Gardens - Miller Seed Vault

Living Collections -

Adkins Arboretum; Alaska Botanical Garden; Arboretum at Flagstaff; Arboretum at Penn State; Arboretum at the University of California, Santa Cruz; Arboretum of The Barnes Foundation; Arnold Arboretum of Harvard University; Atlanta Botanical Garden; Aullwood Garden MetroPark; Bamboo Brook Outdoor Education Center; Berkshire Botanical Garden; Betty Ford Alpine Gardens; Bickelhaupt Arboretum; Bok Tower Gardens Conservation Program; Botanic Garden of Smith College; Botanic Gardens at Kona Kai; Botanic Gardens of the Heard Natural Science Museum; Bowman's Hill Wildflower Preserve; Boyce Thompson Arboretum; Boyce Thompson Arboretum Desert Legume Program; Brooklyn Botanic Garden; Brookside Gardens; C. M. Goethe Arboretum; Cape Fear Botanical Garden; Chanticleer Foundation; Charles R. Keith Arboretum; Checklist of Cultivated Plants of Hawaii (Network of collections); Chester M. Alter Arboretum; Chicago Botanic Garden; Chihuahuan Desert Gardens; Cleveland Botanical Garden; Columbus Botanical Garden; Connecticut College Arboretum; Cornell Plantations; Crosby Arboretum; Dawes Arboretum; Denver Botanic Gardens; Desert Botanic Garden; Dixon Gallery and Gardens; Donald E. Davis Arboretum; Duke Biology Plant Teaching and Research Facility; DuPage Forest: Forest Preserve District of DuPage County; Edison and Ford Winter Estates; Eloise Butler Wildflower Garden & Bird Sanctuary; Enid A. Haupt Glass Garden; Fairchild Tropical Botanic Garden; Fernwood Botanical Garden and Nature Preserve; Florida Botanical Gardens; Forrest Deaner Native Plant Botanic Garden; Fort Worth Botanic Garden; Frederik Meijer Gardens & Sculpture Park; Frelinghuysen Arboretum; Ganna Walska Lotusland Foundation; Gardens at SIUE; Garvan Woodland Gardens; Green Bay Botanical Garden; Green Spring

Gardens; Greenwood Gardens; Heber W. Youngken, Jr. Medicinal Plant Garden; Henry Foundation for Botanical Research; Henry Schmieler Arboretum; Hershey Gardens; Hidden Lake Gardens; Highstead Arboretum; Holden Arboretum; Hoyt Arboretum; Huntington Botanical Gardens; Huntsville Botanical Garden; Jackson's Garden of Union College; JC Raulston Arboretum; Jensen-Olson Arboretum; John C. Gifford Arboretum; Key West Tropical Forest and Botanical Garden; Lady Bird Johnson Wildflower Center at the University of Texas at Austin; Landis Arboretum; Lauritzen Gardens; Lincoln Park Conservatory; Living Desert Zoo & Gardens State Park; Living Desert; Longwood Gardens; Los Angeles County Arboretum and Botanic Garden; Magnolia Plantation and Gardens; Marie Selby Botanical Gardens; Marjorie McNeely Conservatory at Como Park; Matthaei Botanical Gardens & Nichols Arboretum; Maymont Foundation; Mead Garden; Memphis Botanic Garden; Mendocino Coast Botanical Gardens; Minnesota Landscape Arboretum; Missouri Botanical Garden; Missouri State Arboretum; Mobile Botanical Gardens; Montgomery Botanical Center; Morris Arboretum of the University of Pennsylvania; Morton Arboretum; Mount Auburn Cemetery; Mountain Top Arboretum; Mt. Cuba Center; Museum of Life + Science Magic Wings Butterfly House; Naples Botanical Garden; National Tropical Botanical Garden; Nebraska Statewide Arboretum; New England Wild Flower Society - Garden in the Woods; New York Botanical Garden; Norfolk Botanical Garden; North American Plant Collections Consortium - *Acer* and *Quercus* Multi-Site Collections (Network of collections); North Carolina Arboretum; Northwest Trek Wildlife Park; Oak Park Conservatory; Oklahoma City Zoo and Botanical Gardens; Pacific Southwest Research Station, USDA Forest Service; Phoenix Zoo - Gardens; Quarryhill Botanical Garden; Queens Botanical Garden; Rancho Santa Ana Botanic Garden; Reading Public Museum and Arboretum; Red Butte Garden and Arboretum; Reiman Gardens; Rio Grande Botanic Garden; Rogerson Clematis Collection; San Diego Botanic Garden; San Diego Zoo Botanical Gardens; San Diego Zoo's Wild Animal Park; San Francisco Botanical Garden; San Luis Obispo Botanical Garden; Santa Barbara Botanic Garden; Santa Fe Botanical Garden; Sarah P. Duke Gardens; Scott Arboretum of Swarthmore College; Shaw Nature Reserve of the Missouri Botanical Garden; Sister Mary Grace Burns Arboretum; Smith-Gilbert Gardens; Starhill Forest Arboretum; State Arboretum of Virginia; State Botanical Garden of Georgia; Sunshine Farm and Gardens; Taltree Arboretum & Gardens; Toledo Botanical Garden; Trees Atlanta; Tyler Arboretum; UC Davis Arboretum; United States Botanic Garden; United States National Arboretum; University of California Botanical Garden; University of Delaware Botanic Gardens; University of Idaho Arboretum & Botanical Garden; University of Washington Botanic Gardens; Vanderbilt University Arboretum; W.J. Beal Botanical Garden; Waimea Valley; Wallace Desert Gardens; Wheeler Orchid Collection and Species Bank; Willowood Arboretum; Yew Dell Botanical Gardens

Appendix 2: Case study contributors

- 1 **Conservation strategies at the Montreal Biodome for overharvested species.** A. Nault, Montreal Biodome.
- 2 **Community engagement in plant conservation.** K. Shaw for El Charco del Ingenio Botanic Garden.
- 3 ***Pedicularis furbishiae*: an environmental icon.** J. Aucoin, New Brunswick Botanical Garden.
- 4 **Robbins' cinquefoil: an endangered species success story.** W. Brumback, New England Wild Flower Society.
- 5 **Supporting integrated conservation of California native plants.** N. Fraga, Rancho Santa Ana Botanical Garden.
- 6 ***In situ* conservation inside our garden walls.** D. Ehrlinger, San Diego Botanical Garden.
- 7 **Common species threatened by exotic pests.** M. Widrechner, NPGS (USDA-ARS).
- 8 **Integrated plant conservation and collaboration to conserve Colorado's alpine plants.** M. DePrenger-Levin, J. Ramp Neale, Denver Botanic Gardens.
- 9 **The Center for Plant Conservation (CPC) Network.** K. Kennedy, Center for Plant Conservation.
- 10 **An integrated approach to conserve Florida's Scrub Lupine.** C. Peterson, Bok Tower Gardens.
- 11 **Symbiotic reintroduction of a Mexican orchid.** K. Shaw for Microcosmos Bioedáfico Laboratory, Dept. of Soil Science, UNAM.
- 12 ***Trillium* conservation at Southern Illinois University Edwardsville.** K. Barry, D. Conley, Gardens at Southern Illinois University Edwardsville (SIUE).
- 13 **Dawn-redwood *ex situ* collection efforts at the Dawes Arboretum.** M. Ecker, The Dawes Arboretum.
- 14 **Management plan for threatened cactus species.** K. Shaw for Botanic Garden of Cadereyta.
- 15 **Reintroduction of *Echeveria laui* in the Biosphere Reserve of Tehuacán-Cuicatlán.** K. Shaw for UNAM Botanic Garden.
- 16 **San Francisco Manzanita: From Extinct to Endangered.** D. Kruse-Pickler, San Francisco Botanic Garden.
- 17 **Endangered species traveling exhibit.** A. Dorgan, The Morton Arboretum.
- 18 **Walpole Island community plant conservation efforts.** J. Bowles, Sherwood Fox Arboretum.
- 19 **Berry Botanic Garden Seed Bank for rare and endangered plants of the Pacific Northwest.** E. Guerrant, Berry Botanic Garden Seed Bank.
- 20 **Cincinnati Zoo & Botanical Garden: Providing critical tools for conservation.** V. Pence, Cincinnati Zoo & Botanical Garden.
- 21 **A community approach to seed banking.** F. Oxley, M. Eason, D. Waitt, Lady Bird Johnson Wildflower Center at the University of Texas at Austin.
- 22 **Conserving oaks in North American plant collections: a collaborative approach.** E. Griswold, *Quercus* NAPCC Multi-site Collection.
- 23 **Cycad collection and plant records management.** K. Shaw for Francisco Javier Clavijero Botanic Garden.
- 24 **Backing Up Living Conservation Collections.** C. Husby, Montgomery Botanical Center.
- 25 **A 25-year perspective of *ex situ* collection maintenance of *Torreya taxifolia*.** A. Hird, M. Dosmann, Arnold Arboretum of Harvard University; J. Cruse-Sanders, M. Wenzel, Atlanta Botanical Garden.

See supplemental material at www.bgci.org/usa/MakeYourCollectionsCount for full case study content.

Appendix 3:

Status of North America's most threatened plants in *ex situ* collections. Includes taxa listed as G1/T1 (NatureServe), CR (Red List) or PR (NOM).

Name	Present in Germplasm Collections	Present in Living Collections	Red List Status	NatureServe Status	NOM Status
<i>Abies flinckii</i>					Pr
<i>Abronia alpina</i>				G1	
<i>Abronia ammophila</i>	1	1		G1	
<i>Abronia nana</i> var. <i>harrisii</i>				T1	
<i>Abutilon eremitopetalum</i>	1	4	CR	G1	
<i>Abutilon menziesii</i>	2	4	CR	G1	
<i>Abutilon sandwicense</i>	1	2	CR	G1	
<i>Acaena exigua</i>				G1	
<i>Acanthomintha duttonii</i>		1		G1	
<i>Acanthomintha ilicifolia</i>	1			G1	
<i>Acer glabrum</i> var. <i>greenei</i>				T1	
<i>Acer negundo</i> ssp. <i>mexicanum</i>			VU		Pr
<i>Acharagma aguirreanum</i>			CR		Pr
<i>Acharagma roseana</i>		4			Pr
<i>Achillea millefolium</i> var. <i>megacephala</i>				T1	
<i>Achnatherum lemmonii</i> var. <i>pubescens</i>				T1	
<i>Achyranthes mutica</i>	1	1	CR	G1	
<i>Achyranthes splendens</i> var. <i>rotundata</i>	1	2	CR	T1	
<i>Aconitum infectum</i>				G1	
<i>Adenophorus periens</i>				G1	
<i>Adenophyllum wrightii</i>				G1	
<i>Aeschynomene pratensis</i> var. <i>pratensis</i>				T1	
<i>Agalinis acuta</i>	1	1		G1	
<i>Agalinis calycina</i>				G1	
<i>Agalinis navasotensis</i>	1			G1	
<i>Agave arizonica</i>	1	7		G1	
<i>Agave chiapensis</i>	1	10			Pr
<i>Agave congesta</i>	1	2			Pr
<i>Agave gypsophila</i>	1	12			Pr
<i>Agave kewensis</i>					Pr
<i>Agave ornithobroma</i>	1	7			Pr
<i>Agave parrasana</i>	1	18			Pr
<i>Agave peacockii</i>	1	4			Pr
<i>Agave phillipsiana</i>		1		G1	
<i>Agave schottii</i> var. <i>treleasei</i>		4		T1	
<i>Agave titanota</i>	1	14			Pr
<i>Agave vizcainoensis</i>	1	3			Pr
<i>Agrostis clivicola</i> var. <i>punta-reyesensis</i>				T1	
<i>Agrostis hendersonii</i>				G1	
<i>Agrostis novogaliciana</i>					Pr
<i>Agrostis rossiae</i>				G1	
<i>Alectryon macrococcus</i>		1	CR	G1	
<i>Alectryon macrococcus</i> var. <i>auwahiensis</i>	1		CR	T1	
<i>Alectryon macrococcus</i> var. <i>macrococcus</i>	1	2	CR	T1	
<i>Alfaroa mexicana</i>			VU		Pr
<i>Allium bolanderi</i> var. <i>stenanthum</i>				T1	
<i>Allium jepsonii</i>		2		G1	
<i>Allium munzii</i>	1			G1	
<i>Allium passeyi</i>				G1	
<i>Allium shevockii</i>		1		G1	
<i>Alopecurus aequalis</i> var. <i>sonomensis</i>	1			T1	
<i>Alsindendron lychnoides</i>			CR	G1	
<i>Alsindendron obovatum</i>			CR	G1	
<i>Alsindendron trinerve</i>	1		CR	G1	
<i>Alsindendron viscosum</i>			CR	G1	
<i>Alsophila bicrenata</i>					Pr
<i>Alsophila firma</i>		2			Pr
<i>Amaranthus brownii</i>			CR	G1	
<i>Ambrosia pumila</i>		5		G1	
<i>Amoreuxia gonzalezii</i>	1			G1	
<i>Amorpha herbacea</i> var. <i>crenulata</i>	1	1		T1	
<i>Amsinckia grandiflora</i>		1		G1	
<i>Amsonia kearneyana</i>	1	1		G1	
<i>Amsonia tharpai</i>	1	4		G1	

Name	Present in Germplasm Collections	Present in Living Collections	Red List Status	NatureServe Status	NOM Status
<i>Ancistrocarphus keilii</i>				G1	
<i>Anemone edwardsiana</i> var. <i>petraea</i>				T1	
<i>Angelica laurentiana</i>				G1	
<i>Antennaria soliceps</i>		1		G1	
<i>Antidesma platyphyllum</i> var. <i>hillebrandii</i>				T1	
<i>Aquilegia chrysantha</i> var. <i>hinckleyana</i>		3		T1	
<i>Aquilegia chrysantha</i> var. <i>rydbergii</i>	1			T1	
<i>Aquilegia flavescens</i> var. <i>rubicunda</i>				T1	
<i>Aquilegia grahamii</i>		1		G1	
<i>Aquilegia jonesii</i> var. <i>elator</i>				T1	
<i>Aquilegia loriae</i>				G1	
<i>Aquilegia scopulorum</i> var. <i>calcareo</i>				T1	
<i>Arabis breweri</i> var. <i>pecuniaria</i>				T1	
<i>Arabis codyi</i>				G1	
<i>Arabis falcatoria</i>				G1	
<i>Arabis falciflora</i>				G1	
<i>Arabis georgiana</i>		3		G1	
<i>Arabis hirshbergiae</i>				G1	
<i>Arabis hoffmannii</i>	1	1		G1	
<i>Arabis johnstonii</i>				G1	
<i>Arabis koehleri</i> var. <i>koehleri</i>				T1	
<i>Arabis microphylla</i> var. <i>thompsonii</i>				T1	
<i>Arabis ophira</i>				G1	
<i>Arabis pulchra</i> var. <i>duchesnensis</i>				T1	
<i>Arabis pusilla</i>				G1	
<i>Arabis pygmaea</i>				G1	
<i>Arabis rectissima</i> var. <i>simulans</i>				T1	
<i>Arabis suffrutescens</i> var. <i>horizontalis</i>				T1	
<i>Arabis tricornuta</i>				G1	
<i>Arbutus occidentalis</i>		2			Pr
<i>Arctomecon humilis</i>	1	1		G1	
<i>Arctostaphylos confertiflora</i>		3		G1	
<i>Arctostaphylos densiflora</i>		7		G1	
<i>Arctostaphylos gabilanensis</i>				G1	
<i>Arctostaphylos gabrielensis</i>	1	1		G1	
<i>Arctostaphylos glandulosa</i> ssp. <i>crassifolia</i>				T1	
<i>Arctostaphylos hookeri</i> ssp. <i>franciscana</i>				T1	
<i>Arctostaphylos hookeri</i> ssp. <i>heartstium</i>		3		T1	
<i>Arctostaphylos hookeri</i> ssp. <i>ravenii</i>				T1	
<i>Arctostaphylos imbricata</i>		3		G1	
<i>Arctostaphylos mendocinoensis</i>		1		G1	
<i>Arctostaphylos ohloneana</i>				G1	
<i>Arctostaphylos osoensis</i>				G1	
<i>Arctostaphylos pacifica</i>		2		G1	
<i>Arctostaphylos pallida</i>		3		G1	
<i>Arctostaphylos stanfordiana</i> ssp. <i>decumbens</i>		1		T1	
<i>Arctostaphylos stanfordiana</i> ssp. <i>stanfordiana</i>		2		T1	
<i>Arctostaphylos tomentosa</i> ssp. <i>daciticola</i>				T1	
<i>Arctostaphylos wellsii</i>		3		G1	
<i>Arenaria livermorensis</i>				G1	
<i>Arenaria macradenia</i> var. <i>kuschei</i>	1	1		T1	
<i>Arenaria paludicola</i>		1		G1	
<i>Argemone arizonica</i>				G1	
<i>Argemone glauca</i> var. <i>decepiens</i>	1			T1	
<i>Argyroxiphium caliginis</i>			VU	G1	
<i>Argyroxiphium grayanum</i>				G1	
<i>Argyroxiphium kauense</i>			CR	G1	
<i>Argyroxiphium sandwicense</i> ssp. <i>sandwicense</i>			CR	T1	
<i>Arida mattturneri</i>				G1	
<i>Ariocarpus agavoides</i>	1	12	VU		Pr
<i>Ariocarpus bravoanus</i> ssp. <i>bravoanus</i>			CR		
<i>Ariocarpus kotschoubeyanus</i>	1	10			Pr
<i>Ariocarpus retusus</i>	1	16			Pr
<i>Aristida mohrii</i>	1			G1	

Name	Present in Germplasm Collections	Present in Living Collections	Red List Status	NatureServe Status	NOM Status
<i>Armeria maritima</i> ssp. <i>interior</i>				T1	
<i>Arnica chamissonis</i> var. <i>maguirei</i>				T1	
<i>Arnicastrum guerrerense</i>					Pr
<i>Arnoglossum album</i>				G1	
<i>Artemisia aleutica</i>				G1	
<i>Artemisia biennis</i> var. <i>diffusa</i>				T1	
<i>Artemisia campestris</i> var. <i>petiolata</i>				T1	
<i>Artemisia campestris</i> var. <i>wormskioldii</i>				T1	
<i>Asclepias mcvaughii</i>					Pr
<i>Asclepias prostrata</i>				G1	
<i>Asclepias welshii</i>				G1	
<i>Asimina tetramera</i>	2	1	EN	G1	
<i>Aspidogyne stictophylla</i>		1			Pr
<i>Asplenium adulterinum</i> ssp. <i>presolanens</i>				T1	
<i>Asplenium fragile</i> var. <i>insulare</i>	1			G1	
<i>Asplenium haleakalense</i>				G1	
<i>Asplenium plenum</i>				G1	
<i>Asplenium rhomboideum</i>				G1	
<i>Asplenium schizophyllum</i>				G1	
<i>Asplenium tutwilerae</i>				G1	
<i>Astella waialealae</i>			CR	G1	
<i>Astragalus albens</i>	1			G1	
<i>Astragalus amphioxys</i> var. <i>modestus</i>				T1	
<i>Astragalus ampullarioides</i>				G1	
<i>Astragalus anxius</i>				G1	
<i>Astragalus applegatei</i>	1			G1	
<i>Astragalus avonensis</i>				G1	
<i>Astragalus bibullatus</i>	1			G1	
<i>Astragalus clarianus</i>				G1	
<i>Astragalus collinus</i> var. <i>laurentii</i>	1			T1	
<i>Astragalus cremnophylax</i>				G1	
<i>Astragalus cremnophylax</i> var. <i>cremnophylax</i>	1			T1	
<i>Astragalus cremnophylax</i> var. <i>hevronii</i>				T1	
<i>Astragalus cremnophylax</i> var. <i>myriorrhaphis</i>				T1	
<i>Astragalus cusickii</i> var. <i>packardiae</i>	1			T1	
<i>Astragalus desereticus</i>				G1	
<i>Astragalus desperatus</i> var. <i>neeseae</i>				T1	
<i>Astragalus deterior</i>				G1	
<i>Astragalus ensiformis</i> var. <i>gracilior</i>				T1	
<i>Astragalus ertterae</i>				G1	
<i>Astragalus hamiltonii</i>				G1	
<i>Astragalus heilii</i>				G1	
<i>Astragalus holmgreniorum</i>				G1	
<i>Astragalus humillimus</i>	1			G1	
<i>Astragalus hypoxylus</i>	1			G1	
<i>Astragalus iselyi</i>				G1	
<i>Astragalus jaegerianus</i>	1			G1	
<i>Astragalus jejunus</i> var. <i>articulatus</i>				T1	
<i>Astragalus lentiginosus</i> var. <i>ambiguus</i>				T1	
<i>Astragalus lentiginosus</i> var. <i>micans</i>	1	1		T1	
<i>Astragalus lentiginosus</i> var. <i>piscinensis</i>	1			T1	
<i>Astragalus lentiginosus</i> var. <i>pohlii</i>				T1	
<i>Astragalus lentiginosus</i> var. <i>sesquimetralis</i>				T1	
<i>Astragalus lentiginosus</i> var. <i>sierrae</i>	1			T1	
<i>Astragalus limnocharis</i> var. <i>limnocharis</i>				T1	
<i>Astragalus limnocharis</i> var. <i>montii</i>				T1	
<i>Astragalus loanus</i>		1		G1	
<i>Astragalus microcymbus</i>	1	1		G1	
<i>Astragalus missouriensis</i> var. <i>humistratus</i>	1			T1	
<i>Astragalus montii</i>	1			T1	
<i>Astragalus newberryi</i> var. <i>aquarii</i>				T1	
<i>Astragalus nuttallii</i> var. <i>virgatus</i>	1			T1	
<i>Astragalus osterhoutii</i>	1			G1	
<i>Astragalus pachypus</i> var. <i>jaegeri</i>	1			T1	
<i>Astragalus pinonis</i> var. <i>atwoodii</i>				T1	
<i>Astragalus preussii</i> var. <i>cutleri</i>				T1	
<i>Astragalus proimanthus</i>				G1	
<i>Astragalus pycnostachyus</i> var. <i>lanosissimus</i>	1	1		T1	
<i>Astragalus ravenii</i>				G1	
<i>Astragalus riparius</i>				G1	
<i>Astragalus robbinsii</i> var. <i>fernaldii</i>				T1	
<i>Astragalus robbinsii</i> var. <i>jesupii</i>	1			T1	

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<i>Astragalus sabulosus</i>				G1	
<i>Astragalus sabulosus</i> var. <i>sabulosus</i>				T1	
<i>Astragalus sabulosus</i> var. <i>vehiculus</i>				T1	
<i>Astragalus schmolliae</i>	1			G1	
<i>Astragalus sinuatus</i>	2			G1	
<i>Astragalus tener</i>				G1	
<i>Astragalus tener</i> var. <i>ferrisiae</i>				T1	
<i>Astragalus tener</i> var. <i>tener</i>	1			T1	
<i>Astragalus tener</i> var. <i>titi</i>	1	1		T1	
<i>Astragalus tortipes</i>	1			G1	
<i>Astragalus tricarinatus</i>	1			G1	
<i>Astragalus webberi</i>				G1	
<i>Astragalus zionis</i> var. <i>vigulus</i>				T1	
<i>Astrophytum asterias</i>	1	15	VU	G1	
<i>Atriplex argentea</i> var. <i>longitrichoma</i>				T1	
<i>Atriplex canescens</i> var. <i>gigantea</i>	1			T1	
<i>Atriplex coronata</i> var. <i>notatior</i>	1			T1	
<i>Atriplex minuscula</i>				G1	
<i>Atriplex nudicaulis</i>				G1	
<i>Atriplex parishii</i>				G1	
<i>Atriplex tularensis</i>				G1	
<i>Aureolaria grandiflora</i> var. <i>grandiflora</i>	1			T1	
<i>Aztekium hintonii</i>	1	3			Pr
<i>Baccharis malibuensis</i>	1	2		G1	
<i>Baccharis plummerae</i> ssp. <i>glabrata</i>		1		T1	
<i>Baccharis vanessae</i>		5		G1	
<i>Backebergia militaris</i>		1			Pr
<i>Bactris balanoides</i>		1			Pr
<i>Balmea stormae</i>		1			Pr
<i>Baptisia arachnifera</i>		5		G1	
<i>Baptisia calycosa</i> var. <i>calycosa</i>				T1	
<i>Barkeria scandens</i>		6			Pr
<i>Barkeria shoemakeri</i>		1			Pr
<i>Barkeria skinneri</i>		2			Pr
<i>Barkeria whartoni</i>					Pr
<i>Batesimalva violacea</i>	1			G1	
<i>Bauhinia fryxellii</i>					Pr
<i>Berberis harrisoniana</i>		2		G1	
<i>Beschornia albiflora</i>		6			Pr
<i>Beschornia calcicola</i>					Pr
<i>Beschornia tubiflora</i>		1			Pr
<i>Beschornia wrightii</i>		1			Pr
<i>Betula murrayana</i>		1		G1	
<i>Betula uber</i>		20	CR	G1	
<i>Bidens amplexans</i>		1	VU	G1	
<i>Bidens campylothea</i> ssp. <i>pentamera</i>				CR	T1
<i>Bidens campylothea</i> ssp. <i>waihoiensis</i>				CR	T1
<i>Bidens conjuncta</i>		1	VU	G1	
<i>Bidens forbesii</i> ssp. <i>kahiliensis</i>				T1	
<i>Bidens hillebrandiana</i> ssp. <i>hillebrandiana</i>		1		T1	
<i>Bidens micrantha</i> ssp. <i>ctenophylla</i>				T1	
<i>Bidens micrantha</i> ssp. <i>kalealaha</i>	1			T1	
<i>Bidens molokaiensis</i>		1	VU	G1	
<i>Bidens populifolia</i>		1	VU	G1	
<i>Bidens sandwicensis</i> ssp. <i>confusa</i>		2		T1	
<i>Bidens wiebkei</i>			CR	G1	
<i>Blennosperma bakeri</i>	1			G1	
<i>Blennosperma nanum</i> var. <i>robustum</i>				T1	
<i>Blepharizonia plumosa</i> ssp. <i>plumosa</i>				T1	
<i>Blephilia subnuda</i>				G1	
<i>Bloomeria humilis</i>		1		G1	
<i>Bohea sandwicensis</i>		2	VU	G1	
<i>Bohea timonioides</i>		1	EN	G1	
<i>Boechea evadens</i>				G1	
<i>Boechea glareosa</i>				G1	
<i>Boechea yorkii</i>				G1	
<i>Boltonia montana</i>				G1	
<i>Bonamia menziesii</i>	2	3	CR	G1	
<i>Bonamia ovalifolia</i>	1	1		G1	
<i>Botrychium acuminatum</i>				G1	
<i>Botrychium gallicomontanum</i>				G1	
<i>Botrychium pseudopinnatum</i>				G1	

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<i>Bouteloua kayi</i>				G1	
<i>Bouvardia capitata</i>					Pr
<i>Bouvardia dictyonera</i>					Pr
<i>Bouvardia langlassei</i>					Pr
<i>Bouvardia rosei</i>					Pr
<i>Bouvardia xylosteoides</i>					Pr
<i>Brahea berlandieri</i>		2			Pr
<i>Brahea edulis</i>		14	EN		Pr
<i>Brahea moorei</i>		5			Pr
<i>Brahea nitida</i>	1	8	VU		Pr
<i>Braya longii</i>				G1	
<i>Braya pilosa</i>				G1	
<i>Brickellia eupatorioides</i> var. <i>floridana</i>				T1	
<i>Brickellia mosieri</i>		1		T1	
<i>Brighamia insignis</i>	2	15	CR	G1	
<i>Brighamia rockii</i>		5	CR	G1	
<i>Brodiaea coronaria</i> ssp. <i>rosea</i>				T1	
<i>Brodiaea pallida</i>		5		G1	
<i>Brodiaea santarosae</i>				G1	
<i>Bursera bonetii</i>					Pr
<i>Bursera coyucensis</i>					Pr
<i>Caesalpinia kavaiensis</i>	2	1	CR	G1	
<i>Calamagrostis cainii</i>				G1	
<i>Calamagrostis expansa</i>			VU	G1	
<i>Calamagrostis hillebrandii</i>			EN	G1	
<i>Calamagrostis perplexa</i>				G1	
<i>Calliandra eriophylla</i> var. <i>chamaedryis</i>				T1	
<i>Callitriche fassettii</i>				G1	
<i>Calochortus clavatus</i> var. <i>recurvifolius</i>				T1	
<i>Calochortus coxii</i>	1	1		G1	
<i>Calochortus foliosus</i>					Pr
<i>Calochortus nigrescens</i>					Pr
<i>Calochortus palmeri</i> var. <i>munzii</i>	1			T1	
<i>Calochortus raichei</i>		1		G1	
<i>Calochortus syntrophus</i>				G1	
<i>Calochortus tiburonensis</i>		1		G1	
<i>Calopogon tuberosus</i> var. <i>simpsonii</i>				T1	
<i>Calycadenia truncata</i> ssp. <i>microcephala</i>				T1	
<i>Calycanthus brockiana</i>				G1	
<i>Calystegia collina</i> ssp. <i>tridactylosa</i>				T1	
<i>Calystegia stebbinsii</i>	1	1		G1	
<i>Calystegia subcaulis</i> ssp. <i>episcopalis</i>				T1	
<i>Camissonia bairdii</i>				G1	
<i>Camissonia benitensis</i>				G1	
<i>Camissonia bolanderi</i>				G1	
<i>Camissonia confertiflora</i>				G1	
<i>Camissonia exilis</i>				G1	
<i>Camissonia gouldii</i>				G1	
<i>Camissonia hardhamiae</i>				G1	
<i>Camissonia pallida</i> ssp. <i>hallii</i>		1		T1	
<i>Camissonia specuicola</i> ssp. <i>hesperia</i>				T1	
<i>Camissonia specuicola</i> ssp. <i>specuicola</i>				T1	
<i>Campanula robinsiae</i>	1	1		G1	
<i>Campanula sharsmithiae</i>				G1	
<i>Canavalia molokaiensis</i>	1	1	CR	G1	
<i>Canavalia napallensis</i>		1	CR	G1	
<i>Canavalia pubescens</i>	1	1	CR	G1	
<i>Carex aboriginum</i>				G1	
<i>Carex albida</i>	1	1		G1	
<i>Carex brysonii</i>				G1	
<i>Carex constanceana</i>				G1	
<i>Carex deweyana</i> var. <i>collectanea</i>				T1	
<i>Carex mckittrickensis</i>				G1	
<i>Carex oligosperma</i> var. <i>churchilliana</i>				T1	
<i>Carex rariflora</i> var. <i>androgyna</i>				T1	
<i>Carex tiogana</i>				G1	
<i>Carex viridula</i> var. <i>saxillitoralis</i>				T1	
<i>Carex wahuensis</i> ssp. <i>herbstii</i>		1		T1	
<i>Carphochaete macrocephala</i>					Pr
<i>Castilleja affinis</i> ssp. <i>neglecta</i>		1		T1	
<i>Castilleja chambersii</i>				G1	
<i>Castilleja christii</i>	1			G1	

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<i>Castilleja chrymactis</i>				G1	
<i>Castilleja levisecta</i>	2			G1	
<i>Castilleja mcvaughii</i>					Pr
<i>Castilleja mollis</i>				G1	
<i>Castilleja ornata</i>				G1	
<i>Castilleja salsuginosa</i>	1			G1	
<i>Castilleja victoriae</i>				G1	
<i>Caulanthus californicus</i>	1	1		G1	
<i>Caularthron bilamellatum</i>		2			Pr
<i>Caulostramina jaegeri</i>				G1	
<i>Ceanothus ferrisiae</i>		3		G1	
<i>Ceanothus ferrisiae</i>				G1	
<i>Ceanothus foliosus</i> var. <i>vineatus</i>				T1	
<i>Ceanothus greggii</i> var. <i>franklinii</i>				T1	
<i>Ceanothus hearstiorum</i>		7		G1	
<i>Ceanothus masonii</i>		3		G1	
<i>Ceanothus ophiochilus</i>	1	3		G1	
<i>Cedrela odorata</i>	1	16	VU		Pr
<i>Cenchrus agrimonioides</i>			CR	G1	
<i>Cenchrus agrimonioides</i> var. <i>agrimonioides</i>	2	2	CR	T1	
<i>Centaurium blumbergianum</i>				G1	
<i>Centaurium sebaeoides</i>			CR	G2	
<i>Cephalocereus nizardensis</i>		2			Pr
<i>Ceratozamia euryphillidia</i>			CR		P
<i>Ceratozamia fusco-viridis</i>			CR		
<i>Ceratozamia kuesteriana</i>		17	CR		P
<i>Ceratozamia norstogii</i>		11	CR		P
<i>Ceratozamia zaragozae</i>		8	CR		P
<i>Cercocarpus traskiae</i>	1	5	CR	G1	
<i>Chaenactis carphoclinia</i> var. <i>peirsonii</i>				T1	
<i>Chamaedorea klotzschiana</i>		7			Pr
<i>Chamaesyce arnottiana</i>				G1	
<i>Chamaesyce celastroides</i> var. <i>kaenana</i>		1	EN	T1	
<i>Chamaesyce celastroides</i> var. <i>laehiensis</i>			VU	T1	
<i>Chamaesyce celastroides</i> var. <i>stokesii</i>			VU	T1	
<i>Chamaesyce chaetocalyx</i> var. <i>triligulata</i>				T1	
<i>Chamaesyce deltoidea</i> ssp. <i>adhaerens</i>				T1	
<i>Chamaesyce deltoidea</i> ssp. <i>deltoidea</i>	1			T1	
<i>Chamaesyce deltoidea</i> ssp. <i>pinetorum</i>				T1	
<i>Chamaesyce deltoidea</i> ssp. <i>serpyllum</i>				T1	
<i>Chamaesyce deppeana</i>	1		CR	G1	
<i>Chamaesyce eleanoriae</i>			CR	G1	
<i>Chamaesyce garberi</i>				G1	
<i>Chamaesyce halemanui</i>			CR	G1	
<i>Chamaesyce herbstii</i>			CR	G1	
<i>Chamaesyce kuwaleana</i>	1		EN	G1	
<i>Chamaesyce remyi</i>			CR	G1	
<i>Chamaesyce remyi</i> var. <i>kauaiensis</i>			CR	T1	
<i>Chamaesyce remyi</i> var. <i>remyi</i>			CR	T1	
<i>Chamaesyce rockii</i>			CR	G1	
<i>Chamaesyce skottsbergii</i> var. <i>vaccinioides</i>	1			T1	
<i>Chamaesyce sparsiflora</i>			VU	G1	
<i>Charpentiera densiflora</i>	1	3	CR	G1	
<i>Cheirodendron dominii</i>			EN	G1	
<i>Chlorogalum purpureum</i>				G1	
<i>Chlorogalum purpureum</i> var. <i>purpureum</i>				T1	
<i>Chlorogalum purpureum</i> var. <i>reductum</i>		1		T1	
<i>Chorizanthe biloba</i> var. <i>immemora</i>				T1	
<i>Chorizanthe cuspidata</i> var. <i>villosa</i>				T1	
<i>Chorizanthe howellii</i>				G1	
<i>Chorizanthe ortcutiana</i>				G1	
<i>Chorizanthe parryi</i> var. <i>fernandina</i>	1			T1	
<i>Chorizanthe pungens</i> var. <i>hartwegiana</i>				T1	
<i>Chorizanthe rectispina</i>				G1	
<i>Chorizanthe robusta</i> var. <i>hartwegii</i>				T1	
<i>Chorizanthe robusta</i> var. <i>robusta</i>				T1	
<i>Chorizanthe valida</i>	1			G1	
<i>Christella boydiae</i>	1			G1	
<i>Chromolaena frustrata</i>		1		G1	
<i>Chrysopsis floridana</i>	1	1		G1	
<i>Chrysothamnus eremobius</i>				G1	
<i>Cinna bolanderi</i>				G1	

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<i>Cirsium eatonii</i> var. <i>viperinum</i>				T1	
<i>Cirsium fontinale</i> var. <i>fontinale</i>	1			T1	
<i>Cirsium fontinale</i> var. <i>obispoense</i>				T1	
<i>Cirsium hydrophilum</i>				G1	
<i>Cirsium hydrophilum</i> var. <i>hydrophilum</i>	1			T1	
<i>Cirsium hydrophilum</i> var. <i>vaseyi</i>		1		T1	
<i>Cirsium joannae</i>				G1	
<i>Cirsium parryi</i> ssp. <i>mogollonicum</i>				T1	
<i>Cirsium rusbyi</i>				G1	
<i>Cirsium scapanolepis</i>				G1	
<i>Cistanthe pulchella</i>				G1	
<i>Clarkia borealis</i> ssp. <i>arida</i>				T1	
<i>Clarkia concinna</i> ssp. <i>raichei</i>		1		T1	
<i>Clarkia franciscana</i>		1		G1	
<i>Clarkia imbricata</i>	1	1		G1	
<i>Clarkia lingulata</i>	1			G1	
<i>Clarkia speciosa</i> ssp. <i>immaculata</i>	1			T1	
<i>Clarkia springvillensis</i>				G1	
<i>Clarkia tembloriensis</i> ssp. <i>calientensis</i>				T1	
<i>Clarkia xantiana</i> ssp. <i>parviflora</i>	1			T1	
<i>Claytonia lanceolata</i> var. <i>peirsonii</i>	1			T1	
<i>Claytonia ogilviensis</i>				G1	
<i>Claytonia virginica</i> var. <i>hammondiae</i>				T1	
<i>Clematis socialis</i>	3	4		G1	
<i>Clermontia arborescens</i> ssp. <i>arborescens</i>			EN	T1	
<i>Clermontia arborescens</i> ssp. <i>walkoluensis</i>				T1	
<i>Clermontia calophylla</i>			EN	G1	
<i>Clermontia drepanomorpha</i>			EN	G1	
<i>Clermontia grandiflora</i> ssp. <i>maxima</i>				T1	
<i>Clermontia lindseyana</i>	2		EN	G1	
<i>Clermontia oblongifolia</i> ssp. <i>brevipes</i>	1		CR	T1	
<i>Clermontia oblongifolia</i> ssp. <i>mauiensis</i>			CR	T1	
<i>Clermontia peleana</i>			EW	G1	
<i>Clermontia pyrularia</i>	2		CR	G1	
<i>Clermontia samuelii</i>			CR	G1	
<i>Clermontia samuelii</i> ssp. <i>hanaensis</i>			CR	T1	
<i>Clermontia samuelii</i> ssp. <i>samuelii</i>			CR	T1	
<i>Clermontia tuberculata</i>			EN	G1	
<i>Clermontia waimeae</i>			EN	G1	
<i>Clowesia glaucoglossa</i>		1			Pr
<i>Cnemidaria apiculata</i>					Pr
<i>Cnemidaria decurrens</i>					Pr
<i>Cnidocolus autlanensis</i>					Pr
<i>Cochemiea halei</i>		4			Pr
<i>Cochemiea pondii</i> var. <i>maritima</i>					Pr
<i>Cochemiea pondii</i> var. <i>setispina</i>					Pr
<i>Cochleanthes flabelliformis</i>		2			Pr
<i>Cochlearia sessilifolia</i>				G1	
<i>Coelia densiflora</i>					Pr
<i>Collinsia corymbosa</i>				G1	
<i>Collomia renata</i>	1			G1	
<i>Colubrina cubensis</i> var. <i>floridana</i>				T1	
<i>Colubrina oppositifolia</i>	2	3	CR	G1	
<i>Comarostaphylis discolor</i>		2			Pr
<i>Condalia hookeri</i> var. <i>edwardsiana</i>				T1	
<i>Conradina etonia</i>	1	5		G1	
<i>Conradina glabra</i>	1	6		G1	
<i>Cooperia smallii</i>				G1	
<i>Corallorrhiza bentleyi</i>				G1	
<i>Corallorrhiza macrantha</i>					Pr
<i>Cordia urticacea</i>			CR		
<i>Cordylanthus mollis</i> ssp. <i>mollis</i>				T1	
<i>Cordylanthus nidularius</i>				G1	
<i>Cordylanthus palmatus</i>	1			G1	
<i>Cordylanthus rigidus</i> ssp. <i>littoralis</i>				T1	
<i>Cordylanthus tenuis</i> ssp. <i>capillaris</i>				T1	
<i>Cordylanthus tenuis</i> ssp. <i>pallascens</i>				T1	
<i>Coreopsis integrifolia</i>		7		G1	
<i>Corethrogyne californica</i> var. <i>californica</i>				T1	
<i>Corethrogyne californica</i> var. <i>lyonii</i>				T1	
<i>Corethrogyne filaginifolia</i> var. <i>incana</i>				T1	
<i>Corethrogyne filaginifolia</i> var. <i>linifolia</i>				T1	

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<i>Corispermum hookeri</i> var. <i>pseudodeclinatum</i>				T1	
<i>Corispermum navicula</i>	1	1		G1	
<i>Cornus florida</i> ssp. <i>urbiniana</i>		8			Pr
<i>Coryphantha delicata</i>		3			Pr
<i>Coryphantha durangensis</i>	1	7			Pr
<i>Coryphantha elephantidens</i> ssp. <i>greenwoodii</i>			EN		Pr
<i>Coryphantha elephantidens</i> subsp. <i>greenwoodii</i>			EN		Pr
<i>Coryphantha georgii</i>		3			Pr
<i>Coryphantha pseudoechinus</i>		5			Pr
<i>Coryphantha pulleineana</i>		4			Pr
<i>Coryphantha retusa</i> var. <i>melleospina</i>					Pr
<i>Coryphantha schwarzi</i>					Pr
<i>Coryphantha vogtheriana</i>		2	CR		A
<i>Coryphantha wohlschlagerei</i>		2			Pr
<i>Crataegus distincta</i>				G1	
<i>Crataegus harbisonii</i>		7		G1	
<i>Crataegus latebrosa</i>				G1	
<i>Crataegus nananixonii</i>				G1	
<i>Crataegus perjucunda</i>				G1	
<i>Crepis modocensis</i> ssp. <i>glareosa</i>				T1	
<i>Crepis nana</i> ssp. <i>clivicola</i>				T1	
<i>Crotalaria avonensis</i>	2	1		G1	
<i>Croton guatemalensis</i>					Pr
<i>Croton pottsii</i> var. <i>thermophilus</i>				T1	
<i>Crusea coronata</i>					Pr
<i>Crusea hispida grandiflora</i>					Pr
<i>Crusea lucida</i>					Pr
<i>Cryptantha clevelandii</i> var. <i>dissita</i>				T1	
<i>Cryptantha clokeyi</i>				G1	
<i>Cryptantha crassipes</i>	1	1		G1	
<i>Cryptantha crinita</i>				G1	
<i>Cryptantha ganderi</i>				G1	
<i>Cryptantha gypsophila</i>				G1	
<i>Cryptantha incana</i>				G1	
<i>Cryptantha johnstonii</i>				G1	
<i>Cryptantha ochroleuca</i>				G1	
<i>Cryptantha roosiorum</i>				G1	
<i>Cryptantha semiglabra</i>				G1	
<i>Cryptantha shackletteana</i>				G1	
<i>Cryptarrhena lunata</i>					Pr
<i>Ctenitis squamigera</i>	1		CR	G1	
<i>Cucurbita okechobeensis</i>	1			G1	
<i>Culcita conifolia</i>					Pr
<i>Cumarinia odorata</i>		2	VU		Pr
<i>Cupressus abramsiana</i>		3		G1	
<i>Cupressus arizonica</i> ssp. <i>stephensonii</i>				T1	
<i>Cupressus arizonica</i> var. <i>montana</i>		10	VU		Pr
<i>Cupressus goveniana</i> ssp. <i>goveniana</i>				T1	
<i>Cupressus guadalupensis</i> ssp. <i>guadalupensis</i>		1	CR		
<i>Cupressus lusitanica</i>		20			Pr
<i>Cupressus macrocarpa</i>	1	14	VU	G1	
<i>Cupressus stephensonii</i>		6		T1	
<i>Cuscuta dentatasquamata</i>				G1	
<i>Cuscuta plattensis</i>				G1	
<i>Cyanea acuminata</i>			CR	G2	
<i>Cyanea asarifolia</i>	1		CR	G1	
<i>Cyanea asplenifolia</i>	2			G1	
<i>Cyanea calycina</i>	1		CR	G1	
<i>Cyanea copelandii</i>			CR	G1	
<i>Cyanea copelandii</i> ssp. <i>haleakalaensis</i>	2		CR	T1	
<i>Cyanea crispa</i>	2			G1	
<i>Cyanea dunbariae</i>	2			G1	
<i>Cyanea dunbarii</i>				G1	
<i>Cyanea eleeleensis</i>			CR	GH	
<i>Cyanea gibsonii</i>	1		EN	T1	
<i>Cyanea glabra</i>	2		CR	G1	
<i>Cyanea grimesiana</i>				G1	
<i>Cyanea grimesiana</i> ssp. <i>grimesiana</i>	1			T1	
<i>Cyanea grimesiana</i> ssp. <i>obatae</i>				T1	
<i>Cyanea hamatiflora</i>			CR	G1	
<i>Cyanea hamatiflora</i> ssp. <i>carlsonii</i>			CR	T1	

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<i>Cyanea hamatiflora</i> ssp. <i>hamatiflora</i>			CR	T1	
<i>Cyanea horrida</i>			CR	G2	
<i>Cyanea humboldtiana</i>	1			G1	
<i>Cyanea kolekoleensis</i>				G1	
<i>Cyanea koolauensis</i>	2			G1	
<i>Cyanea lanceolata</i>	1	1		G1	
<i>Cyanea lindseyana</i>				G1	
<i>Cyanea lobata</i>	2			G1	
<i>Cyanea longiflora</i>	1			G1	
<i>Cyanea macrostegia</i> ssp. <i>gibsonii</i>			EN	T1	
<i>Cyanea marksii</i>			EX	G1	
<i>Cyanea mcelandowneyi</i>	2			G1	
<i>Cyanea munroi</i>	2			G1	
<i>Cyanea obtusa</i>				G1	
<i>Cyanea pinnatifida</i>	2	1	EW	G1	
<i>Cyanea platyphylla</i>	1			G1	
<i>Cyanea procera</i>	2		CR	G1	
<i>Cyanea purpurellifolia</i>	2			G1	
<i>Cyanea remyi</i>	2			G1	
<i>Cyanea salicina</i>				G1	
<i>Cyanea shipmanii</i>	2			G1	
<i>Cyanea solanacea</i>	2	1		G1	
<i>Cyanea stictophylla</i>	1		CR	G1	
<i>Cyanea st-johnii</i>	2			G1	
<i>Cyanea superba</i>			EW	G1	
<i>Cyanea superba</i> ssp. <i>superba</i>			EW	T1	
<i>Cyanea tritomantha</i>			VU	G1	
<i>Cyanea undulata</i>	1			G1	
<i>Cyathea divergens</i> var. <i>tuerckheimii</i>		1			Pr
<i>Cyathea fulva</i>		2			Pr
<i>Cyathea salvinii</i>					Pr
<i>Cyathea scabriuscula</i>					Pr
<i>Cyathea schiedeana</i>					Pr
<i>Cyathea valdecrenata</i>					Pr
<i>Cylindropuntia anteojoensis</i>		1			Pr
<i>Cylindropuntia santamaria</i>	1	1			Pr
<i>Cymopterus beckii</i>				G1	
<i>Cymopterus goodrichii</i>				G1	
<i>Cymopterus minimus</i>				G1	
<i>Cynanchum blodgettii</i>				G1	
<i>Cyperus auriculatus</i>				G1	
<i>Cyperus fauriei</i>				G1	
<i>Cyperus pennatiformis</i>				G1	
<i>Cyperus pennatiformis</i> var. <i>bryanii</i>		1		T1	
<i>Cyperus trachysanthos</i>	1	3		G1	
<i>Cyripedium dickinsonianum</i>					Pr
<i>Cyrtandra biserrata</i>				G1	
<i>Cyrtandra confertiflora</i> var. <i>obovata</i>				T1	
<i>Cyrtandra cyaneoides</i>		1		G1	
<i>Cyrtandra dentata</i>				G1	
<i>Cyrtandra ferripilosa</i>				G1	
<i>Cyrtandra filipes</i>				G1	
<i>Cyrtandra halawensis</i>				G1	
<i>Cyrtandra hematos</i>				G1	
<i>Cyrtandra kaulantha</i>	2		CR	G1	
<i>Cyrtandra lydgatei</i>	1			G1	
<i>Cyrtandra munroi</i>	2			G1	
<i>Cyrtandra nanawaleensis</i>				G1	
<i>Cyrtandra oenobarba</i>				G1	
<i>Cyrtandra oxybapha</i>				G1	
<i>Cyrtandra paliku</i>				G1	
<i>Cyrtandra polyantha</i>	2		CR	G1	
<i>Cyrtandra rivularis</i>				G1	
<i>Cyrtandra sandwicensis</i>				G1	
<i>Cyrtandra sessilis</i>	2			G1	
<i>Cyrtandra subumbellata</i>	1	1		G1	
<i>Cyrtandra tintinnabula</i>	1	1		G1	
<i>Cyrtandra viridiflora</i>				G1	
<i>Cystopteris sandwicensis</i>				G1	
<i>Dahlia scapigera</i>		1			Pr
<i>Dahlia tenuicaulis</i>		3			Pr
<i>Dalea bartonii</i>				G1	

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<i>Dalea carthagenensis</i> var. <i>floridana</i>		1		T1	
<i>Dalea tentaculoides</i>	1			G1	
<i>Decazyx esparzae</i>			CR		
<i>Deeringothamnus pulchellus</i>	1			G1	
<i>Deeringothamnus rugelii</i>	1	1		G1	
<i>Deinandra conjugens</i>	1			G1	
<i>Deinandra halliana</i>	1			G1	
<i>Deinandra increscens</i> ssp. <i>villosa</i>	1			T1	
<i>Delissea rhytidosperra</i>	2	4		G1	
<i>Delissea rivularis</i>	3	1		G1	
<i>Delissea subcordata</i>	2	3		G1	
<i>Delissea undulata</i>	1		CR	T1	
<i>Delissea undulata</i> ssp. <i>kauaiensis</i>	1		EX	T1	
<i>Delissea undulata</i> ssp. <i>undulata</i>			CR	T1	
<i>Delphinium bakeri</i>		1		G1	
<i>Delphinium luteum</i>	1	4		G1	
<i>Delphinium variegatum</i> ssp. <i>kinkiense</i>	1			T1	
<i>Delphinium variegatum</i> ssp. <i>thornei</i>	1			T1	
<i>Dendromecon rigida</i> ssp. <i>rhamnoides</i>				T1	
<i>Dendropanax hondurensis</i>			CR		
<i>Descurainia kenheilii</i>				G1	
<i>Descurainia torulosa</i>	1			G1	
<i>Desmodium humifusum</i>	1	1		G1	
<i>Desmodium ochroleucum</i>	1	1		G1	
<i>Desmodium paniculatum</i> var. <i>epetiolatum</i>				T1	
<i>Dicerandra christmanii</i>	1	1		G1	
<i>Dicerandra cornutissima</i>	1	1		G1	
<i>Dicerandra frutescens</i>	1	1		G1	
<i>Dicerandra immaculata</i>	1			G1	
<i>Dicerandra radfordiana</i>		1		G1	
<i>Dichantherium hirstii</i>				G1	
<i>Dicksonia sellowiana</i>		7			Pr
<i>Diella erecta</i>	1			G1	
<i>Diella laciniata</i>				G1	
<i>Diella mannii</i>	1			G1	
<i>Diella pallida</i>	1	1		G1	
<i>Diella unisora</i>				G1	
<i>Digitaria floridana</i>				G1	
<i>Digitaria gracillima</i>				G1	
<i>Digitaria paniculata</i>					Pr
<i>Digitaria pauciflora</i>	1			G1	
<i>Dioon caputoi</i>		7	CR		P
<i>Diplazium molokaiense</i>	1			G1	
<i>Disocactus macdougallii</i>					Pr
<i>Dissanthelium californicum</i>	1			G1	
<i>Dodecahema leptoceras</i>	1			G1	
<i>Dodecatheon dentatum</i> ssp. <i>utahense</i>	1			T1	
<i>Donnellsmithia silvicola</i>					Pr
<i>Doodia lyonii</i>	1			G1	
<i>Doryopteris angelica</i>	1	1		G1	
<i>Doryopteris takeuchii</i>				G1	
<i>Downingia concolor</i> var. <i>brevior</i>	1			T1	
<i>Downingia concolor</i> var. <i>tricolor</i>				T1	
<i>Draba asprella</i> var. <i>kaibabensis</i>				T1	
<i>Draba asprella</i> var. <i>stelligera</i>				T1	
<i>Draba asterophora</i> var. <i>macrocarpa</i>				T1	
<i>Draba brachystylis</i>				G1	
<i>Draba inexpectata</i>				G1	
<i>Draba kassii</i>				G1	
<i>Draba kluanei</i>				G1	
<i>Draba malpighiacea</i>				G1	
<i>Draba monoensis</i>				G1	
<i>Draba oreibata</i> var. <i>serpentina</i>				T1	
<i>Draba paucifruita</i>				G1	
<i>Draba porsildii</i> var. <i>brevicula</i>				T1	
<i>Draba ramulosa</i>				G1	
<i>Draba sharsmithii</i>				G1	
<i>Draba weberi</i>	1			G1	
<i>Draba yukonensis</i>				G1	
<i>Dracula pusilla</i>		4			Pr
<i>Dryadella guatemalensis</i>					Pr
<i>Dryopteris podosora</i>				G1	

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<i>Dryopteris rossii</i>				G1	
<i>Dryopteris tenebrosa</i>				G1	
<i>Dryopteris tetrapinnata</i>				G1	
<i>Dubautia arborea</i>		1	EN	G1	
<i>Dubautia herbstobatae</i>	1	1		G1	
<i>Dubautia imbricata</i>				G1	
<i>Dubautia imbricata</i> ssp. <i>acronaea</i>				T1	
<i>Dubautia imbricata</i> ssp. <i>imbricata</i>				T1	
<i>Dubautia kalalauensis</i>	1			G1	
<i>Dubautia kenwoodii</i>				G1	
<i>Dubautia latifolia</i>		1		G1	
<i>Dubautia paleata</i>				G1	
<i>Dubautia pauciflora</i>	1			G1	
<i>Dubautia plantaginea</i> ssp. <i>humilis</i>	2			T1	
<i>Dubautia plantaginea</i> ssp. <i>magnifolia</i>				T1	
<i>Dubautia sherffiana</i>				G1	
<i>Dubautia syndetica</i>				G1	
<i>Dubautia waialealae</i>	1			G1	
<i>Dudleya abramsii</i> ssp. <i>bettinae</i>				T1	
<i>Dudleya bettinae</i>		1		T1	
<i>Dudleya blochmaniae</i> ssp. <i>brevifolia</i>	2			T1	
<i>Dudleya blochmaniae</i> ssp. <i>insularis</i>				T1	
<i>Dudleya cymosa</i> ssp. <i>agourensis</i>	1			T1	
<i>Dudleya cymosa</i> ssp. <i>crebrifolia</i>				T1	
<i>Dudleya densiflora</i>	1	6		G1	
<i>Dudleya gnoma</i>				G1	
<i>Dudleya nesiotica</i>	1	4		G1	
<i>Dudleya setchellii</i>	1	1		G1	
<i>Dudleya stolonifera</i>	1	2		G1	
<i>Dudleya traskiae</i>		5		G1	
<i>Dudleya verityi</i>	1	6		G1	
<i>Dudleya virens</i> ssp. <i>virens</i>		1		T1	
<i>Echeandia texensis</i>		3		G1	
<i>Echeveria amphoralis</i>					Pr
<i>Echeveria moranii</i>		3			Pr
<i>Echinacea paradoxa</i> var. <i>neglecta</i>	1			T1	
<i>Echinocactus grusonii</i>	1	41	CR		P
<i>Echinocactus platyacanthus</i>	2	24			Pr
<i>Echinocereus bristolii</i>		2			Pr
<i>Echinocereus chisoensis</i> var. <i>chisoensis</i>				T1	
<i>Echinocereus chloranthus</i> var. <i>neocapillus</i>		1		T1	
<i>Echinocereus engelmannii</i> var. <i>howei</i>				T1	
<i>Echinocereus engelmannii</i> var. <i>purpureus</i>				T1	
<i>Echinocereus fendleri</i> var. <i>kuenzleri</i>		6		T1	
<i>Echinocereus leucanthus</i>		5			Pr
<i>Echinocereus longisetus</i> ssp. <i>longisetus</i>		2			Pr
<i>Echinocereus milleri</i>				G1	
<i>Echinocereus nivosus</i>		7			Pr
<i>Echinocereus papillosus</i> var. <i>angusticeps</i>		3		T1	
<i>Echinocereus pulchellus</i> var. <i>pulchellus</i>		2			Pr
<i>Echinocereus pulchellus</i> var. <i>weinbergii</i>		2			Pr
<i>Echinocereus reichenbachii</i> var. <i>albertii</i>	1	2		T1	
<i>Echinocereus sciurus</i>		5			Pr
<i>Echinocereus stoloniferus</i>	1	4			Pr
<i>Echinocereus subinermis</i>		9			Pr
<i>Echinocereus viridiflorus</i> var. <i>canus</i>		1		T1	
<i>Echinocereus viridiflorus</i> var. <i>davisii</i>	1	11		T1	
<i>Echinocereus waldeisii</i>					Pr
<i>Echinodorus floridanus</i>		2		G1	
<i>Echinomastus erectocentrus</i> var. <i>acunensis</i>	1	2		T1	P
<i>Echinomastus unguispinus</i> ssp. <i>unguispinus</i>		3			Pr
<i>Echinomastus warnockii</i>	1	4			Pr
<i>Elaphoglossum pellucidum</i>			CR	G2	
<i>Elatine ojiwayensis</i>				G1	
<i>Eleocharis brachycarpa</i>				G1	
<i>Eleocharis cylindrica</i>				G1	
<i>Eleocharis diandra</i>				G1	
<i>Eleocharis torticulmis</i>				G1	
<i>Elymus texensis</i>				G1	
<i>Encyclia atrorubens</i>		1			Pr
<i>Encyclia distantiflora</i>					Pr
<i>Encyclia lorata</i>					Pr

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<i>Encyclia pollardiana</i>		2			Pr
<i>Encyclia tuerckheimii</i>					Pr
<i>Epidendrum alabastratum</i>					Pr
<i>Epidendrum cerinum</i>					Pr
<i>Epidendrum chloe</i>					Pr
<i>Epidendrum coronatum</i>		2			Pr
<i>Epidendrum cystosum</i>					Pr
<i>Epidendrum dorsocarinatum</i>					Pr
<i>Epidendrum dressleri</i>					Pr
<i>Epidendrum incomptoides</i>					Pr
<i>Epidendrum isthmi</i>		1			Pr
<i>Epidendrum skutchii</i>					Pr
<i>Epidendrum smaragdinum</i>					Pr
<i>Eragrostis fosbergii</i>					G1
<i>Eragrostis pectinacea</i> var. <i>tracyi</i>					T1
<i>Eremalche parryi</i> ssp. <i>kernensis</i>	1				T1
<i>Eriastrum densifolium</i> ssp. <i>sanctorum</i>					T1
<i>Ericameria discoidea</i> var. <i>winwardii</i>					T1
<i>Ericameria gilmanii</i>					G1
<i>Ericameria lignumviridis</i>					G1
<i>Ericameria nauseosa</i> var. <i>psilocarpa</i>					T1
<i>Ericameria parryi</i> var. <i>montana</i>					T1
<i>Erigeron abajensis</i>					G1
<i>Erigeron acomanus</i>					G1
<i>Erigeron awapensis</i>					G1
<i>Erigeron bistiensis</i>					G1
<i>Erigeron breweri</i> var. <i>bisanctus</i>					T1
<i>Erigeron calvus</i>					G1
<i>Erigeron clokeyi</i> var. <i>clokeyi</i>					T1
<i>Erigeron decumbens</i> var. <i>decumbens</i>	1				T1
<i>Erigeron heliographis</i>					G1
<i>Erigeron hessii</i>					G1
<i>Erigeron higginsii</i>					G1
<i>Erigeron huberi</i>					G1
<i>Erigeron inornatus</i> var. <i>keillii</i>					T1
<i>Erigeron kuschei</i>					G1
<i>Erigeron lemmonii</i>					G1
<i>Erigeron maniopotamicus</i>					G1
<i>Erigeron piscaticus</i>	1				G1
<i>Erigeron serpentinus</i>		1			G1
<i>Erigeron supplex</i>					G1
<i>Erigeron wilkenii</i>					G1
<i>Erigeron zothecinus</i>					G1
<i>Eriocaulon nigrobacteatum</i>					G1
<i>Eriodictyon capitatum</i>		2			G1
<i>Eriogonum ammophilum</i>					G1
<i>Eriogonum apricum</i> var. <i>prostratum</i>					T1
<i>Eriogonum argophyllum</i>	1				G1
<i>Eriogonum brandegeei</i>	1				G1
<i>Eriogonum butterworthianum</i>					G1
<i>Eriogonum callistum</i>					G1
<i>Eriogonum capistratum</i> var. <i>capistratum</i>					T1
<i>Eriogonum cedrorum</i>					G1
<i>Eriogonum codium</i>	1				G1
<i>Eriogonum corymbosum</i> var. <i>heilii</i>					T1
<i>Eriogonum cronquistii</i>					G1
<i>Eriogonum diatomaceum</i>					G1
<i>Eriogonum douglasii</i> var. <i>elkoense</i>					T1
<i>Eriogonum eastwoodianum</i>					G1
<i>Eriogonum eremicola</i>					G1
<i>Eriogonum ericifolium</i> var. <i>thornei</i>					T1
<i>Eriogonum evanidum</i>	1				G1
<i>Eriogonum grande</i> var. <i>timorum</i>		1			T1
<i>Eriogonum gypsophilum</i>	1				G1
<i>Eriogonum heermannii</i> var. <i>apachense</i>					T1
<i>Eriogonum heermannii</i> var. <i>subspinosum</i>					T1
<i>Eriogonum holmgrenii</i>					G1
<i>Eriogonum hylophilum</i>					G1
<i>Eriogonum kelloggii</i>		1			G1
<i>Eriogonum kennedyi</i> var. <i>pinicola</i>					T1
<i>Eriogonum luteolum</i> var. <i>saltuarium</i>					T1
<i>Eriogonum microthecum</i> var. <i>lacus-ursi</i>	1				T1

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<i>Eriogonum mitophyllum</i>				G1	
<i>Eriogonum mortonianum</i>				G1	
<i>Eriogonum ovalifolium</i> var. <i>monarchense</i>				T1	
<i>Eriogonum ovalifolium</i> var. <i>pansum</i>				T1	
<i>Eriogonum ovalifolium</i> var. <i>vineum</i>	1	1		T1	
<i>Eriogonum ovalifolium</i> var. <i>williamsiae</i>	1			T1	
<i>Eriogonum phoeniceum</i>				G1	
<i>Eriogonum smithii</i>				G1	
<i>Eriogonum soledium</i>		1		G1	
<i>Eriogonum spectabile</i>				G1	
<i>Eriogonum sphaerocephalum</i> var. <i>fasciculifolium</i>				T1	
<i>Eriogonum terrenatum</i>				G1	
<i>Eriogonum thompsoniae</i> var. <i>atwoodii</i>				T1	
<i>Eriogonum thompsoniae</i> var. <i>matthewsiae</i>				T1	
<i>Eriogonum tiehmii</i>				G1	
<i>Eriogonum truncatum</i>		1		G1	
<i>Eriogonum umbellatum</i> var. <i>cladophorum</i>				T1	
<i>Eriogonum umbellatum</i> var. <i>lautum</i>				T1	
<i>Eriogonum wrightii</i> var. <i>olanchense</i>				T1	
<i>Eriophyllum lanatum</i> var. <i>hallii</i>				T1	
<i>Eriophyllum latilobum</i>	1			G1	
<i>Erycina crista-galli</i>					Pr
<i>Erycina pumilio</i>					Pr
<i>Eryngium constancei</i>	1			G1	
<i>Eryngium cuneifolium</i>	1	1		G1	
<i>Eryngium pendletonensis</i>				G1	
<i>Erysimum capitatum</i> var. <i>angustatum</i>	1	1		T1	
<i>Erysimum menziesii</i> ssp. <i>eurekaense</i>	1			T1	
<i>Erysimum menziesii</i> ssp. <i>yadonii</i>				T1	
<i>Erythronium pluriflorum</i>				G1	
<i>Erythronium propullans</i>		2		G1	
<i>Erythronium quinaultense</i>	1			G1	
<i>Erythronium taylorii</i>				G1	
<i>Eschscholzia lemmonii</i> ssp. <i>kernensis</i>				T1	
<i>Eschscholzia rhombipetala</i>	1			G1	
<i>Escobaria chaffeyi</i>		3		T1	
<i>Escobaria dasyacantha</i> ssp. <i>chaffeyi</i>		5		T1	
<i>Escobaria dasyacantha</i> var. <i>duncanii</i>	1	1		T1	
<i>Escobaria guadalupeensis</i>		1		G1	
<i>Escobaria laredoi</i>		6			Pr
<i>Escobaria minima</i>	1	5		G1	
<i>Escobaria robbinsiorum</i>				G1	
<i>Euchile citrina</i>		1			Pr
<i>Eugenia koolauensis</i>	1	1	EN	G1	
<i>Eupatorium frustratum</i>				G1	
<i>Eupatorium leucolepis</i> var. <i>novae-angliae</i>	1	2		T1	
<i>Euphorbia aaron-rossii</i>				G1	
<i>Euphorbia haeleleana</i>		2	EN	G1	
<i>Euphorbia rosescens</i>				G1	
<i>Euphorbia telephoides</i>	1			G1	
<i>Eurybia saxicastellii</i>				G1	
<i>Eurybia spinulosa</i>				G1	
<i>Eurystyles borealis</i>					Pr
<i>Eutrema penlandii</i>	1			G1	
<i>Exocarpos gaudichaudii</i>			EN	G1	
<i>Exocarpos luteolus</i>				G1	
<i>Ferocactus cylindraceus</i> var. <i>eastwoodiae</i>	1	3		T1	
<i>Ferocactus haematacanthus</i>		6			Pr
<i>Ferocactus histrix</i>	2	18			Pr
<i>Ferocactus johnstonianus</i>		3			Pr
<i>Ferocactus pilosus</i>	2	21			Pr
<i>Ferocactus reppenhagenii</i>		2			Pr
<i>Festuca hawaiiensis</i>				G1	
<i>Festuca ligulata</i>	1	1		G1	
<i>Flueggea neowawraea</i>	1	3	CR	G1	
<i>Fouquieria leonilae</i>		3			Pr
<i>Fouquieria shrevei</i>	1	3			Pr
<i>Frangula purshiana</i> ssp. <i>ultramafica</i>				T1	
<i>Frasera gypsicola</i>				G1	
<i>Fremontodendron decumbens</i>		1		G1	
<i>Fritillaria affinis</i> var. <i>tristulis</i>		2		T1	

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<i>Fritillaria gentneri</i>	1			G1	
<i>Fritillaria grayana</i>	1	1		G1	
<i>Fryxella pygmaea</i>	1			G1	
<i>Gahnia lanaiensis</i>	1			G1	
<i>Gaillardia multiceps</i> var. <i>microcephala</i>				T1	
<i>Galactia smallii</i>		1		G1	
<i>Galactia watsoniana</i>				G1	
<i>Galeandra bicarinata</i>				G1	
<i>Galeottiella sarcoglossa</i>					Pr
<i>Galium angustifolium</i> ssp. <i>jacinticum</i>				T1	
<i>Galium argense</i>				G1	
<i>Galium californicum</i> ssp. <i>primum</i>				T1	
<i>Galium californicum</i> ssp. <i>sierrae</i>	1			T1	
<i>Galium carmenicola</i>					Pr
<i>Galium carterae</i>					Pr
<i>Galium hypotrichium</i> ssp. <i>tomentellum</i>				T1	
<i>Galium moranii</i>					Pr
<i>Gardenia brighamii</i>	2	4	CR	G1	
<i>Gardenia mannii</i>	1	1	CR	G1	
<i>Gardenia remyi</i>	1	2	VU	G1	
<i>Genistidium dumosum</i>	1			G1	
<i>Gentiana caliculata</i>					Pr
<i>Gentiana spathacea</i>					Pr
<i>Gentianella tenella</i> ssp. <i>pribilofii</i>				T1	
<i>Geohintonia mexicana</i>		4			Pr
<i>Geranium arboreum</i>	1			G1	
<i>Geranium hanaense</i>				G1	
<i>Geranium humile</i>				G1	
<i>Geranium kauaiense</i>				G1	
<i>Geum geniculatum</i>	1			G1	
<i>Geum rossii</i> var. <i>depressum</i>	1			T1	
<i>Gilia capitata</i> ssp. <i>tomentosa</i>				T1	
<i>Gilia maculata</i>				G1	
<i>Gilia sedifolia</i>	1			G1	
<i>Gilia tenuiflora</i> ssp. <i>hoffmannii</i>				T1	
<i>Gilia tenuis</i>				G1	
<i>Gilia yorkii</i>				G1	
<i>Gilmania luteola</i>				G1	
<i>Glaucocarpum suffrutescens</i>	2			G1	
<i>Glossopetalon texense</i>				G1	
<i>Gongora tridentata</i>		1			Pr
<i>Gouania hillebrandii</i>	1			G1	
<i>Gouania meyenii</i>	1			G1	
<i>Gouania vitifolia</i>	1		CR	G1	
<i>Govenia tequilana</i>					Pr
<i>Graptopetalum grande</i>		3			Pr
<i>Gutierrezia elegans</i>	1			G1	
<i>Gymnotheca laxa</i>					Pr
<i>Habenaria umbratilis</i>					Pr
<i>Hackelia gracilentata</i>				G1	
<i>Hackelia ibapensis</i>				G1	
<i>Hackelia venusta</i>	2			G1	
<i>Hagsatera brachycolumna</i>					Pr
<i>Hamamelis ovalis</i>		10		G1	
<i>Hamelia rovirosae</i>					Pr
<i>Haplostachys haplostachya</i>	1	1		G1	
<i>Harmonia guggolziorum</i>				G1	
<i>Harperocalis flava</i>	1	3		G1	
<i>Harrisia aboriginum</i>		5		G1	
<i>Harrisia fragrans</i>	2	6		G1	
<i>Hasteola robertiorum</i>				G1	
<i>Hazardia orcuttii</i>	1	2		G1	
<i>Hedyotis butterwickiae</i>				G1	
<i>Hedyotis cookiana</i>				G1	
<i>Hedyotis coriacea</i>		1		G1	
<i>Hedyotis degeneri</i>				G1	
<i>Hedyotis degeneri</i> var. <i>coprosimifolia</i>				T1	
<i>Hedyotis degeneri</i> var. <i>degeneri</i>	1			T1	
<i>Hedyotis elatior</i>				G1	
<i>Hedyotis fluviatilis</i>				G1	
<i>Hedyotis flynnii</i>				G1	
<i>Hedyotis formosa</i>				G1	

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<i>Hedyotis littoralis</i>	1	2		G1	
<i>Hedyotis mannii</i>	1			G1	
<i>Hedyotis parvula</i>	1			G1	
<i>Hedyotis pooleana</i>				G1	
<i>Hedyotis schlechtendahlana</i> var. <i>remyi</i>				T1	
<i>Hedyotis st.-johnii</i>	1	1		G1	
<i>Hedyotis tryblium</i>				G1	
<i>Hedysarum boreale</i> var. <i>gremiale</i>				T1	
<i>Helianthus carnosus</i>	1	1		G1	
<i>Helianthus verticillatus</i>		3		G1	
<i>Hemizonia arida</i>				G1	
<i>Hemizonia conjugens</i>				G1	
<i>Hemizonia corymbosa</i> ssp. <i>macrocephala</i>				T1	
<i>Hemizonia halliana</i>				G1	
<i>Hemizonia increscens</i> ssp. <i>villosa</i>				T1	
<i>Hesperolinon didymocarpum</i>				G1	
<i>Hesperolinon tehamense</i>				G1	
<i>Hesperomannia arborescens</i>	1		CR	G1	
<i>Hesperomannia arbuscula</i>	1	1	CR	G1	
<i>Hesperomannia lydgatei</i>		1	CR	G1	
<i>Heterotheca barbata</i>				G1	
<i>Heterotheca monarchensis</i>				G1	
<i>Heterotheca shevockii</i>				G1	
<i>Heuchera alpestris</i>				G1	
<i>Hexaletris revoluta</i>				G1	
<i>Hibiscadelphus distans</i>	1	2	CR	G1	
<i>Hibiscadelphus giffardianus</i>		1	CR	GH	
<i>Hibiscadelphus hualalaiensis</i>	1	1	CR	GH	
<i>Hibiscadelphus woodii</i>	1		CR	G1	
<i>Hibiscus arnottianus</i> ssp. <i>immaculatus</i>			EN	T1	
<i>Hibiscus brackenridgei</i>	1	3		G1	
<i>Hibiscus brackenridgei</i> ssp. <i>brackenridgei</i>			EN	T1	
<i>Hibiscus brackenridgei</i> ssp. <i>mokuleianus</i>			EN	T1	
<i>Hibiscus clayi</i>	1	3	CR	G1	
<i>Hibiscus dasycalyx</i>		7		G1	
<i>Hibiscus kokio</i> ssp. <i>kokio</i>			VU	T1	
<i>Hibiscus kokio</i> ssp. <i>saintjohnianus</i>			EN	T1	
<i>Hibiscus waimeae</i> ssp. <i>hannerae</i>			EN	T1	
<i>Hieracium scabrum</i> var. <i>leucocaulae</i>				T1	
<i>Hoffmannia chiapensis</i>					Pr
<i>Hoffmannseggia tenella</i>				G1	
<i>Holmgrenanthe petrophila</i>				G1	
<i>Holocarpa macradenia</i>	1	1		G1	
<i>Holographis argyrea</i>					Pr
<i>Horkelia bolanderi</i>	1	1		G1	
<i>Horkelia clevelandii</i>	1	2		G1	
<i>Horkelia cuneata</i> ssp. <i>sericea</i>		1		T1	
<i>Horkelia hendersonii</i>	1	1		G1	
<i>Horkelia rydbergii</i>	1	1		G1	
<i>Horkelia tularensis</i>				G1	
<i>Horkelia wilderae</i>				G1	
<i>Houstonia correllii</i>				G1	
<i>Hudsonia montana</i>	1			G1	
<i>Huperzia mannii</i>				G1	
<i>Huperzia nutans</i>				G1	
<i>Huperzia stemmermanniae</i>	1			G1	
<i>Hydrocleys parviflora</i>					Pr
<i>Hymenocallis godfreyi</i>		1		G1	
<i>Hymenocallis punta-gordensis</i>				G1	
<i>Hymenoclea sandersonii</i>				G1	
<i>Hymenoxys ambigens</i> var. <i>ambigens</i>				T1	
<i>Hymenoxys lapidicola</i>		1		G1	
<i>Ilex cuthbertii</i>				G1	
<i>Iliamna corei</i>	1			G1	
<i>Ionactis caelestis</i>				G1	
<i>Ionopsis satyrioides</i>					Pr
<i>Ipomopsis congesta</i> ssp. <i>nevadensis</i>				T1	
<i>Ipomopsis polyantha</i>				G1	
<i>Ipomopsis sancti-spiritus</i>	1			G1	
<i>Isocoma arguta</i>				G1	
<i>Isodendron hosakae</i>		1		G1	
<i>Isodendron laurifolium</i>	2			G1	

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<i>Isodendron pyriformium</i>		1		G1	
<i>Isoetes boomii</i>				G1	
<i>Isoetes hawaiiensis</i>				G1	
<i>Isoetes junciformis</i>				G1	
<i>Isoetes melanospora</i>		1		G1	
<i>Isoetes microvela</i>				G1	
<i>Isoetes tegetiformans</i>	1	1		G1	
<i>Isoetes tennesseensis</i>				G1	
<i>Isoetes virginica</i>				G1	
<i>Ivesia aperta</i> var. <i>canina</i>				T1	
<i>Ivesia arizonica</i> var. <i>saxosa</i>				T1	
<i>Ivesia callida</i>				G1	
<i>Ivesia kingii</i> var. <i>eremica</i>				T1	
<i>Ivesia longibracteata</i>				G1	
<i>Ivesia patellifera</i>				G1	
<i>Ivesia rhypara</i> var. <i>shellyi</i>	1			T1	
<i>Ivesia shockleyi</i> var. <i>ostleri</i>				T1	
<i>Jacquemontia reclinata</i>	1			G1	
<i>Jacquinella gigantea</i>					Pr
<i>Jaffuellobryum arsenaei</i>			EN		Pr
<i>Johanneshowellia crateriorum</i>				G1	
<i>Joinvillea ascendens</i> ssp. <i>ascendens</i>				T1	
<i>Juglans hindsii</i>		7		G1	
<i>Juncus digitatus</i>				G1	
<i>Juncus leiospermus</i> var. <i>ahartii</i>				T1	
<i>Juniperus communis</i> var. <i>megistocarpa</i>				T1	
<i>Juniperus sabinoides monticola</i>					Pr
<i>Kallstroemia perennans</i>	1			G1	
<i>Kalmiopsis fragrans</i>	1			G1	
<i>Kanaloa kahoolawensis</i>	1			G1	
<i>Kefersteinia lactea</i>		2			Pr
<i>Keysseria erici</i>				G1	
<i>Keysseria helenae</i>				G1	
<i>Kokia drynarioides</i>		5	CR	G1	
<i>Kokia kauaiensis</i>	2	3	CR	G1	
<i>Korthalsella degeneri</i>				G1	
<i>Labordia cyrtandrae</i>	1		CR	G1	
<i>Labordia helleri</i>				G1	
<i>Labordia hosakana</i>				G1	
<i>Labordia kaalae</i>			EN	G1	
<i>Labordia lydgatei</i>	2	1	EN	G1	
<i>Labordia pumila</i>				G1	
<i>Labordia tinifolia</i> var. <i>lanaiensis</i>	1		EN	T1	
<i>Labordia tinifolia</i> var. <i>wahiawaensis</i>			CR	T1	
<i>Labordia triflora</i>	2			G1	
<i>Lacandonia schismatica</i>					Pr
<i>Lactuca terrae-novae</i>				G1	
<i>Laelia speciosa</i>		6			Pr
<i>Laennecia turnerorum</i>				G1	
<i>Lantana depressa</i> var. <i>depressa</i>		1		T1	
<i>Lantana depressa</i> var. <i>floridana</i>				T1	
<i>Lantana depressa</i> var. <i>sanibelensis</i>				T1	
<i>Lasthenia burkei</i>	1	1		G1	
<i>Lasthenia conjugens</i>		1		G1	
<i>Lathyrus biflorus</i>				G1	
<i>Lathyrus sulphureus</i> var. <i>argillaceus</i>				T1	
<i>Lathyrus vestitus</i> ssp. <i>vestitus</i>	1			T1	
<i>Layia jonesii</i>				G1	
<i>Layia leucopappa</i>				G1	
<i>Layia munzii</i>				G1	
<i>Leavenworthia alabamica</i> var. <i>brachystyla</i>				T1	
<i>Leavenworthia aurea</i> var. <i>texana</i>	1			T1	
<i>Leavenworthia crassa</i>				G1	
<i>Leavenworthia crassa</i> var. <i>crassa</i>				T1	
<i>Leavenworthia crassa</i> var. <i>elongata</i>				T1	
<i>Leavenworthia exigua</i> var. <i>laciniata</i>				T1	
<i>Leavenworthia exigua</i> var. <i>lutea</i>				T1	
<i>Lechea intermedia</i> var. <i>depauperata</i>				T1	
<i>Lechea mensalis</i>				G1	
<i>Leochilus dignathe</i>					Pr
<i>Lepanthes ancylopetala</i>					Pr
<i>Lepanthes guatemalensis</i>					Pr

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<i>Lepanthes parvula</i>					Pr
<i>Lepanthopsis floripecten</i>					Pr
<i>Lepechinia rossii</i>	1	1		G1	
<i>Lepidium arbuscula</i>		1		G1	
<i>Lepidium barnebyanum</i>		1		G1	
<i>Lepidium flavum</i> var. <i>felipense</i>				T1	
<i>Lepidium huberi</i>				G1	
<i>Lepidium integrifolium</i> var. <i>heterophyllum</i>				T1	
<i>Lepidium jaredii</i>	1			G1	
<i>Lepidium jaredii</i> ssp. <i>album</i>				T1	
<i>Lepidium jaredii</i> ssp. <i>jaredii</i>				T1	
<i>Lepidium latipes</i> var. <i>heckardii</i>				T1	
<i>Lepidium montanum</i> var. <i>alpinum</i>				T1	
<i>Lepidium montanum</i> var. <i>claronense</i>				T1	
<i>Lepidium montanum</i> var. <i>coloradense</i>				T1	
<i>Lepidium montanum</i> var. <i>nevadense</i>				T1	
<i>Lepidium ostleri</i>		1		G1	
<i>Lesquerella carinata</i> var. <i>languida</i>				T1	
<i>Lesquerella congesta</i>	1			G1	
<i>Lesquerella gordonii</i> var. <i>densifolia</i>				T1	
<i>Lesquerella hemiphyssaria</i> var. <i>lucens</i>				T1	
<i>Lesquerella humilis</i>				G1	
<i>Lesquerella kaibabensis</i>	1			G1	
<i>Lesquerella kingii</i> ssp. <i>bernardina</i>	1			T1	
<i>Lesquerella lata</i>				G1	
<i>Lesquerella lescicii</i>				G1	
<i>Lesquerella lyrata</i>				G1	
<i>Lesquerella navajoensis</i>				G1	
<i>Lesquerella pallida</i>	2			G1	
<i>Lesquerella perforata</i>	1			G1	
<i>Lesquerella stonensis</i>	1			G1	
<i>Lesquerella thamnophila</i>	2			G1	
<i>Lesquerella tumulosa</i>				G1	
<i>Lessingia arachnoidea</i>	1			G1	
<i>Lessingia germanorum</i>	1			G1	
<i>Lessingia micradenia</i> var. <i>glabrata</i>				T1	
<i>Lessingia micradenia</i> var. <i>micradenia</i>				T1	
<i>Lewisia congdonii</i>				G1	
<i>Lewisia maguirei</i>				G1	
<i>Lewisia stebbinsii</i>		2		G1	
<i>Liatris densispicata</i> var. <i>densispicata</i>				T1	
<i>Liatris gholsonii</i>				G1	
<i>Liatris oligocephala</i>		1		G1	
<i>Ligeophila clavigera</i>					Pr
<i>Lilium occidentale</i>	1	1		G1	
<i>Lilium pardalinum</i> ssp. <i>pitkinense</i>				T1	
<i>Lilium pitkinense</i>	1	2		T1	
<i>Limnanthes bakeri</i>	1			G1	
<i>Limnanthes douglasii</i> ssp. <i>sulphurea</i>	1	2		T1	
<i>Limnanthes floccosa</i> ssp. <i>californica</i>	1			T1	
<i>Limnanthes floccosa</i> ssp. <i>grandiflora</i>	1			T1	
<i>Limnanthes floccosa</i> ssp. <i>pumila</i>	1			T1	
<i>Linanthus floribundus</i> ssp. <i>hallii</i>				T1	
<i>Linanthus pygmaeus</i> ssp. <i>pygmaeus</i>				T1	
<i>Linanthus serrulatus</i>				G1	
<i>Linum arenicola</i>				G1	
<i>Linum carteri</i> var. <i>carteri</i>				T1	
<i>Lipochaeta connata</i> ssp. <i>connata</i>		1		T1	
<i>Lipochaeta connata</i> var. <i>acris</i>				T1	
<i>Lipochaeta fauriei</i>				G1	
<i>Lipochaeta heterophylla</i>	2			G1	
<i>Lipochaeta kamolensis</i>				G1	
<i>Lipochaeta lobata</i> var. <i>leptophylla</i>				T1	
<i>Lipochaeta micrantha</i>	1			G1	
<i>Lipochaeta micrantha</i> var. <i>exigua</i>				T1	
<i>Lipochaeta micrantha</i> var. <i>micrantha</i>				T1	
<i>Lipochaeta remyi</i>	1			G1	
<i>Lipochaeta rockii</i>		1		G1	
<i>Lipochaeta tenuifolia</i>				G1	
<i>Lipochaeta venosa</i>				G1	
<i>Lipochaeta waimeensis</i>	2	2		G1	
<i>Lithophragma maximum</i>	1			G1	

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<i>Lobelia dunbariae</i>				G1	
<i>Lobelia dunbariae</i> ssp. <i>paniculata</i>				T1	
<i>Lobelia gaudichaudii</i>				G1	
<i>Lobelia gaudichaudii</i> ssp. <i>gaudichaudii</i>				T1	
<i>Lobelia gaudichaudii</i> ssp. <i>koolauensis</i>				T1	
<i>Lobelia gloria-montis</i>				G1	
<i>Lobelia grayana</i>	1			G1	
<i>Lobelia monostachya</i>	2		CR	G1	
<i>Lobelia oahuensis</i>	1			G1	
<i>Lobelia villosa</i>				G1	
<i>Lomatium cookii</i>	1			G1	
<i>Lomatium erythrocarpum</i>	1			G1	
<i>Lomatium greenmanii</i>	1			G1	
<i>Lomatium latilobum</i>	1			G1	
<i>Lomatium observatorium</i>				G1	
<i>Lomatium shevockii</i>				G1	
<i>Lonchocarpus yoroensis</i>			CR		
<i>Lonicera villosa</i> var. <i>fulleri</i>				T1	
<i>Lophocereus schottii</i> var. <i>mieckleyanus</i>		2			Pr
<i>Lophocereus schottii</i> var. <i>monstruosus</i>		3			Pr
<i>Lophochlaena oregona</i>				G1	
<i>Lotus argophyllus</i> ssp. <i>adsurgens</i>	1	1		T1	
<i>Lotus argyraeus</i> var. <i>multicaulis</i>				T1	
<i>Lotus argyraeus</i> var. <i>notitius</i>				T1	
<i>Lotus crassifolius</i> var. <i>otayensis</i>	1	2		T1	
<i>Lotus mearnsii</i> var. <i>equisolensis</i>				T1	
<i>Lotus nuttallianus</i>	1			G1	
<i>Lotus procumbens</i> var. <i>jepsonii</i>				T1	
<i>Lotus rubriflorus</i>				G1	
<i>Louteridium mexicanum</i>					Pr
<i>Ludwigia ravenii</i>	1			G1	
<i>Lupinus abramsii</i>				G1	
<i>Lupinus antoninus</i>				G1	
<i>Lupinus aridorum</i>	2	1		T1	
<i>Lupinus aridus</i> ssp. <i>ashlandensis</i>	1			T1	
<i>Lupinus bingenensis</i> var. <i>bingenensis</i>				T1	
<i>Lupinus citrinus</i> var. <i>deflexus</i>				T1	
<i>Lupinus constancei</i>	1			G1	
<i>Lupinus cusickii</i>	1			G1	
<i>Lupinus cusickii</i> ssp. <i>brachypodus</i>				T1	
<i>Lupinus cusickii</i> ssp. <i>cusickii</i>				T1	
<i>Lupinus elmeri</i>				G1	
<i>Lupinus latifolius</i> ssp. <i>leucanthus</i>	1			T1	
<i>Lupinus latifolius</i> var. <i>barbatus</i>				T1	
<i>Lupinus lemmonii</i>				G1	
<i>Lupinus lutescens</i>				G1	
<i>Lupinus lyallii</i> ssp. <i>alcis-temporis</i>				T1	
<i>Lupinus lyallii</i> ssp. <i>washoensis</i>				T1	
<i>Lupinus magnificus</i> var. <i>magnificus</i>				T1	
<i>Lupinus nipomensis</i>	1			G1	
<i>Lupinus parviflorus</i> var. <i>fulvomaculatus</i>				T1	
<i>Lupinus pratensis</i> var. <i>eristachyus</i>				T1	
<i>Lupinus punto-reyesensis</i>				G1	
<i>Lupinus sublanatus</i>				G1	
<i>Lupinus tidestromii</i> var. <i>layneae</i>				T1	
<i>Lupinus tidestromii</i> var. <i>tidestromii</i>				T1	
<i>Lupinus westianus</i> var. <i>aridorum</i>				T1	
<i>Lycium brevipes</i> var. <i>hassei</i>		1		G1	
<i>Lycium hassei</i>				G1	
<i>Lycodiella margueritiae</i>				G1	
<i>Lygodesmia doloresensis</i>	1			G1	
<i>Lygodesmia entrada</i>				G1	
<i>Lyonthamnus floribundus</i> ssp. <i>floribundus</i>			VU	T1	
<i>Lyroglossa pubicaulis</i>					Pr
<i>Lysimachia daphnoides</i>	2	1		G1	
<i>Lysimachia filitolia</i>	1	1		G1	
<i>Lysimachia graminea</i>				G1	
<i>Lysimachia hillebrandii</i>		1		G1	
<i>Lysimachia iniki</i>				G1	
<i>Lysimachia lydgatei</i>				G1	
<i>Lysimachia maxima</i>	2			G1	
<i>Lysimachia ovoidea</i>				G1	

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<i>Lysimachia pendens</i>				G1	
<i>Lysimachia scopulensis</i>	1			G1	
<i>Lysimachia venosa</i>				G1	
<i>Lysimachia waianaeensis</i>				G1	
<i>Lythrum curtissii</i>				G1	
<i>Machaeranthera canescens</i> var. <i>ziegleri</i>				T1	
<i>Machaeranthera gypsitherma</i>				G1	
<i>Macradenia brassavolae</i>		5			Pr
<i>Mahonia pinnata</i> ssp. <i>insularis</i>				T1	
<i>Malacothamnus abbottii</i>		1		G1	
<i>Malacothamnus davidsonii</i>		1		G1	
<i>Malacothamnus fasciculatus</i> var. <i>nesioticus</i>	1	3		T1	
<i>Malacothrix foliosa</i> ssp. <i>crispifolia</i>				T1	
<i>Malacothrix indecora</i>				G1	
<i>Malacothrix junakii</i>				G1	
<i>Malacothrix squalida</i>				G1	
<i>Malaxis bayardii</i>				G1	
<i>Malaxis greenwoodiana</i>					Pr
<i>Malaxis hagsateri</i>					Pr
<i>Malaxis pandurata</i>					Pr
<i>Mammillaria albicans</i>	1	2			Pr
<i>Mammillaria albicoma</i>		4	EN		Pr
<i>Mammillaria albiflora</i>		1	CR		
<i>Mammillaria albilanata</i> <i>reppenhagenii</i>					Pr
<i>Mammillaria anniana</i>		2	CR		
<i>Mammillaria aureilana</i>		5	VU		Pr
<i>Mammillaria aurihamata</i>		1			Pr
<i>Mammillaria backebergiana</i>		7			Pr
<i>Mammillaria baumii</i>		8			Pr
<i>Mammillaria berkiana</i>			CR		
<i>Mammillaria blossfeldiana</i>		5			Pr
<i>Mammillaria bocasana</i> ssp. <i>eschauzerei</i>		5			Pr
<i>Mammillaria bombycina</i>		15			Pr
<i>Mammillaria boottii</i>		5			Pr
<i>Mammillaria brandegeei</i> subsp. <i>glareosa</i>					Pr
<i>Mammillaria capensis</i>		1			Pr
<i>Mammillaria carretii</i>		6			Pr
<i>Mammillaria cerralboa</i>		2			Pr
<i>Mammillaria columbiana</i> ssp. <i>yucatanensis</i>		2			Pr
<i>Mammillaria crinita</i> ssp. <i>crinita</i>		1			Pr
<i>Mammillaria crinita</i> ssp. <i>painteri</i>		1			Pr
<i>Mammillaria crucigera</i>		7			Pr
<i>Mammillaria dioica</i> subsp. <i>angelensis</i>					Pr
<i>Mammillaria dixanthocentron</i>	1	14			Pr
<i>Mammillaria duoformis</i>		10			Pr
<i>Mammillaria duvei</i>		6	EN		Pr
<i>Mammillaria evermanniana</i>		3			Pr
<i>Mammillaria fittkaui</i>		4			Pr
<i>Mammillaria goodridgii</i>					Pr
<i>Mammillaria grusonii</i>	1	6			Pr
<i>Mammillaria guelzowiana</i>	1	10	CR		A
<i>Mammillaria guerreronis</i>		6			Pr
<i>Mammillaria heidiae</i>		1			Pr
<i>Mammillaria hernandezii</i>		5			Pr
<i>Mammillaria herrerae</i>		7	CR		P
<i>Mammillaria hertrichiana</i>	1	8			Pr
<i>Mammillaria huitzilopochtli</i>	1	11			Pr
<i>Mammillaria insularis</i>		3			Pr
<i>Mammillaria johnstonii</i>		6			Pr
<i>Mammillaria karwinskiana</i> ssp. <i>beiselii</i>		2			Pr
<i>Mammillaria knippeliana</i>		3			Pr
<i>Mammillaria kraehenbuehlii</i>		4			Pr
<i>Mammillaria lindsayi</i>		3			Pr
<i>Mammillaria magnifica</i>		13			Pr
<i>Mammillaria marcosii</i>		3	CR		
<i>Mammillaria marksiana</i>		7			Pr
<i>Mammillaria matudae</i>		9			Pr
<i>Mammillaria melanocentra</i> ssp. <i>rubrograndis</i>		3			Pr
<i>Mammillaria mercadensis</i>		2			Pr
<i>Mammillaria meyranii</i>		6			Pr
<i>Mammillaria microhelia</i>		12	VU		Pr
<i>Mammillaria miegiana</i>		4			Pr

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<i>Mammillaria moelleriana</i>		8			Pr
<i>Mammillaria multigitata</i>		5			Pr
<i>Mammillaria nana</i>	1	3			Pr
<i>Mammillaria neopalmeri</i>	1	4			Pr
<i>Mammillaria orcuttii</i>		1			Pr
<i>Mammillaria parkinsonii</i>		15			Pr
<i>Mammillaria peninsularis</i>		2			Pr
<i>Mammillaria pennispinosa</i>		5	EN		Pr
<i>Mammillaria pennispinosa</i> var. <i>nazasensis</i>		1	CR		
<i>Mammillaria perezdelarosae</i>		8			Pr
<i>Mammillaria pillispina</i>		2			Pr
<i>Mammillaria rettigiana</i>		3	VU		Pr
<i>Mammillaria rhodantha</i> ssp. <i>pringlei</i>		4			Pr
<i>Mammillaria roseoalba</i>		1			Pr
<i>Mammillaria sanchez-mejoradae</i>		2	CR		P
<i>Mammillaria schiedeana</i> var. <i>dumetorum</i>		3			Pr
<i>Mammillaria schwarzii</i>		4	CR		Pr
<i>Mammillaria spinosissima</i> ssp. <i>pilcayensis</i>		4			Pr
<i>Mammillaria stella-de-tacubaya</i>	1	4			Pr
<i>Mammillaria surculosa</i>	1	4			Pr
<i>Mammillaria tayloriorum</i>		5			Pr
<i>Mammillaria tepexcicensis</i>					Pr
<i>Mammillaria thornberi</i> ssp. <i>yaquensis</i>		4			Pr
<i>Mammillaria varieaculeata</i>		4			Pr
<i>Mammillaria xaltiangensis</i>		2			Pr
<i>Mammillaria zeilmanniana</i>		6	EN		Pr
<i>Manfreda guerrerenensis</i>					Pr
<i>Manfreda planifolia</i>					Pr
<i>Manfreda potosina</i>	1				Pr
<i>Manihot walkerae</i>	1			G1	
<i>Marathrum minutiflorum</i>					Pr
<i>Marathrum rubrum</i>					Pr
<i>Marattia weinmanniifolia</i>		2			Pr
<i>Marina orcuttii</i> var. <i>orcuttii</i>		1		T1	
<i>Marsilea villosa</i>	1	1		G1	
<i>Matelea atrostellata</i>				G1	
<i>Matelea texensis</i>				G1	
<i>Maxillaria alba</i>		5			Pr
<i>Maxillaria nasuta</i>		2			Pr
<i>Maxillaria tonsoniae</i>					Pr
<i>Melanthera fauriei</i>		1		G1	
<i>Melanthera kamolensis</i>	1			G1	
<i>Melanthera tenuifolia</i>	1			G1	
<i>Melica subulata</i> var. <i>pammellii</i>				T1	
<i>Melicope adscendens</i>	1			G1	
<i>Melicope balloui</i>			EN	G1	
<i>Melicope christophersenii</i>		1	EN	G1	
<i>Melicope cinerea</i>			EN	G1	
<i>Melicope cruciata</i>			EX	G1	
<i>Melicope degeneri</i>				G1	
<i>Melicope elliptica</i>				G1	
<i>Melicope haupuensis</i>	1	1	CR	G1	
<i>Melicope hiakae</i>				G1	
<i>Melicope kaalaensis</i>			VU	G1	
<i>Melicope knudsenii</i>			CR	G1	
<i>Melicope lydgatei</i>				G1	
<i>Melicope macropus</i>	1		EN	GH	
<i>Melicope makahae</i>			EN	G1	
<i>Melicope mucronulata</i>	1	1	CR	G1	
<i>Melicope munroi</i>				G1	
<i>Melicope ovalis</i>		1	EN	G1	
<i>Melicope pallida</i>		1	EN	G1	
<i>Melicope paniculata</i>	1	1	EX	G1	
<i>Melicope puberula</i>			EN	G1	
<i>Melicope quadrangularis</i>			CR	G1	
<i>Melicope reflexa</i>				G1	
<i>Melicope saint-johnii</i>			EN	G1	
<i>Melicope zahlbruckneri</i>	1		CR	G1	
<i>Mentzelia argillicola</i>				G1	
<i>Mentzelia goodrichii</i>				G1	
<i>Mentzelia leucophylla</i>	1			G1	
<i>Mentzelia memorabilis</i>				G1	

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<i>Mentzelia multicaulis</i> var. <i>flumensevera</i>				T1	
<i>Mentzelia multicaulis</i> var. <i>librina</i>				T1	
<i>Mentzelia shultziiorum</i>				G1	
<i>Mentzelia tiehmii</i>				G1	
<i>Mespilus canescens</i>	2	5		G1	
<i>Metrosideros polymorpha</i> var. <i>macrophylla</i>				T1	
<i>Mimulus angustifolius</i>				G1	
<i>Mimulus brachiatus</i>				G1	
<i>Mimulus fremontii</i> var. <i>vandenbergensis</i>				T1	
<i>Mimulus gemmiparus</i>				G1	
<i>Mimulus glabratus</i> var. <i>michiganensis</i>		2		T1	
<i>Mimulus latifolius</i>	1			G1	
<i>Mimulus ovatus</i>				G1	
<i>Mimulus purpureus</i> var. <i>purpureus</i>				T1	
<i>Minuartia decumbens</i>				G1	
<i>Minuartia godfreyi</i>				G1	
<i>Minuartia litorea</i>				G1	
<i>Minuartia stolonifera</i>				G1	
<i>Mirabilis pudica</i> var. <i>pubescens</i>				T1	
<i>Monarda fistulosa</i> ssp. 1				T1	
<i>Monardella beneolens</i>				G1	
<i>Monardella douglasii</i> ssp. <i>venosa</i>	1	1		T1	
<i>Monardella linoidea</i> var. <i>viminea</i>		4		T1	
<i>Monardella stebbinsii</i>				G1	
<i>Monardella stoneana</i>				G1	
<i>Monotropa hypopitys</i>					Pr
<i>Morangaya pensilis</i>		3			Pr
<i>Mucuna sloanei</i> var. <i>persericea</i>				T1	
<i>Muhlenbergia jaliscana</i>					Pr
<i>Munroidendron racemosum</i>	1	5	CR	G1	
<i>Myrsine denticulata</i>				G1	
<i>Myrsine fosbergii</i>			VU	G1	
<i>Myrsine helleri</i>				G1	
<i>Myrsine juddii</i>				G1	
<i>Myrsine knudsenii</i>	1	1	EN	G1	
<i>Myrsine linearifolia</i>		1		G1	
<i>Myrsine mezii</i>	1		CR	G1	
<i>Myrsine vaccinioides</i>				G1	
<i>Najas filifolia</i>				G1	
<i>Najas guadalupensis</i> ssp. <i>muenscheri</i>				T1	
<i>Navarretia fossalis</i>	1			G1	
<i>Navarretia gowenii</i>				G1	
<i>Navarretia leucocephala</i> ssp. <i>pauciflora</i>	1			T1	
<i>Navarretia leucocephala</i> ssp. <i>plleantha</i>				T1	
<i>Navarretia myersii</i>				G1	
<i>Navarretia myersii</i> ssp. <i>deminuta</i>				T1	
<i>Navarretia myersii</i> ssp. <i>myersii</i>				T1	
<i>Navarretia ojaiensis</i>				G1	
<i>Navarretia setiloba</i>				G1	
<i>Navarretia willamettensis</i>				G1	
<i>Nemacladus calcaratus</i>				G1	
<i>Nemacladus twisselmannii</i>				G1	
<i>Neraudia angulata</i>				G1	
<i>Neraudia angulata</i> var. <i>angulata</i>		1		T1	
<i>Neraudia angulata</i> var. <i>dentata</i>		1		T1	
<i>Neraudia kauaiensis</i>		1		G1	
<i>Neraudia ovata</i>	1	1	CR	G1	
<i>Neraudia sericea</i>				G1	
<i>Nitrophila mohavensis</i>				G1	
<i>Nolina cismontana</i>				G2	Pr
<i>Nolina interrata</i>	2	6		G1	
<i>Nothoctrum breviflorum</i>		2	CR	G1	
<i>Nothoctrum latifolium</i>			EN	G1	
<i>Nothoctrum peltatum</i>	1		CR	G1	
<i>Nototrichium divaricatum</i>		2		G1	
<i>Ochrosia haleakalae</i>		1	EN	G1	
<i>Ochrosia kauaiensis</i>		1	EN	G1	
<i>Ochrosia kilaueaensis</i>			CR	GH	
<i>Oenothera californica</i> ssp. <i>eurekensis</i>	1			T1	
<i>Oenothera deltoidea</i> ssp. <i>howellii</i>				T1	
<i>Oenothera heterophylla</i> ssp. <i>orientalis</i>	1			T1	
<i>Oenothera murdockii</i>				G1	

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<i>Oenothera wolfii</i>	1	1		G1	
<i>Omittemia filisepala</i>		4			Pr
<i>Omittemia longipes</i>					Pr
<i>Oncidium ensatum</i>				GNR	Pr
<i>Oncidium exauriculatum</i>					Pr
<i>Oncidium stelligerum</i>					Pr
<i>Oncidium suttonii</i>					Pr
<i>Oncidium wentworthianum</i>		3			Pr
<i>Opuntia aureispina</i>		2		G1	
<i>Opuntia bravoana</i>	1	4			Pr
<i>Opuntia chaffeyi</i>		3	CR		
<i>Opuntia corallicola</i>		3		G1	
<i>Opuntia densispina</i>		1		G1	
<i>Opuntia engelmannii</i> var. <i>flexospina</i>				T1	
<i>Opuntia engelmannii</i> var. <i>linguiformis</i>		13		T1	
<i>Opuntia excelsa</i>	1	3			Pr
<i>Opuntia imbricata</i> var. <i>argentea</i>				T1	
<i>Opuntia littoralis</i> var. <i>pieceri</i>				T1	
<i>Opuntia littoralis</i> var. <i>vaseyi</i>		3		T1	
<i>Opuntia martiniana</i>		2		G1	
<i>Orbexilum virgatum</i>				G1	
<i>Orbignya guacuyule</i>		1			Pr
<i>Orcuttia viscida</i>				G1	
<i>Oreoxis humilis</i>				G1	
<i>Oreoxis trotteri</i>				G1	
<i>Orthocarpus pachystachyus</i>				G1	
<i>Oserya coulteriana</i>					Pr
<i>Osmorhiza mexicana</i> ssp. <i>bipatriata</i>				T1	
<i>Oxytheca parishii</i> var. <i>cienegensis</i>				T1	
<i>Oxytheca parishii</i> var. <i>goodmaniana</i>				T1	
<i>Oxytropis campestris</i> var. <i>chartacea</i>	1			T1	
<i>Oxytropis campestris</i> var. <i>columbiana</i>				T1	
<i>Oxytropis campestris</i> var. <i>wanapum</i>	1			T1	
<i>Oxytropis nigrescens</i> var. <i>lonchopoda</i>				T1	
<i>Pachyphyllum mexicanum</i>					Pr
<i>Packera castoreus</i>				G1	
<i>Packera franciscana</i>				G1	
<i>Packera malmstenii</i>				G1	
<i>Panicum fauriei</i> var. <i>carteri</i>				T1	
<i>Panicum hirstii</i>	1			G1	
<i>Panicum longivaginatium</i>				G1	
<i>Panicum mohavense</i>				G1	
<i>Panicum niihavense</i>	1	2		G1	
<i>Papperitzia leiboldii</i>					Pr
<i>Paronychia chartacea</i> ssp. <i>minima</i>				T1	
<i>Paronychia congesta</i>				G1	
<i>Paronychia lundelliorum</i>				G1	
<i>Paronychia maccartii</i>				G1	
<i>Pedicularis furbishiae</i>	1			G1	
<i>Pedicularis glabra</i>					Pr
<i>Pediocactus bradyi</i>		4		G1	
<i>Pediocactus knowltonii</i>		5		G1	
<i>Pediocactus peeblesianus</i>		1		G1	
<i>Pediocactus peeblesianus</i> var. <i>fickeiseniae</i>		2		T1	
<i>Pediocactus peeblesianus</i> var. <i>peeblesianus</i>				T1	
<i>Pediomelum humile</i>	1			G1	
<i>Pediomelum megalanthum</i> var. <i>epipsilum</i>				T1	
<i>Pediomelum pentaphyllum</i>				G1	
<i>Pediomelum piedmontanum</i>				G1	
<i>Pelecyphora aselliformis</i>		7			Pr
<i>Pelexia congesta</i>					Pr
<i>Pellaea glabella</i> ssp. <i>missouriensis</i>				T1	
<i>Peniocereus cuixmalensis</i>		5			Pr
<i>Peniocereus fosterianus</i>		3			Pr
<i>Peniocereus lazaro-cardenasii</i>					Pr
<i>Peniocereus maculatus</i>		4			Pr
<i>Peniocereus marianus</i>	1	5			Pr
<i>Peniocereus tepalcatepecanus</i>		3			Pr
<i>Peniocereus zopilotensis</i>		2			Pr
<i>Penstemon deamii</i>				G1	
<i>Penstemon debilis</i>	1	3		G1	
<i>Penstemon deustus</i> var. <i>variabilis</i>	1			T1	

Name	Present in Germplasm Collections	Present in Living Collections	Red List Status	NatureServe Status	NOM Status
<i>Penstemon dolius</i> var. <i>duchesnensis</i>				T1	
<i>Penstemon floribundus</i>				G1	
<i>Penstemon flowersii</i>		1		G1	
<i>Penstemon franklinii</i>				G1	
<i>Penstemon gibbensii</i>	1			G1	
<i>Penstemon haydenii</i>	2	1		G1	
<i>Penstemon linarioides</i> ssp. <i>maguirei</i>				T1	
<i>Penstemon moriahensis</i>				G1	
<i>Penstemon navajoa</i>				G1	
<i>Penstemon newberryi</i> ssp. <i>sonomensis</i>				T1	
<i>Penstemon penlandii</i>	1	1		G1	
<i>Penstemon pinorum</i>				G1	
<i>Penstemon pudicus</i>				G1	
<i>Penstemon rhizomatosus</i>				G1	
<i>Penstemon scariosus</i> var. <i>albifluvis</i>	1	1		T1	
<i>Penstemon tiehmii</i>				G1	
<i>Penstemon tracyi</i>	1	1		G1	
<i>Pentachaeta bellidiflora</i>		1		G1	
<i>Pentachaeta exilis</i> ssp. <i>aeolica</i>				T1	
<i>Peperomia rockii</i>				G1	
<i>Peperomia subpetiolata</i>	2			G1	
<i>Perideridia erythrorhiza</i>	1			G1	
<i>Periptera ctenotricha</i>					Pr
<i>Periptera macrostelis</i>					Pr
<i>Perityle ajoensis</i>				G1	
<i>Perityle ambrosiifolia</i>				G1	
<i>Perityle bisetosa</i> var. <i>scalaris</i>				T1	
<i>Perityle cochisensis</i>				G1	
<i>Perityle fosteri</i>				G1	
<i>Perityle huecoensis</i>				G1	
<i>Perityle saxicola</i>				G1	
<i>Perityle specuicola</i>				G1	
<i>Perityle villosa</i>				G1	
<i>Perityle vitreomontana</i>				G1	
<i>Perityle warnockii</i>				G1	
<i>Petrophyton acuminatum</i>				G1	
<i>Petrophyton cinerascens</i>	2	4		G1	
<i>Phacelia argillacea</i>	1			G1	
<i>Phacelia argylensis</i>				G1	
<i>Phacelia ciliata</i> var. <i>opaca</i>				T1	
<i>Phacelia cookei</i>				G1	
<i>Phacelia cronquistiana</i>				G1	
<i>Phacelia formosula</i>	1			G1	
<i>Phacelia glandulosa</i> var. <i>deserta</i>				T1	
<i>Phacelia indecora</i>				G1	
<i>Phacelia insularis</i> var. <i>continentis</i>		1		T1	
<i>Phacelia lutea</i> var. <i>mackenzieorum</i>	1			T1	
<i>Phacelia lyonii</i>				G1	
<i>Phacelia phacelioides</i>				G1	
<i>Phacelia pulchella</i> var. <i>sabulonum</i>				T1	
<i>Phacelia suaveolens</i> ssp. <i>keckii</i>				T1	
<i>Phemeranthus thompsonii</i>		1		G1	
<i>Philadelphus floridus</i>		4		G1	
<i>Phlegmariurus nutans</i>	1			G1	
<i>Phlox hirsuta</i>	1			G1	
<i>Phlox idahonis</i>	1	1		G1	
<i>Phlox pilosa</i> ssp. <i>sangamonensis</i>				T1	
<i>Phyllanthus fluitans</i>					Pr
<i>Phyllostegia bracteata</i>	1			G1	
<i>Phyllostegia brevidens</i>		1		G1	
<i>Phyllostegia floribunda</i>	1			G1	
<i>Phyllostegia hirsuta</i>	1			G1	
<i>Phyllostegia hispida</i>	2	1		G1	
<i>Phyllostegia kaalaensis</i>	2		CR	G1	
<i>Phyllostegia kahiliensis</i>				G1	
<i>Phyllostegia knudsenii</i>				G1	
<i>Phyllostegia mannii</i>	2			G1	
<i>Phyllostegia mollis</i>	2	1	CR	G1	
<i>Phyllostegia parviflora</i>				G1	
<i>Phyllostegia parviflora</i> var. <i>lydgatei</i>	1			T1	
<i>Phyllostegia pilosa</i>	2			G1	
<i>Phyllostegia racemosa</i>	1			G1	

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<i>Phyllostegia renovans</i>		1		G1	
<i>Phyllostegia stachyoides</i>	2	1		G1	
<i>Phyllostegia velutina</i>	1			G1	
<i>Phyllostegia waimeae</i>		1		G1	
<i>Phyllostegia warshaueri</i>				G1	
<i>Phyllostegia wawrana</i>				G1	
<i>Phymosia rosea</i>					Pr
<i>Phymosia rzedowskii</i>					Pr
<i>Physalis latiphysa</i>				G1	
<i>Physalis virginiana</i> var. <i>campaniforma</i>				T1	
<i>Physaria didymocarpa</i> ssp. <i>lyrata</i>	1			T1	
<i>Physaria dornii</i>				G1	
<i>Physaria grahamii</i>				G1	
<i>Physaria newberryi</i> var. <i>racemosa</i>				T1	
<i>Physaria obcordata</i>	1	1		G1	
<i>Physaria pulvinata</i>	1			G1	
<i>Physaria repanda</i>				G1	
<i>Physaria scrotiformis</i>				G1	
<i>Physaria stylosa</i>				G1	
<i>Physocarpus alternans</i> ssp. <i>annulatus</i>				T1	
<i>Physocarpus alternans</i> ssp. <i>panamintensis</i>				T1	
<i>Physogyne gonzalesii</i>					Pr
<i>Picea martinezii</i>		5	CR		P
<i>Pilosocereus cometes</i>		1			Pr
<i>Pilosocereus robinii</i>	1	4		G1	
<i>Pilosocereus robinii</i> var. <i>deeringii</i>				T1	
<i>Pilosocereus robinii</i> var. <i>robinii</i>	1			T1	
<i>Pinarophyllon flavum</i>					Pr
<i>Pinus cembroides</i> ssp. <i>lagunae</i>			VU		Pr
<i>Pinus durangensis</i>		8			Pr
<i>Pinus johannis</i>		7			Pr
<i>Pinus muricata</i> var. <i>remorata</i>		4		T1	
<i>Pinus radiata</i>	1	15	LR/cd	G1	
<i>Pinus strobus</i> var. <i>chiapensis</i>			VU		Pr
<i>Pinus torreyana</i>		15	VU	G1	
<i>Pinus torreyana</i> var. <i>insularis</i>				T1	
<i>Pinus torreyana</i> var. <i>torreyana</i>	1	1		T1	
<i>Piperia elegans</i> ssp. <i>decurtata</i>				T1	
<i>Pisonia floridana</i>				G1	
<i>Pisonia wagneriana</i>		2	EN	G1	
<i>Pittosporum argentifolium</i>				G1	
<i>Pittosporum napaliense</i>		3	EN	G1	
<i>Pityopsis ruthii</i>	1			G1	
<i>Plagiobothrys figuratus</i> ssp. <i>corallicarpus</i>				T1	
<i>Plagiobothrys hirtus</i>				G1	
<i>Plagiobothrys hystericulus</i>				G1	
<i>Plagiobothrys parishii</i>				G1	
<i>Plagiobothrys strictus</i>	1			G1	
<i>Plantago hawaiiensis</i>				G1	
<i>Plantago princeps</i>				G1	
<i>Plantago princeps</i> var. <i>anomala</i>	1			T1	
<i>Plantago princeps</i> var. <i>laxiflora</i>				T1	
<i>Plantago princeps</i> var. <i>longibracteata</i>				T1	
<i>Plantago princeps</i> var. <i>princeps</i>	1			T1	
<i>Platanthera holochila</i>	1			G1	
<i>Platanthera shriveri</i>				G1	
<i>Platydesma cornuta</i>				G1	
<i>Platydesma cornuta</i> var. <i>cornuta</i>				T1	
<i>Platydesma cornuta</i> var. <i>decurrens</i>				T1	
<i>Platydesma remyi</i>			EN	G1	
<i>Platydesma rostrata</i>				G1	
<i>Platystele repens</i>					Pr
<i>Platythelys venustula</i>					Pr
<i>Pleomele fernaldii</i>			EN	G1	
<i>Pleomele forbesii</i>		1	EN	G1	
<i>Pleomele hawaiiensis</i>		2	EN	G1	
<i>Pleuropogon hooverianus</i>	1	1		G1	
<i>Pleuropogon oregonus</i>	1			G1	
<i>Pleurothallis abbreviata</i>					Pr
<i>Pleurothallis deregularis</i>					Pr
<i>Pleurothallis endotrachys</i>					Pr
<i>Pleurothallis hintonii</i>					Pr

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<i>Pleurothallis lanceola</i>		1			Pr
<i>Pleurothallis liebmanniana</i>					Pr
<i>Pleurothallis nelsonii</i>					Pr
<i>Pleurothallis nigriflora</i>					Pr
<i>Pleurothallis saccatilibia</i>					Pr
<i>Pleurothallis setosa</i>					Pr
<i>Pleurothallis unguicallosa</i>		1			Pr
<i>Pleurothallis violacea</i>		1			Pr
<i>Poa diaboli</i>				G1	
<i>Poa hartzii</i> ssp. <i>alaskana</i>				T1	
<i>Poa laxa</i> ssp. <i>banffiana</i>				T1	
<i>Poa mannii</i>		1		G1	
<i>Poa napensis</i>	1	1		G1	
<i>Poa sandvicensis</i>				G1	
<i>Poa siphonoglossa</i>				G1	
<i>Podocarpus matudae</i>		11			Pr
<i>Podostemum riciiforme</i>					Pr
<i>Pogogyne clareana</i>	1			G1	
<i>Pogogyne nudiuscula</i>	1			G1	
<i>Polemonium chartaceum</i>	1			G1	
<i>Polemonium nevadense</i>				G1	
<i>Polemonium occidentale</i> var. <i>lacustre</i>	1			T1	
<i>Pollanthes densiflora</i>					Pr
<i>Pollanthes howardii</i>		5			Pr
<i>Pollanthes longiflora</i>					Pr
<i>Pollanthes palustris</i>					Pr
<i>Pollanthes platyphylla</i>					Pr
<i>Polygala rimulicola</i> var. <i>mescalerorum</i>				T1	
<i>Polygala smallii</i>	1			G1	
<i>Polygonum hickmanii</i>				G1	
<i>Polygonum marinense</i>				G1	
<i>Polymnia cossatotensis</i>				G1	
<i>Polystichum aleuticum</i>	1			G1	
<i>Ponera dressleriana</i>					Pr
<i>Ponera pellita</i>					Pr
<i>Pontederia rotundifolia</i>		1			Pr
<i>Ponthieva parviflora</i>					Pr
<i>Populus guzmanantensis</i>			EN		Pr
<i>Populus simaroa</i>					Pr
<i>Portulaca biloba</i>				G1	
<i>Portulaca molokiniensis</i>		7		G1	
<i>Portulaca villosa</i>	1	2		G1	
<i>Potamogeton clystocarpus</i>				G1	
<i>Potamogeton floridanus</i>				G1	
<i>Potamogeton methyensis</i>				G1	
<i>Potamogeton ogdenii</i>				G1	
<i>Potentilla albiflora</i>				G1	
<i>Potentilla angelliae</i>				G1	
<i>Potentilla basaltica</i>				G1	
<i>Potentilla cottamii</i>				G1	
<i>Potentilla crinita</i> var. <i>lemmonii</i>				T1	
<i>Potentilla glandulosa</i> ssp. <i>ewanii</i>				T1	
<i>Potentilla hickmanii</i>				G1	
<i>Potentilla johnstonii</i>				G1	
<i>Potentilla macounii</i>				G1	
<i>Potentilla morefieldii</i>				G1	
<i>Potentilla rhyolitica</i>				G1	
<i>Potentilla rhyolitica</i> var. <i>chiricahuensis</i>				T1	
<i>Potentilla rhyolitica</i> var. <i>rhyolitica</i>				T1	
<i>Potentilla robbinsiana</i>	1			G1	
<i>Potentilla thurberi</i> var. <i>sanguinea</i>		2		T1	
<i>Primula capillaris</i>				G1	
<i>Primula domensis</i>		1		G1	
<i>Primula maguirei</i>	1			G1	
<i>Pritchardia affinis</i>	1	9	CR	GH	
<i>Pritchardia aylmer-robinsonii</i>	1	5		T1	
<i>Pritchardia beccariana</i>		9		G1	
<i>Pritchardia forbesiana</i>		7	EN	G1	
<i>Pritchardia glabrata</i>		6		T1	
<i>Pritchardia hardyi</i>		3	CR	G1	
<i>Pritchardia hillebrandii</i>	1	13		G1	
<i>Pritchardia kaalae</i>	1	4	CR	G1	

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<i>Pritchardia lanaiensis</i>		3	EN	G1	
<i>Pritchardia lanigera</i>		3	EN	G1	
<i>Pritchardia limahuliensis</i>		2	CR	G1	
<i>Pritchardia lowreyana</i>		6	VU	G1	
<i>Pritchardia martii</i>		7		G1	
<i>Pritchardia minor</i>	1	7		G1	
<i>Pritchardia munroi</i>	2	5	CR	G1	
<i>Pritchardia napaliensis</i>	2	3		T1	
<i>Pritchardia perlmantii</i>		1	EN	G1	
<i>Pritchardia remota</i>	1	9	EN	G1	
<i>Pritchardia remota</i> ssp. <i>remota</i>				T1	
<i>Pritchardia schattaueri</i>		6	CR	G1	
<i>Pritchardia viscosa</i>	1	2	CR	G1	
<i>Pritchardia waialealeana</i>		2	VU	G1	
<i>Proboscidea spicata</i>	1			G1	
<i>Prosthechea abbreviata</i>		1			Pr
<i>Prosthechea neurosa</i>					Pr
<i>Prosthechea vagans</i>		1			Pr
<i>Prosthechea vitellina</i>		2			Pr
<i>Prunus eremophila</i>				G1	
<i>Prunus subcordata</i> var. <i>rubicunda</i>				T1	
<i>Psacaliun nanum</i>					Pr
<i>Pseudoclaplia watsonii</i>				G1	
<i>Pseudocranichis thysanochila</i>					Pr
<i>Pseudognaphalium sandwicense</i> var. <i>molokaiense</i>				T1	
<i>Pseudogoodyera wrightii</i>					Pr
<i>Pseudomitrocereus fulviceps</i>					Pr
<i>Psorothamnus polydenius</i> var. <i>jonesii</i>				T1	
<i>Psychotria grandiflora</i>	1		EN	G1	
<i>Psychotria hexandra</i> ssp. <i>oahuensis</i>	1			T1	
<i>Psychotria hobdyi</i>	1	1	EN	G1	
<i>Pteralyxia kauaiensis</i>		1	EN	G1	
<i>Pteralyxia macrocarpa</i>	1	1	VU	G1	
<i>Pteris lydgatei</i>				G1	
<i>Ptilimnium ahlesii</i>				G1	
<i>Puccinellia howellii</i>	1			G1	
<i>Puccinellia hultenii</i>				G1	
<i>Puccinellia macra</i>				G1	
<i>Puccinellia poacea</i>				G1	
<i>Puccinellia sublaevis</i>				G1	
<i>Pycnanthemum clinopodioides</i>	1	2		G1	
<i>Quercus acerifolia</i>		6	EN	G1	
<i>Quercus boyntonii</i>		7	EN	G1	
<i>Quercus dumosa</i>		9	EN	G1	
<i>Quercus dumosa</i> var. <i>dumosa</i>				T1	
<i>Quercus dumosa</i> var. <i>elegantula</i>				T1	
<i>Quercus gambelii</i> var. <i>bonina</i>				T1	
<i>Quercus graciliformis</i>	1	8	CR	G1	
<i>Quercus hinckleyi</i>			CR	G2	
<i>Quercus hintonii</i>		1	CR		
<i>Quercus parvula</i> var. <i>tamalpaisensis</i>				T1	
<i>Quercus robusta</i>			DD	G1	
<i>Quercus tardifolia</i>			CR	G1	
<i>Ranunculus aestivalis</i>	1			G1	
<i>Ranunculus coloradensis</i>				G1	
<i>Ranunculus hawaiiensis</i>				G1	
<i>Ranunculus inamoenus</i> var. <i>subaffinis</i>				T1	
<i>Reinhardtia gracilis</i>		8			Pr
<i>Remya kauaiensis</i>	1	1		G1	
<i>Remya mauiensis</i>	2			G1	
<i>Remya montgomeryi</i>	2			G1	
<i>Rhodiola integrifolia</i> ssp. <i>leedyi</i>				T1	
<i>Rhodiola integrifolia</i> ssp. <i>neomexicana</i>				T1	
<i>Rhododendron chapmanii</i>	1	21		G1	
<i>Rhododon angulatus</i>				G1	
<i>Rhynchospora californica</i>				G1	
<i>Rhynchospora culixa</i>				G1	
<i>Rhynchospora punctata</i>				G1	
<i>Rhynchospora solitaria</i>				G1	
<i>Rhynchosstele galeottiana</i>					Pr
<i>Rhynchosstele pygmaea</i>					Pr

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<i>Ribes canthariforme</i>		1		G1	
<i>Ribes echinellum</i>	1	4		G1	
<i>Robinia hispida</i> var. <i>fertilis</i>	1	5		T1	
<i>Robinia hispida</i> var. <i>kelseyi</i>		1		T1	
<i>Rodriguezia dressleriana</i>					Pr
<i>Rollandia angustifolia</i>				G1	
<i>Rollandia crispa</i>				G1	
<i>Rollandia humboldtiana</i>				G1	
<i>Rollandia longiflora</i>				G1	
<i>Rollandia purpurellifolia</i>				G1	
<i>Rollandia st.-johnii</i>				G1	
<i>Rorippa gambellii</i>				G1	
<i>Rorippa gambellii</i>	1			G1	
<i>Rorippa subumbellata</i>	2			G1	
<i>Rosa stellata</i> var. <i>erlansoniae</i>				T1	
<i>Roystonea dunlapiana</i>		1	EN		Pr
<i>Rubus adenocaulis</i>				G1	
<i>Rubus defectionis</i>				G1	
<i>Rubus densissimus</i>				G1	
<i>Rubus glaucifolius</i> var. <i>ganderi</i>				T1	
<i>Rubus hanesii</i>				G1	
<i>Rubus hypolasius</i>				G1	
<i>Rubus impar</i>				G1	
<i>Rubus inclinis</i>				G1	
<i>Rubus kelloggii</i>				G1	
<i>Rubus leucodermis</i> var. <i>bernardinus</i>		1		T1	
<i>Rubus nefrens</i>				G1	
<i>Rubus nigerrimus</i>				G1	
<i>Rubus paludivagus</i>				G1	
<i>Rubus porteri</i>				G1	
<i>Rubus prosper</i>				G1	
<i>Rubus saltuensis</i>				G1	
<i>Rubus variispinus</i>				G1	
<i>Ruellia carolinensis</i> var. <i>succulenta</i>				T1	
<i>Sabal gretheriae</i>			VU		Pr
<i>Sabal pumos</i>		3	VU		Pr
<i>Sabal uresana</i>		16	VU		Pr
<i>Sabatia arkansana</i>				G1	
<i>Sagittaria secundifolia</i>				G1	
<i>Salicornia borealis</i>				G1	
<i>Salix chlorolepis</i>		1		G1	
<i>Salix jejuna</i>		2		G1	
<i>Salix turnorii</i>				G1	
<i>Salvia columbariae</i> var. <i>ziegleri</i>				T1	
<i>Salvia manatlanensis</i>					Pr
<i>Salvia pachyphylla</i> ssp. <i>eremopictus</i>				T1	
<i>Salvia penstemonoides</i>		8		G1	
<i>Salvia pentstemonoides</i>				G1	
<i>Sanicula mariversa</i>				G1	
<i>Sanicula purpurea</i>	1			G1	
<i>Santalum freycinetianum</i> var. <i>lanaiense</i>			VU	T1	
<i>Santalum haleakalae</i>	2		VU	G1	
<i>Sarcoglottis cerina</i>					Pr
<i>Sarracenia oreophila</i>			CR	G2	
<i>Sarracenia rubra</i> ssp. <i>alabamensis</i>			CR	T1	
<i>Saurauia serrata</i>			EN		Pr
<i>Saxifraga hitchcockiana</i>				G1	
<i>Saxifraga tischii</i>				G1	
<i>Scaevola coriacea</i>	1	1		G1	
<i>Scaevola kilauaeae</i>		1		G1	
<i>Schiedea adamantis</i>	2	1	CR	G1	
<i>Schiedea apokremnos</i>		1		G1	
<i>Schiedea attenuata</i>				G1	
<i>Schiedea diffusa</i>	2			G1	
<i>Schiedea haleakalensis</i>				G1	
<i>Schiedea helleri</i>				G1	
<i>Schiedea hookeri</i>		2		G1	
<i>Schiedea jacobii</i>	2			G1	
<i>Schiedea kaalae</i>	2		CR	G1	
<i>Schiedea kauaiensis</i>		2		G1	
<i>Schiedea kealiae</i>		1		G1	
<i>Schiedea laui</i>	2			G1	

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<i>Schiedea lychnoides</i>	1		CR	G1	
<i>Schiedea lydgatei</i>	1			G1	
<i>Schiedea membranacea</i>	1	1		G1	
<i>Schiedea menziesii</i>				G1	
<i>Schiedea nuttallii</i>		1		G1	
<i>Schiedea obovata</i>	1		CR	G1	
<i>Schiedea perlmanii</i>		2		G1	
<i>Schiedea pubescens</i> var. <i>pubescens</i>				T1	
<i>Schiedea salicaria</i>	1			G1	
<i>Schiedea sarmentosa</i>				G1	
<i>Schiedea spergulina</i> var. <i>leiopoda</i>	1			T1	
<i>Schiedea stellarioides</i>		1		G1	
<i>Schiedea verticillata</i>		2		G1	
<i>Schiedea viscosa</i>	1		CR	G1	
<i>Schiedeella nagelii</i>					Pr
<i>Schizachyrium niveum</i>				G1	
<i>Schizachyrium sericatum</i>				G1	
<i>Schoenocaulon jaliscense</i>					Pr
<i>Schoenocaulon pringlei</i>					Pr
<i>Schoenocrambe argillacea</i>				G1	
<i>Schoenocrambe barnebyi</i>	1			G1	
<i>Sclerocactus blainei</i>				G1	
<i>Sclerocactus brevispinus</i>		1		G1	
<i>Sclerocactus cloveriae</i> ssp. <i>brackii</i>				T1	
<i>Sclerocactus contortus</i>				G1	
<i>Sclerocactus erectocentrus</i> var. <i>acunencis</i>				T1	
<i>Sclerocactus nyensis</i>				G1	
<i>Sclerocactus sileri</i>				G1	
<i>Scutellaria arguta</i>				G1	
<i>Scutellaria laevis</i>				G1	
<i>Sedella leiocarpa</i>				G1	
<i>Sedum eastwoodiae</i>				G1	
<i>Sedum integrifolium</i> ssp. <i>leadyi</i>	1			T1	
<i>Sedum moranii</i>	1	1		G1	
<i>Sedum obtusatum</i> ssp. <i>paradisum</i>				T1	
<i>Sedum platyphyllum</i>		1			Pr
<i>Sedum torulosum</i>		4			Pr
<i>Selaginella deflexa</i>				G1	
<i>Selenicereus atropilosus</i>		3			Pr
<i>Selinocarpus maloneanus</i>				G1	
<i>Senecio franciscanus</i>		1		G1	
<i>Senecio fremontii</i> var. <i>inexpectatus</i>				T1	
<i>Senecio musiniensis</i>				G1	
<i>Senecio quaylei</i>				G1	
<i>Senna ripleyana</i>				G1	
<i>Sessilanthra heliantha</i>					Pr
<i>Sibara filifolia</i>	1			G1	
<i>Sicyos albus</i>				G1	
<i>Sicyos cucumerinus</i>				G1	
<i>Sicyos herbstii</i>		1		G1	
<i>Sicyos lanceoloides</i>				G1	
<i>Sicyos macrophyllus</i>				G1	
<i>Sicyos maximowiczii</i>	1			G1	
<i>Sicyos waimanaloensis</i>				G1	
<i>Sida inflexa</i>				G1	
<i>Sidalcea hickmanii</i> ssp. <i>anomala</i>				T1	
<i>Sidalcea hickmanii</i> ssp. <i>napensis</i>				T1	
<i>Sidalcea hickmanii</i> ssp. <i>parishii</i>	1			T1	
<i>Sidalcea hickmanii</i> ssp. <i>pillsburiensis</i>				T1	
<i>Sidalcea keckii</i>	1			G1	
<i>Sidalcea malviflora</i> var. <i>uliginosa</i>				T1	
<i>Sidalcea oregana</i> ssp. <i>eximia</i>				T1	
<i>Sidalcea oregana</i> ssp. <i>valida</i>	1	2		T1	
<i>Sidalcea oregana</i> var. <i>calva</i>	1			T1	
<i>Sidalcea pedata</i>	1			G1	
<i>Sidalcea stipularis</i>	1	2		G1	
<i>Sideroxylon alachuense</i>		1		G1	
<i>Sideroxylon reclinatatum</i> ssp. <i>austrofloridense</i>				T1	
<i>Sigmatostalix mexicana</i>					Pr
<i>Silene alexandri</i>	2	1		G1	
<i>Silene douglasii</i> var. <i>oraria</i>	1			T1	
<i>Silene lanceolata</i>	2			G1	

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<i>Silene nuda</i> ssp. <i>nuda</i>				T1	
<i>Silene parishii</i> var. <i>parishii</i>				T1	
<i>Silene perlmanii</i>	3	2		G1	
<i>Silene petersonii</i> var. <i>minor</i>				T1	
<i>Silene rectiramea</i>				G1	
<i>Silene salmonacea</i>				G1	
<i>Silene virginica</i> var. <i>robusta</i>				T1	
<i>Silphium perplexum</i>				G1	
<i>Sloanea terniflora</i>					Pr
<i>Smelowskia johnsonii</i>				G1	
<i>Smelowskia ovalis</i> var. <i>congesta</i>				T1	
<i>Sobralia lindleyana</i>		2			Pr
<i>Sobralia mucronata</i>					Pr
<i>Solanum bahamense</i> var. <i>luxurians</i>				T1	
<i>Solanum carolinense</i> var. <i>hirsutum</i>				T1	
<i>Solanum incompletum</i>		1		G1	
<i>Solanum leptosepalum</i>				G1	
<i>Solanum sandwicense</i>	2	3		G1	
<i>Solanum xanti</i> var. <i>montanum</i>				T1	
<i>Solidago canadensis</i> var. <i>bartramiana</i>				T1	
<i>Solidago plumosa</i>	1	1		G1	
<i>Solidago shortii</i>	2	2		G1	
<i>Solidago simplex</i> var. <i>chlorolepis</i>				T1	
<i>Solidago spithamea</i>	1			G1	
<i>Solidago victorinii</i>				G1	
<i>Solidago villosicarpa</i>	1			G1	
<i>Sophora gypsophila</i>				G1	
<i>Sophora gypsophila</i> var. <i>guadalupensis</i>				T1	
<i>Sphaeralcea gierischii</i>				G1	
<i>Sphaeralcea grossulariifolia</i> var. <i>fumariensis</i>				T1	
<i>Sphaeralcea janeae</i>				G1	
<i>Sphaeralcea rusbyi</i> ssp. <i>eremicola</i>				T1	
<i>Sphaeropteris horrida</i>		2			Pr
<i>Spigelia gentianoides</i>	2	1		G1	
<i>Spigelia gentianoides</i> var. <i>alabamensis</i>		1		T1	
<i>Spigelia gentianoides</i> var. <i>gentianoides</i>		1		T1	
<i>Spiranthes amesiana</i>				G1	
<i>Spiranthes brevilabris</i>				G1	
<i>Spiranthes brevilabris</i> var. <i>brevilabris</i>				T1	
<i>Spiranthes brevilabris</i> var. <i>floridana</i>				T1	
<i>Spiranthes delitescens</i>	1			G1	
<i>Spiranthes infernalis</i>				G1	
<i>Spiranthes lanceolata</i> var. <i>paludicola</i>				T1	
<i>Stanfordia californica</i>				G1	
<i>Stanleya confertiflora</i>	1			G1	
<i>Stanleya pinnata</i> var. <i>texana</i>				T1	
<i>Stelis chihobensis</i>					Pr
<i>Stellaria oxyphylla</i>				G1	
<i>Stellaria porsildii</i>				G1	
<i>Stenandrium dulce</i> var. <i>floridanum</i>				T1	
<i>Stenanthium diffusum</i>				G1	
<i>Stenocactus coptonogonus</i>		8			Pr
<i>Stenocactus sulphureus</i>		1			Pr
<i>Stenocereus martinezii</i>		4			Pr
<i>Stenogyne bifida</i>	1	1		G1	
<i>Stenogyne calycosa</i>				G1	
<i>Stenogyne campanulata</i>		1		G1	
<i>Stenogyne cranwelliae</i>		1		G1	
<i>Stenogyne kealiae</i>		1		G1	
<i>Stephanomeria malheurensis</i>	1			G1	
<i>Stephanomeria minor</i> var. <i>uintaensis</i>				T1	
<i>Stevia cruzii</i>					Pr
<i>Streptanthus albidus</i> ssp. <i>albidus</i>	1			T1	
<i>Streptanthus batrachopus</i>				G1	
<i>Streptanthus brachiatus</i> ssp. <i>brachiatus</i>				T1	
<i>Streptanthus brachiatus</i> ssp. <i>hoffmanii</i>				T1	
<i>Streptanthus callistus</i>				G1	
<i>Streptanthus cordatus</i> var. <i>piutensis</i>				T1	
<i>Streptanthus glandulosus</i> var. <i>pulchellus</i>	1			T1	
<i>Streptanthus hispidus</i>				G1	
<i>Streptanthus insignis</i> ssp. <i>lyonii</i>				T1	
<i>Streptanthus morrisonii</i> ssp. <i>hirtiflorus</i>				T1	

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<i>Streptanthus morrisonii</i> ssp. <i>kruckebergii</i>				T1	
<i>Streptanthus niger</i>	1			G1	
<i>Streptanthus oblancoolatus</i>				G1	
<i>Streptanthus vernalis</i>				G1	
<i>Stylocline masonii</i>				G1	
<i>Styrax platanifolius</i> ssp. <i>texanus</i>				T1	
<i>Styrax platanifolius</i> ssp. <i>youngiae</i>				T1	
<i>Styrax texanus</i>	1			T1	
<i>Styrax youngiae</i>		2		T1	
<i>Suaeda californica</i>				G1	
<i>Suaeda rolandii</i>				G1	
<i>Swallenia alexandrae</i>	1			G1	
<i>Symphotrichum nahanniense</i>				G1	
<i>Symphotrichum rhiannon</i>				G1	
<i>Symphotrichum subulatum</i> var. <i>obtusifolius</i>				T1	
<i>Symplocos austromexicana</i>					Pr
<i>Symplocos coccinea</i>			VU		Pr
<i>Symplocos excelsa</i>					Pr
<i>Symplocos sousae</i>					Pr
<i>Talinum gooddingii</i>				G1	
<i>Talinum thompsonii</i>				G1	
<i>Tauschia bicolor</i>					Pr
<i>Tauschia howellii</i>	1			G1	
<i>Tauschia tarahumara</i>					Pr
<i>Taxus floridana</i>			CR	G2	
<i>Taxus globosa</i>		7			Pr
<i>Tephrosia angustissima</i>				G1	
<i>Tephrosia angustissima</i> var. <i>corallicola</i>		1		T1	
<i>Tephrosia angustissima</i> var. <i>curtissii</i>				T1	
<i>Tetracoccus ilicifolius</i>				G1	
<i>Tetramolopium arenarium</i>	1			G1	
<i>Tetramolopium arenarium</i> var. <i>arenarium</i>				T1	
<i>Tetramolopium capillare</i>	1			G1	
<i>Tetramolopium consanguineum</i>				G1	
<i>Tetramolopium consanguineum</i> var. <i>leptophyllum</i>				T1	
<i>Tetramolopium filiforme</i>		1		G1	
<i>Tetramolopium filiforme</i> var. <i>filiforme</i>				T1	
<i>Tetramolopium filiforme</i> var. <i>polyphyllum</i>				T1	
<i>Tetramolopium humile</i> var. <i>sublaeve</i>				T1	
<i>Tetramolopium lepidotum</i>				G1	
<i>Tetramolopium lepidotum</i> ssp. <i>lepidotum</i>	2			T1	
<i>Tetramolopium remyi</i>	1	1		G1	
<i>Tetramolopium rockii</i>	1			G1	
<i>Tetramolopium rockii</i> var. <i>calcisabulorum</i>				T1	
<i>Tetramolopium rockii</i> var. <i>rockii</i>				T1	
<i>Tetramolopium sylvae</i>				G1	
<i>Tetraneuris acaulis</i> var. <i>nana</i>				T1	
<i>Tetraneuris verdiensis</i>				G1	
<i>Tetraplasandra bisattenuata</i>	1			G1	
<i>Tetraplasandra flynnii</i>	1	1		G1	
<i>Tetraplasandra gymnocarpa</i>			CR	G1	
<i>Teuscheria pickiana</i>					Pr
<i>Thelesperma caespitosum</i>				G1	
<i>Thelesperma pubescens</i>	1			G1	
<i>Thelocactus bicolor</i> var. <i>schwarzii</i>		2			Pr
<i>Thelocactus conothelos</i> var. <i>flavus</i>					Pr
<i>Thelocactus conothelos</i> ssp. <i>argenteus</i>		2	CR		
<i>Thelypodopsis ambigua</i> var. <i>erecta</i>				T1	
<i>Thelypodium howellii</i> var. <i>spectabilis</i>	1			T1	
<i>Thelypodium stenopetalum</i>	1			G1	
<i>Thelypodium tenue</i>				G1	
<i>Thelypteris boydlae</i>				G1	
<i>Thelypteris pilosa</i> var. <i>alabamensis</i>				T1	
<i>Thelypteris wallele</i>				G1	
<i>Thermopsis macrophylla</i>		1		G1	
<i>Thlaspi californicum</i>				G1	
<i>Thysanocarpus conchuliferus</i>	1			G1	
<i>Tigridia bicolor</i>					Pr
<i>Tigridia flammea</i>					Pr
<i>Tigridia hintonii</i>					Pr
<i>Tigridia huajuapensis</i>					Pr

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<i>Tigridia inusitata</i>					Pr
<i>Tigridia orthantha</i>		1			Pr
<i>Tillandsia festucoides</i>		4			Pr
<i>Tonestus graniticus</i>				G1	
<i>Tonestus kingii</i> var. <i>barnebyana</i>				T1	
<i>Torreya taxifolia</i>		20	CR	G1	
<i>Townsendia microcephala</i>				G1	
<i>Townsendia smithii</i>				G1	
<i>Tracyina rostrata</i>				G1	
<i>Tradescantia leiandra</i> var. <i>glandulosa</i>				T1	
<i>Trematolobelia singularis</i>	2			G1	
<i>Trichocentron flavovirens</i>					Pr
<i>Trichocentron hoegei</i>					Pr
<i>Trichomanes punctatum</i> ssp. <i>floridanum</i>	2	1		T1	
<i>Trichosalpinx cedralensis</i>					Pr
<i>Trichostema austrorontanum</i> ssp. <i>compactum</i>	1			T1	
<i>Trichostema suffrutescens</i>		1		G1	
<i>Trifolium amoenum</i>	1	1		G1	
<i>Trifolium andinum</i> var. <i>podocephalum</i>				T1	
<i>Trifolium barnebyi</i>		2		G1	
<i>Trifolium buckwestiorum</i>	1			G1	
<i>Trifolium calcaricum</i>	1			G1	
<i>Trifolium friscanum</i>				G1	
<i>Trifolium jokerstii</i>	1			G1	
<i>Trifolium trichocalyx</i>	1			G1	
<i>Trillium persistens</i>	1	1		G1	
<i>Triphora craigheadii</i>				G1	
<i>Triphora latifolia</i>				G1	
<i>Triphora trianthophora</i> var. <i>texensis</i>				T1	
<i>Triphora yucatanensis</i>				G1	
<i>Tripsacum zopilotense</i>					Pr
<i>Triteleia clementina</i>	1	1		G1	
<i>Tropidocarpum californicum</i>				G1	
<i>Tropidocarpum capparideum</i>	1			G1	
<i>Tuctoria mucronata</i>	1			G1	
<i>Turbincarpus alonsoi</i>		2	CR		
<i>Turbincarpus beguinii</i>		6			Pr
<i>Turbincarpus gielsdortianus</i>	1	6	CR		P
<i>Turbincarpus hoferi</i>			CR		A
<i>Turbincarpus laui</i>		7	VU		Pr
<i>Turbincarpus lophophoroides</i>	1	6	VU		Pr
<i>Turbincarpus mandragora</i>			CR		A
<i>Turbincarpus pseudomacrolele</i> ssp. <i>lausseri</i>			CR		
<i>Turbincarpus pseudopectinatus</i>		5	VU		Pr
<i>Turbincarpus saueri</i> ssp. <i>knuthianus</i>		1			Pr
<i>Turbincarpus saueri</i> ssp. <i>nelissae</i>		1	CR		
<i>Turbincarpus saueri</i> ssp. <i>saueri</i>			CR		
<i>Turbincarpus schmiedickeanus</i> ssp. <i>andersonii</i>		1	CR		P
<i>Turbincarpus schmiedickeanus</i> ssp. <i>dicksoniae</i>	1	3	CR		
<i>Turbincarpus schmiedickeanus</i> ssp. <i>gracilis</i>	1	2	CR		P
<i>Turbincarpus schmiedickeanus</i> ssp. <i>jauernigii</i>			CR		
<i>Turbincarpus schmiedickeanus</i> ssp. <i>klinkerianus</i>	1	4			Pr
<i>Turbincarpus schmiedickeanus</i> ssp. <i>rioverdensis</i>			CR		P
<i>Turbincarpus schmiedickeanus</i> ssp. <i>schmiedickeanus</i>		2	CR		A

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<i>Turbincarpus schmiedickeanus</i> var. <i>flaviflorus</i>	1	5	CR		A
<i>Turbincarpus schmiedickeanus</i> var. <i>schwarzii</i>		9	CR		A
<i>Turbincarpus subterraneus</i> ssp. <i>booleanus</i>			CR		
<i>Turbincarpus swoboda</i>	1	5	CR		A
<i>Turbincarpus valdezius</i>	1	5	VU		Pr
<i>Turbincarpus viereckii</i> ssp. <i>major</i>	1	3			Pr
<i>Urera kaalae</i>	2	1	CR	G1	
<i>Vaccinium sempervirens</i>	1			T1	
<i>Valeriana pratensis</i>					Pr
<i>Vallesia spectabilis</i>					Pr
<i>Vanilla planifolia</i>		38			Pr
<i>Vanroyenella plumosa</i>					Pr
<i>Vauquelinia californica</i> ssp. <i>sonorensis</i>		1		T1	
<i>Viburnum bracteatum</i>		19		G1	
<i>Vicia menziesii</i>	1			G1	
<i>Vicia ocalensis</i>	1			G1	
<i>Vigna owahuensis</i>				G1	
<i>Viola chamissoniana</i> ssp. <i>chamissoniana</i>	1			T1	
<i>Viola clauseniana</i>				G1	
<i>Viola frank-smithii</i>				G1	
<i>Viola guadalupensis</i>				G1	
<i>Viola helenae</i>	2			G1	
<i>Viola kauaensis</i> var. <i>wahiawaensis</i>				T1	
<i>Viola lanaiensis</i>	1			G1	
<i>Viola lithion</i>				G1	
<i>Viola oahuensis</i>				G1	
<i>Warea amplexifolia</i>	1			G1	
<i>Wikstroemia bicornuta</i>			EN	G1	
<i>Wikstroemia uva-ursi</i> var. <i>kauaiensis</i>		1		T1	
<i>Wilkesia hobbii</i>		1		G1	
<i>Wissadula parvifolia</i>				G1	
<i>Xylorhiza cronquistii</i>				G1	
<i>Xylorhiza glabruscula</i> var. <i>linearifolia</i>				T1	
<i>Xylosma crenata</i>	1	1		G1	
<i>Xyris isoetifolia</i>	1			G1	
<i>Xyris panacea</i>		1		G1	
<i>Xyris spathifolia</i>		2		G1	
<i>Yermo xanthocephalus</i>	1			G1	
<i>Yucca cernua</i>		2		G1	
<i>Yucca endlichiana</i>	1	9			Pr
<i>Yucca grandiflora</i>	1	6			Pr
<i>Yucca harrimaniae</i> var. <i>sterilis</i>		1		T1	
<i>Yucca necopina</i>	1			G1	
<i>Yucca queretaroensis</i>		2			Pr
<i>Zamia herrerae</i>		5	VU		Pr
<i>Zamia inermis</i>		12	CR		P
<i>Zamia paucijuga</i>		5			Pr
<i>Zamia picta</i>		4	CR		
<i>Zamia polymorpha</i>		7			Pr
<i>Zamia spartea</i>		6	CR		P
<i>Zamia variegata</i>		6	EN		Pr
<i>Zamia vazquezii</i>		8	CR		P
<i>Zanthoxylum dipetalum</i> var. <i>tomentosum</i>	1		CR	T1	
<i>Zanthoxylum hawaiiense</i>			EN	G1	
<i>Zanthoxylum oahuense</i>	1		VU	G1	
<i>Zinnia citrea</i>					Pr
<i>Zizania texana</i>				G1	
<i>Ziziphus celata</i>	2	1	VU	G1	



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