University of Washington Botanic Gardens

Conservation in the City

An Assessment of the UWBG Collection at the WPA

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Abstract

In the face of continued habitat alteration and loss of species, *ex situ* conservation efforts are being reframed as more than just supporting acts to *in situ* projects. Botanic gardens in particular have emerged as significant resources for *ex situ* conservation. The University of Washington Botanic Gardens (UWBG) maintains a collection of woody plants at the Washington Park Arboretum (WPA). The UWBG's Conservation Policy indicates that inventory and assessment of their plants of global conservation concern is to be conducted every 5 years, and yet this work has not been done since 2001. Goals of the 2012 assessment included: Identifying conservation species within the collection; noting the most recent available conservation category, criteria, and taxonomy for each species within the database; performing field checks of the individual plants to confirm health, location, and proper labeling; and a brief analysis of the updated collection. As expected, the number of species in the conservation collection has grown dramatically since 2001. This work has helped give an identity to the collection, and has clarified processes and resources to help manage the collection and make future assessments easier.

Conservation and Plant Rarity

"Conservation" is a term heard so frequently that it is nearly a buzzword in some circles, in danger of becoming stripped of its meaning. Many people may not realize the extent that some plant and animal species need protection, given the many tough survivalists we see in the natural world every day. In other circles, individuals may feel that so much damage has already been done that efforts to save species are too little, too

late. There is also a danger of simple misunderstanding, as individuals may interpret the phrase "survival of the fittest" to mean that loss of species is a foregone conclusion. In order to fully understand conservation, one must know the drivers of conservation needs, as well as the goals that activists have set for their efforts. The inherent rarity of certain plant species and current trajectories of habitat modification, both independently and combined, drive the need for conservation action. Goals of conservation remain simple, and are perhaps best described by the very definition of the word, according to the Oxford English Dictionary: "The action of keeping from harm, decay, loss, or waste; careful preservation" and includes "The preservation of existing conditions, institutions, rights, etc." (OED 1993). Ultimately, conservation hopes to prevent the extinction of species and preserve as much biodiversity as possible.

In some ways, understanding that many plants are rare may be difficult. After all, there are many weedy and invasive species that are so pervasive that making a dent in their populations seems impossible. Yet, many plant species are rare due to biological and environmental limitations to their population growth. Examples of biological limitations are the age at which an individual plant is able to reproduce and dependence upon the presence of certain pollinators or seed dispersal agents, and impact plant rarity by increasing the risk that reproduction and regeneration will be hindered or unsuccessful. Environmental limitations may be geological, climatic, or due to the edaphic factors present in the soil that allow a plant to grow and thrive.

Plant rarity may also be misunderstood because of the presence in cultivation of rare species, primarily through their hybrids and cultivars. Many species have desirable traits for gardeners, such as interesting bark, pleasing form, exotic flowers, or evergreen

leaves. An example of a familiar horticultural specimen plant is *Acer palmatum*, which is particularly well known for its wide range of leaf traits, which result in several hundred distinct cultivars (Royal Horticultural Society 2012). Although not yet considered globally threatened due to its large range across Japan, eastern China, Taiwan, and Korea, this species is considered to be vulnerable in China (Gibbs 2009). Other rare species with cultivars seen in ornamental horticulture include *Sequoia sempervirens* and *Arctostaphylos densiflora*.

There are many reasons for plants to be threatened. Some plants, such as *Acer buergerianum* var. *formosanum* (critically endangered), are removed whole from their habitat for ornamental use (Gibbs 2009). Many plants, such as various *Rhododendron* species, live in forested areas where they become collateral damage during the logging and removal of other species (Gibbs 2011). Species in rural areas may be exploited for firewood, as in the case of *Acer pentaphyllum* (critically endangered) (Gibbs 2009). Other uses may strike a species at a vulnerable point, as happens with *Magnolia amoena* (vulnerable) in Asia, where the flower buds are removed for medicinal purposes and thus regeneration of the plant is hampered (Cicuzza 2007). Some species are simply threatened due to their slow growth and time to reproductive maturity combined with loss of habitat to cultivation, such as *Metasequoia glyptostroboides* (critically endangered), the very recognizable dawn redwood of China (IUCN 2012). In addition to human impacts of removal of species, the introduction of predators and disease via human pathways has also placed some species under threat. In North America, *Chamaecyparis lawsoniana* (vulnerable) has been affected by the introduction of *Phytophthora lateralis* into wild areas (IUCN 2012). Lastly, even indirect impacts of human activity can affect

sensitive species; air pollution has impacted *Quercus dumosa* (endangered), and grazing pressure has slowed the regeneration of many oak species, including *Quercus alnifolia* (vulnerable) (Oldfield 2007).

Remembering that species rarely occur in isolation, but are part of communities, is highly important to understanding plant rarity and the impacts of habitat alteration. Plant communities are full of coevolved species, from the plants themselves to fungi, bacteria, insects, and higher animals. Such intricacy describes a system in which changes to one species may ripple outward, affecting the entire community. In the natural world, as in the human one, change is one of the few constants. Change can often be viewed as a good thing, an agent that drives adaptation, creating opportunities for both existing and new species alike. One of the greatest challenges in today's world, however, has been how human activity has modified and accelerated the scale of change more than ever before. Humans have continued to push into new areas in the search for and harvesting of natural resources. Our global economy combined with the speed and ease of travel has facilitated the introductions of new species. Finally, the climate of the world is warming. While this is not a novel occurrence, the speed at which the climate is changing, combined with the rates at which habitats are being altered or destroyed, is creating an unprecedented situation for many fragile species. In light of these events, conservation action attempts to slow the loss of habitats, communities, and species.

While there are many possible specific actions, conservation is generally broken down into two classifications: *in situ*, wherein species are preserved in their natural settings, and *ex situ*, wherein species are maintained outside of their native range. *In situ* conservation efforts are considered to be the most important in preserving species, with

ex situ strategies playing a complementary but growing role (Pritchard 2010). Continued habitat loss and alteration, as well as the visible effects of global climate change, has heightened the importance of *ex situ* conservation for plant species has grown. There are two primary *ex situ* methods of plant conservation, seed banking and living collections. In seed banking, seeds from wild plants are collected and maintained for future planting. Seed banking helps preserve genetic diversity because seeds are the product of sexual reproduction, as opposed to the taking of cuttings or other vegetative propagation methods which simply create clones of the mother plant. Seed banking is also a useful tool for conservation because the seeds of many plants are stable, large numbers can be stored in a relatively small space, and under proper conditions may be stored almost indefinitely (BGCI 2012). Cultivation of individual plants in managed areas outside of their native habitat is another *ex situ* tactic. Generally, this refers to the maintenance of individual plants in collections through botanic gardens and arboreta. This form of conservation allows not only for species to be grown, but provides an opportunity for research and public education about conservation, ecology, and the myriad of ways in which plants enhance and impact human lives.

Ex situ conservation has taken a role of greater importance just within the past few years. Botanic Gardens Conservation International (BGCI), a leading plant conservation group, reevaluated the importance of *ex situ* conservation in 2010, eight years after adoption of the Biodiversity Target by the Convention on Biological Diversity (CBD). The Target intended to reduce the loss of biodiversity by 2010, and complemented Target 8 of the Global Strategy for Plant Conservation (GSPC): that 60 per cent of globally threatened plants would be held in *ex situ* collections. By 2010

assessments, there had not been a slowing in the loss of biodiversity since 2002, and 40% of threatened plant species were identified as being held *ex situ* (Oldfield 2010). This created a turning point for a change in attitude about the value of *in situ* and *ex situ* conservation. Writing for BGCI, Diana Pritchard states that in 1992, the Earth Summit in Rio designated *in situ* efforts as "the legal and institutional priority". By, 2010, however, the reality of high extinction rates combined with newer and more sophisticated climate change modeling capabilities to make it clear that even protected areas would not remain immune to alteration. Meanwhile, participants in *ex situ* conservation embraced their new role in conservation by changing collection strategies from exotic species to ones with conservation value. Pritchard concludes:

> If the conservation mission is to be coupled successfully, as it should be, with the pressing issues of wider global agendas including the need to secure food security, human health and even human survival, *ex situ* strategies can no longer be regarded as mere support mechanisms for *in situ* conservation but rather as a crucial means in themselves to fulfil [sic] a wider and integrated mission to preserve global biodiversity (Pritchard 2010).

In the end, the imperatives prescribed within the definition of "conservation" have never been more critically needed. Rare plants are under more pressures than ever, from the internal pressures of their own biology to accelerated change across the globe. Having a solid understanding of these circumstances helps to frame the vital role that botanic gardens are now performing in *ex situ* conservation efforts.

The Washington Park Arboretum (WPA)

The Washington Park Arboretum's 230 acres are located within the city of Seattle, Washington, sandwiched between the gated development of Broadmoor along the shores of Lake Washington to the east and the urban neighborhood of Montlake to the

west. The WPA's southern boundary is at the intersection of Madison Avenue and Lake Washington Boulevard; the northern boundary is the Union Bay arm of Lake Washington. The majority of the WPA is closed to auto traffic, but the heavily-used Lake Washington Boulevard winds through the grounds at a rough parallel to the boundary, about 200-300 yards to the west. At the northern end, E. Foster Island Road, a Parks Department road, separates Foster Island from the main WPA property, and allows traffic in to the Graham Visitor Center as well as to Broadmoor. The WPA encompasses a wide range of terrain, from hillsides and knolls to creekbeds, valleys, and glens. Foster Island contains open woodland and wetland areas. The climate of the Pacific Northwest, the microclimate of the WPA's location, and the topography within the park allow for a great variety of plants from temperate zones around the world to be grown successfully here.

The role of the WPA at the University has changed over time, from a working laboratory for forestry students to an outdoor classroom hosting hydrology, landscape architecture, restoration, and botany students. When the WPA was designed, arboreta were considered to be living museums, with specimens organized distinctly by taxa (Boyle 2003). Today, the WPA has seven core collections, which all rank in the top five in number of taxa holdings of North American peer institutions. These consist of maples (*Acer*), hollies (*Ilex*), pines and their kin (*Abies, Picea,* and *Pinus*), magnolias (*Magnolia*), mountain ashes (*Sorbus*), oaks (*Quercus*), and viburnums (*Viburnum*). The WPA also has extensive holdings of other, "minor" collections that are not considered among the core, including *Camellia* and *Rhododendron* (Zuckerman pers. comm.). Visitors to the WPA today are more likely to have a garden experience than a museum

one, as they meander through the areas known as Rhododendron Glen (home not just to rhododendrons but specimens of *Metasequoia, Sequoia*, and *Camellia*) or the Woodland Garden (home to *Acer* and *Magnolia* specimens as well as a *Glyptostrobus lineatus*). While one may still see vestiges of the original design in areas with discrete genera (e.g., the Brian O. Mulligan Mountain Ash Collection), newer garden plantings such as the New Zealand Gateway Garden display plant communities in an ecologically correct fashion. The educational value of such plantings is multi-faceted; the public sees not only attractive plants that will grow well in the region, but is exposed to the variety and complexity of plant communities in other temperate parts of the world.

The WPA was created in an agreement made in 1934 between the city of Seattle and the University of Washington. In this arrangement, the city would continue to own the property heretofore known as Washington Park, and the University would own the trees and shrubs selected to create its collections. While the idea of an arboretum was not new, at the time there were few arboreta in the United States. The University, and specifically the College of Forest Resources, desired a collection of woody species for research and study; the city was interested in creating a new destination that would equal the popular success of the Arnold Arboretum at Harvard (Boyle 2003). In 1976 the Center for Urban Horticulture (CUH) was created to administer the research purposes of the Arboretum, as well as to house a horticultural library (the Elisabeth C. Miller Library) and herbarium (the Otis Douglas Hyde Herbarium). Together, the many programs and gardens of the CUH and the WPA are known as the University of Washington Botanic Gardens (UWBG), a part of the School of Environmental and Forest Sciences.

The mission statement of UWBG is *"Sustaining natural to managed ecosystems and the human spirit through plant research, display, and education"*. This mission statement creates an imperative for the UWBG to be an active participant in conservation of rare and threatened species, both *in* and *ex situ*. In 2009, UWBG adopted a conservation policy that defines conservation goals and directs conservation practices. Modeled in part after the North American Botanic Garden Strategy for Plant Conservation, the conservation policy has four primary objectives: 1) To foster understanding of plant diversity; 2) to conserve plant diversity; 3) to promote public awareness about plant diversity through research, display, and education; and 4) to build capacity for conservation of plant diversity. Strategies to attain these goals, specifically regarding the WPA, include: Provide an annually updated plant list for the species at the WPA; perform a physical inventory of the collection for IUCN-listed plants every 5 years; curate the many regional threatened, endangered, and culturally important species in the both WPA's accessioned collection as well as the native plant matrix; provide educational opportunities for the public both through workshops and lectures, and youth programs aimed to instill a conservation ethic in school-age children; provide live materials for researchers working in conservation; and focus on conserving and collecting plants with historic or cultural significance.

Many of these strategies are ongoing, built into the continual evolution of the WPA. For example, the WPA participates in the Oak and Maple multisite collections administered by the North American Plant Collections Consortium (NAPCC), with an application for Magnolias pending, andhas a NAPCC-recognized collection of hollies that predates the multisite paradigm. The 5-year inventory of conservation plants,

however, is a goal that has not been achieved since 2001. While mandated by UWBG conservation and collections policies, budget constraints, limited staff, and reorganization have prevented the inventory from being completed on schedule. From the UWBG perspective, the inventory is important because the knowledge of the conservation collection will help guide curation, research, and educational efforts. From a wider standpoint, the collection is important as botanic gardens as a whole begin to manage their collections in cooperation with each other, through membership in BGCI, the Center for Plant Conservation (CPC), and participation in the aforementioned NAPCC multisite collections. By knowing which species are well-represented in *ex situ* collections, conservation organizations will be better able to address which species need further *ex situ* conservation attention as well as *in situ* protections.

Inventory of the collection is comprised of several parts. First, species of conservation concern are identified by checking the contents of the collection against recognized authorities in globally threatened species. In this phase of the work, not only are new species added, but species that had already been identified with conservation concern are reviewed as well for current threat rankings. Also at this time, a nomenclatural review is performed for each plant, verifying that the database name on record is still taxonomically correct. After the Conservation Collection at the WPA has been identified and noted in the computer, field checks are performed. These checks accomplish several purposes: To verify the location of the plant, review it with a horticultural eye for general health and appearance, and make sure that the specimen is properly labeled and correctly identified. The field check information is then entered into

the plant records database; with these updates, an analysis of the Collection can be performed.

Sources and Materials

The International Union for the Conservation of Nature (IUCN) is the recognized global authority on conservation, and produces a Red List of globally threatened species. A key component of the Red List is the use of clearly delineated criteria to assign a threat ranking to a given species. The 8 potential conservation ranking categories in order of escalation are: Least Concern (LC), Near Threatened (NT), Data Deficient (DD), Vulnerable (VU), Endangered (EN), Critically Endangered (CR), Extinct in the Wild (EW), and Extinct (EX). A Least Concerned rating means that the taxon has been evaluated but there is no conclusion of risk. Near Threatened taxa are considered to be close to qualifying as Vulnerable, and in some cases may be Red Listed in an individual country while being Vulnerable globally. An example of a Near Threatened species is *Quercus polymorpha*, which has a wide distribution area from Texas through Mesoamerica, but is considered to be Vulnerable in Guatemala due to habitat fragmentation in that country (Oldfield 2007). Plants ranked as Vulnerable or higher on the IUCN Red List are considered to be globally threatened. Data deficient is a ranking that is granted when it is believed that a species does qualify as Vulnerable but a lack of data prevents a more accurately designated threat level. An example is *Acer sikkimense*, which is considered to be Vulnerable in China, but is also found in other countries (Bhutan, India, Viet Nam, and Myanmar) where details of its conservation status are unknown as of the latest Red List publication (Gibbs 2009).

When a species has a Red List entry, a category abbreviation will appear after its name, followed by the criteria used to declare the ranking, and the version of criteria used at the time of the listing (e.g., *Quercus boyntonii*, EN B1+2c ver 2.3). At the present time, there are two versions of criteria present in the Red List, version 2.3 (1994), and version 3.1 (2001). The version of criteria given as support for a species' ranking indicates the last time the species was assessed, although the detailed species record entered on the Red List will also state the last time the species was surveyed. (The defined categories and criteria for versions 2.3 and 3.1 are excerpted as Appendices C and D, respectively.)

The Red List was formerly a publication known as the Red Book, which was the reference used for the last conservation assessment in 2001. Now, however, the information is available on the internet, and it is possible to run a search and save the file for importation into an Excel spreadsheet. Access to and use of the Red List is free, although to save and export searches one must register and state the intent of use with the information from the list. For this assessment, a search was run for all plants on the Red List on January 21, 2012. This Red List was the master list for identification of species of conservation concern within the WPA collections.

The IUCN is not the only organization that provides conservation information. BGCI has published their own Red List for each of a select group of plants: Magnolias (2007), Maples (2009), Oaks (2007), Rhododendrons (2011) and Trees of Central Asia (2009), with a publication on Hydrangeas planned next. The information in these publications comes from in-depth surveys on these taxa in their native habitat, and provides extensive information on a species' known range, threats, and taxonomic status

if applicable. Conveniently, the BGCI works in conjunction with the IUCN and uses the latter's criteria and threat ranking system. For these reasons, the BGCI references are invaluable for use in identifying species at the WPA that are of conservation concern.

The last reference used for identifying conservation species at the WPA comes from NatureServe. This reference is of limited value because only North American native plants are addressed, and NatureServe has its own ranking for threat level. Despite this, NatureServe was consulted in a few instances where North American native plants were identified in 2001 as of conservation concern, and yet did not appear in current IUCN or BGCI publications. Current NatureServe rankings were also updated in the plant records database, so that all known conservation information is available for these species.

The information provided by these three organizations was matched against the software used by UWBG to manage its collections, known as BG-BASE. BG-BASE is the industry standard for collection accession management and contains the complete records of all living and nonliving taxa at the UWBG. BG-BASE was queried on all living taxa on December 12, 2011 to create the master list to cross-reference against the IUCN Red List. The work during this phase of the project was completed in collaboration with Plant Records at UWBG, so any newly accessioned taxa were promptly added to the master list, and thus did not slip through the inventory.

In addition to the inventory portion of the assessment, a quick nomenclatural review was performed for each identified species. While there are several options available for vetting species names and naming authorities, the one selected for use in this assessment was Tropicos, provided by Missouri Botanical Garden. Already a

favorite resource of UWBG Plant Records, Tropicos is available online and is very simple to use. While not exhaustive, the records are extensive and fairly up-to-date. Tropicos provides not only naming authority and publication history of species, but also gives synonyms of accepted names when appropriate, and occasionally has updated IUCN conservation information as well. Cross-referencing names through Tropicos accomplishes two important goals. First, it provides additional certainty that species names in BG-BASE are the currently accepted proper names, so the conservation collection holdings can be clearly understood by UWBG along with any institutions with whom information is shared. Second, the work serves to catch any species that may have had their names changed since the last assessment, in case such a name change results in their not appearing on a conservation list at the present time.

Methods I: Inventory

The inventory portion of the assessment was completed using the references provided from the IUCN, BGCI, and NatureServe, cross-referenced against the master list of the UWBG living collection from BG-BASE. The IUCN Red List and BG-BASE master list were compared line-by-line in Excel. The files were reviewed three times to ensure thoroughness and accuracy. As the lists were reviewed, species that were present on both lists were highlighted in both files. The importation of the IUCN Red List created an Excel file that would not allow modification, and the BG-BASE master list contained information that was critical for later locating records in the database. In this way, when plant records were updated with conservation status in the database later on,

the IUCN criteria information could be pulled from the Red List file, while the actual specimen information for the plant could be pulled from the BG-BASE file.

The BGCI publications were reviewed in a similar manner, although their Red Lists are published in booklet forms (downloaded as PDF files for computer use). Lastly, when there were several North American native species that were formerly identified as of conservation concern but did not currently appear on either the IUCN or BGCI Red List, they were searched individually on NatureServe's web site for that institution's information.

When the UWBG conservation species had been identified, the plant records were updated in BG-BASE with the most recent available threat category and criteria. At the same time, each species name record in BG-BASE was cross-checked against the Tropicos database for nomenclature discrepancies. Once the records were completely updated, a query was run to pull out all living taxa with any text in the conservation module of their record. In this manner, a list was generated of all the conservation plants within the BG-BASE records. The query was structured to provide not just species names but each individual plant record with conservation status. This generated a list of individual plants at the WPA. Along with the names of individual plants, the query provided their locations on the existing grid maps, the category and criteria provided by the IUCN, and a notation of the condition of the plant at the most recent field check. Finally, this information was imported into a standardized plant inventory template in Excel. This provided us with the sheets necessary to perform the next step of the assessment—the field checks.

Methods II: Field Checks

Field checks are an important stage in the inventory from both records and horticultural perspectives. Checks on individual plants in the field determine that the information recorded in BG-BASE and on the drawn grid maps is accurate. In addition the plants were reviewed with a horticultural eye to general appearance and health. Notations were made about conditions such as form, structure, health of the canopy, presence or absence of mulch rings, and appropriateness of the planting site (too close to neighbors, too shady, too sunny, etc.).

Plants were also examined for the presence of two forms of identification. Each plant should have a permanent metal tag with simply an accession number, and a more decorative and informative plastic tag that includes not only the accession number but the common name and origin of the plant. Every specimen, when accessioned into the system, is assigned an accession number, based on the year of acquisition and the number of acquisitions that year (e.g., the 23rd acquisition of 1977). Within the past decade, qualifiers have been introduced into the system to further ensure that each individual plant can be uniquely identified. A single specimen of any species within an acquisition is given an "A" qualifier. Multiple specimens of a plant species are designated "A", "B", "C", and so on, to tell them apart both on maps and in database records. This is particularly important to prevent confusion of plant identities in future field checks, in the case of a plant being moved to a new location or even removed from the collection altogether. Many plants are labeled with their original tags, and since the qualifier system was instigated relatively recently, these original tags do not display the proper

accession number and form. As a result, an important part of the field checks was noting not only if a label was missing in entirety, but if the label was old and lacking a qualifier.

The final step in the field check work was to then enter all the new information into BG-BASE under the plant records. Information on label status was entered into a grid template in Excel and saved for use by Plant Records, so the labeling work can commence at their discretion.

Results and Analysis: Inventory

A. The Least Concern Collection

Upon completion of the identification of IUCN and BGCI Red Listed plants, a significant number of plants had been found to be ranked as Least Concern. This category may be found as LR/lc (Lower Risk/least concern, ver 2.3) or simply as LC (Least Concern, ver 3.1); here the designation LC will be used to apply to both categories. Often, widespread taxa are evaluated and found to be LC, such as *Pseudotsuga menziesii*. Subsequent discussion of the Conservation Collection will include plants ranked as Near Threatened or higher only. For the record, an additional 439 taxa representing 69 genera, or 11.3% of the collection, are listed as least concern (LC). A list of the species from the living collection that are listed as Least Concern may be found as Appendix B; the composition of the Least Concern Collection in terms of the core collections is shown in Figure 1.

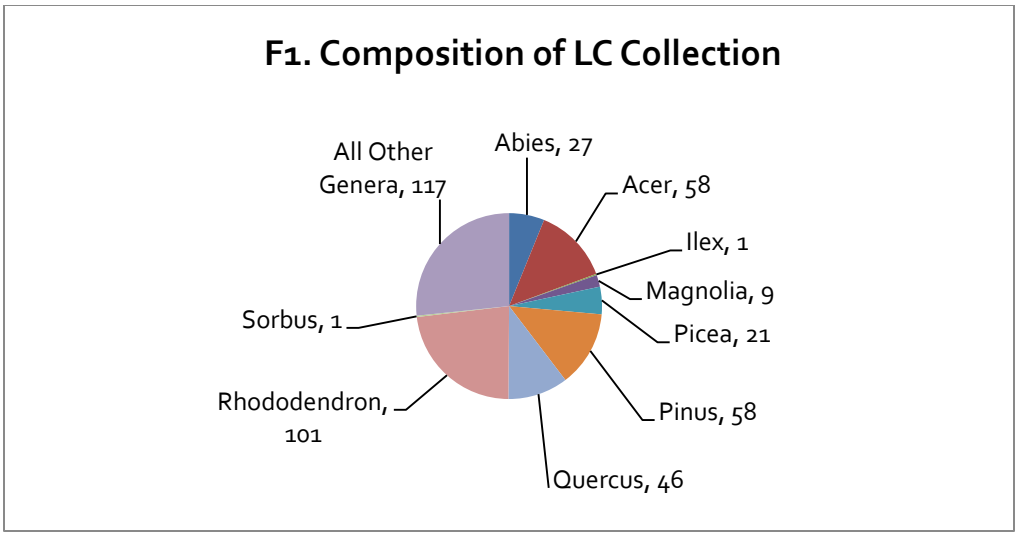

Figure 1: The composition of the Least Concern collection, as expressed through the core collections and *Rhododendrons* sorted from the whole.

B. Assessment of threat rankings

The inventory found that of the 3,887 accessioned taxa in the living collection, 212 taxa representing 56 genera comprise the conservation collection and are ranked as vulnerable or higher. This translates to 5.4% of the entire living collection being globally threatened with extinction. The complete list of conservation species in the collection may be found as Appendix A. Figure 2 below shows the representation, by number of taxa, of each threat level:

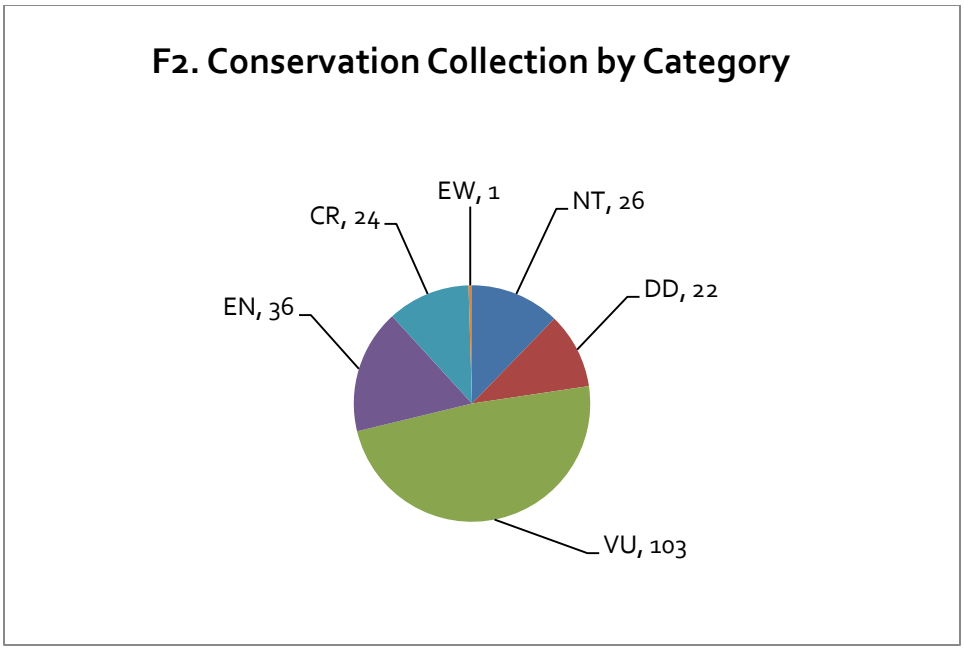

Figure 2: NT=Near Threatened, DD=Data Deficient, VU=Vulnerable, EN=Endangered, CR=Critically Endangered, EW=Extinct in the Wild.

48.6% of the conservation collection is VU, the single most populated ranking. There are a fair number of EN-ranked plants, followed closely by the nearly equal numbers of NT, DD and CR. Since the definition of DD indicates a ranking of at least VU, this translates as 59% of the conservation collection as being vulnerable. The WPA collection has only one species known to be extinct in the wild—the American native *Franklinia alatamaha*.

C. Assessment of representation of taxa

Figure 3 illustrates the composition of the WPA conservation collection by genus. Separated out are six of the seven core collections (the seventh, Viburnums, does not contain any conservation species) as well as the genus *Rhododendron*. Rhododendrons are included here because of all the genera in the collection, this genus has the most taxa that are red listed.

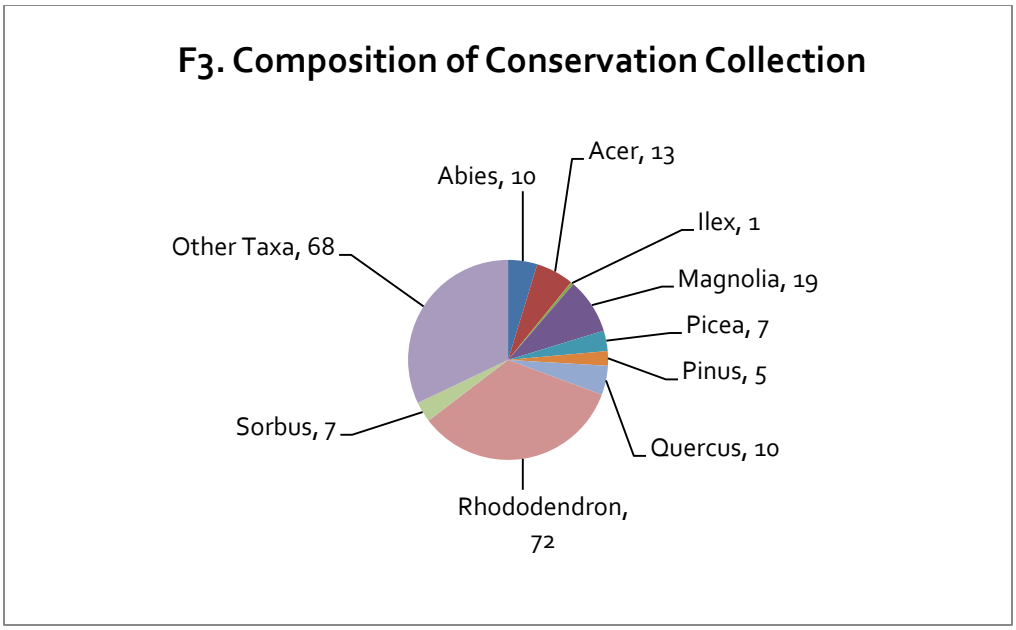

Figure 3: Composition of the Conservation Collect, as expressed through the core collections and *Rhododendron*.

Figure 4 contains the breakdown of ranking category information for each of the core collections and *Rhododendron*. Interesting to note is that among the eight core collections, the threat rankings are much more evenly spread—vulnerable plants do not constitute half of the taxa, as they do in the conservation collection as a whole.

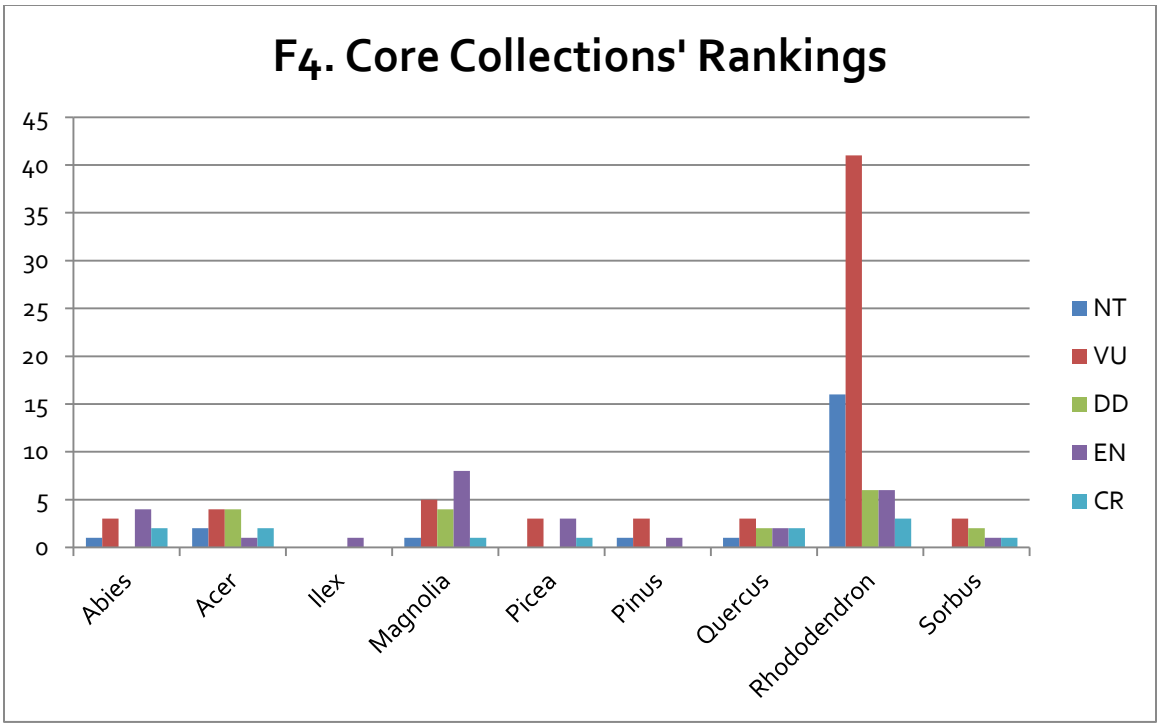

Figure 4: The threat rankings of the core collections and *Rhododendron*. NT=Near Threatened, DD=Data Deficient, VU=Vulnerable, EN=Endangered, CR=Critically Endangered.

D. Assessment of Collection compared to known taxa

The BGCI Red List publications provide assessment information for the taxa surveyed. For magnolias, all known species in the genus were assessed. In the oak survey, approximately 300 species were not evaluated. The rhododendron assessment surveyed not only all the known species, but many subspecies as well. Lastly, the maple survey includes not only the known maples, but certain subspecies and also members of a closely related genus, *Dipteronia*. The following table illustrates how the BGCI surveys compare with the living and conservation collections at the WPA.

Table 1

	BGCI Assessment			WPA Inventory		
	Total Spp.	Under Threat	% Threatened	Living Collection	Conservation Collection	% of Collection Threatened
Magnolias	245	131	53.5%	52 (21.2%)	19 (14.5%)	36.5%
Maples	191	83	43.5%	127 (66.5%)	14 (16.9%)	11.0%
Quercus	508	111	21.5%	102 (20.1%)	10 (9.0%)	9.8%
Rhododendrons	1157	674	58.3%	360 (31.1%)	72 (10.7%)	20.0%

Table 1: Comparison of the Living and Conservation Collections against known and threatened taxa. Percentages of the living and conservation collections are expressed against known taxa, as identified by BGCI Red List surveys.

These results suggest that magnolias and rhododendrons are well-represented, not only as groups in the living collection but within the conservation collection as well. While it is not surprising that the maple collection at the WPA comprises a high percentage of known taxa, conservation maples are not well represented. Finally, while there is a good-sized collection of *Quercus* taxa, the representation of globally threatened oaks could be better. It is important to note, however, that BGCI states that approximately 300 *Quercus* taxa have not been surveyed for risk, so of the 508 known total oak taxa, well more than 21.5% could be threatened.

E. Assessment of representation of ranges

The living collection at the WPA is comprised of plants from temperate regions throughout the world. An analysis of how well these regions' woody species are represented in general, and their threatened plants in particular, may help guide accession and curation efforts at the WPA in the future. This may be especially true in the development of the new, ecologically-themed gardens of the Pacific Connections Gateway collections, which will demonstrate the flora of Chile, China, and New Zealand.

Specific numbers are difficult to come by, but estimates approximate the total number of known woody species, as well as how many of those species are at risk. China holds over 2,800 woody species within its borders (China 2012). An estimated 75 gymnosperms and 836 angiosperms are endangered; in general, approximately 10% of plant species in temperate areas of China are considered to be vulnerable or endangered, primarily as a result of heavy deforestation (Biodiversity Committee, 2012). In Europe, current estimates place 21% of vascular plants, including 47% of endemics, as threatened (Silva 2008). Chile has just over 5,000 plant species, with an uncommonly high rate of endemism (46%) (Chileflora 2012). The current IUCN Red List contains 49 ranked plants native to Chile. Lastly, the IUCN ranks 586 plant species as being threatened throughout the United States, Canada, and Mexico (IUCN 2012).

Figure 4 contains the range information for the plants in in the conservation collection, by numeric value. Due to the overlap of countries in many plant ranges, the information is best displayed by the broadest generalities, but because Asia is so large, it is a worthwhile exercise to break down the conservation collection's Asian components. In Figure 5, the range composition of the conservation collection is illustrated, with a sub-chart showing the breakdown of plants from Asia. As shown, plants from Asia constistute 64% of the conservation collection, and of these plants, 43% are Chinese endemics.

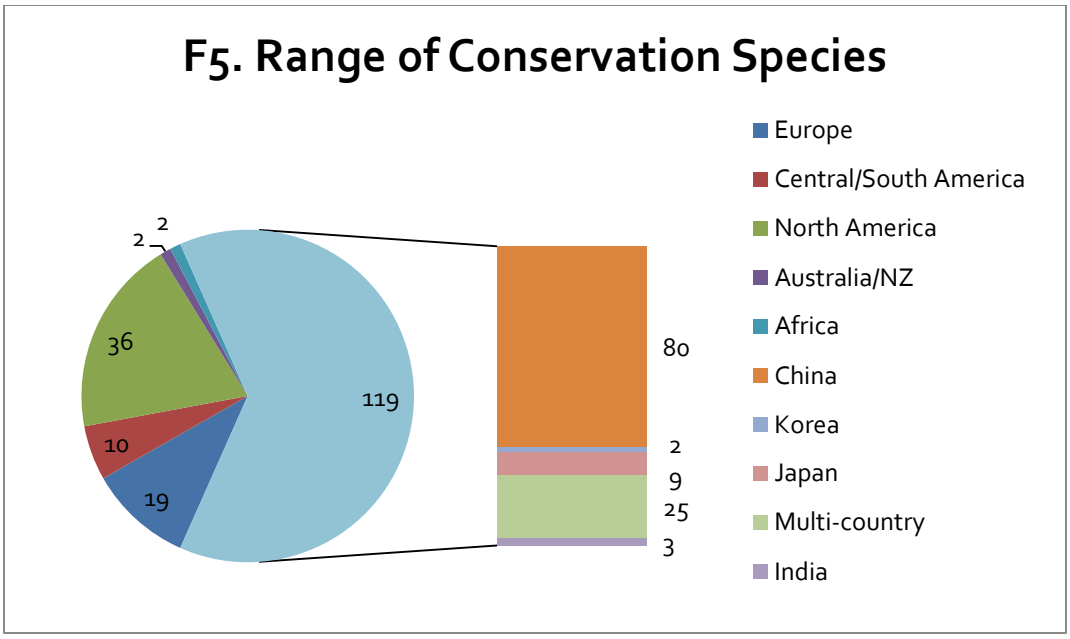

Figure 5: The range of the species of the Conservation Collection. Asian endemics are specified.

F. Assessment of Provenance of Conservation Accessions

The provenance of the conservation collection plants allows a better grasp of the value of the plants from a conservation standpoint. Wild-collected plants will have greater conservation value because of their genetic heritage and the ability to utilize them in reintroduction efforts. Plants that are of garden origin are of lesser conservation value because their genes are at least a single generation removed from native populations. They are not suitable for reintroduction or managed relocation, yet they still have research, education, and horticulture value (CBD 2012). The WPA utilizes three provenance categories: G (garden origin), W (wild-collected stock, e.g. a cutting or seed), and Z, which is first-generation garden-origin stock (i.e., a seed or cutting is taken from a plant that is located in cultivation but is itself of wild-provenance).

The simplest way to retrieve provenance information from BG-BASE is through a query run on living accessions with conservation status, rather than individual plants or taxa. This is because even plants of the same species within a given accession (uniquely

identified by their qualifiers) may have different provenance. The conservation collection is represented by 538 accessions. Of these accessions, 303 (56.3%) are of garden origin, 188 (34.9%) are from the wild, and 43 (8%) are first-generation garden origin. In addition, there are four accessions (one each of *Abies fraseri* (VU IUCN), *Magnolia sargentiana* (VU BGCI), *Metasequoia glyptostroboides* (CR IUCN), and *Rhododendron williamsianum* VU BGCI)) that are of unknown provenance. The provenance composition by category is illustrated in Figure 6 below.

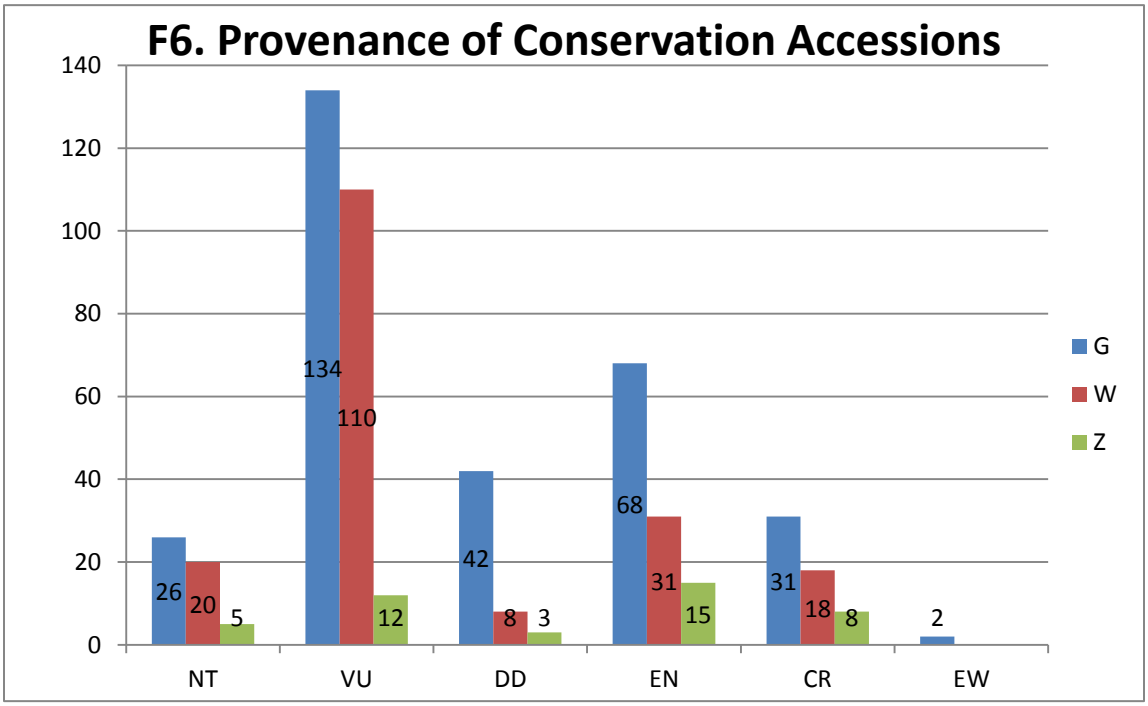

Figure 6: The provenance of all conservation collection accessions. NT=Near Threatened, DD=Data Deficient, VU=Vulnerable, EN=Endangered, CR=Critically Endangered, EW=Extinct in the Wild. G=Garden origin, W=Wild origin, Z=1st generation garden origin.

Figure 7 displays the provenance of all core collections and *Rhododendron*. While garden-origin stock makes up the majority of provenance through these collections as well, for *Abies* there are actually more wild-collected accessions. *Pinus* has an equal number of wild and garden accessions, and both *Quercus* and *Picea* are nearly equal. For

Rhododendron and *Magnolia*, garden-origin accessions are more than double the number of wild-origin accessions.

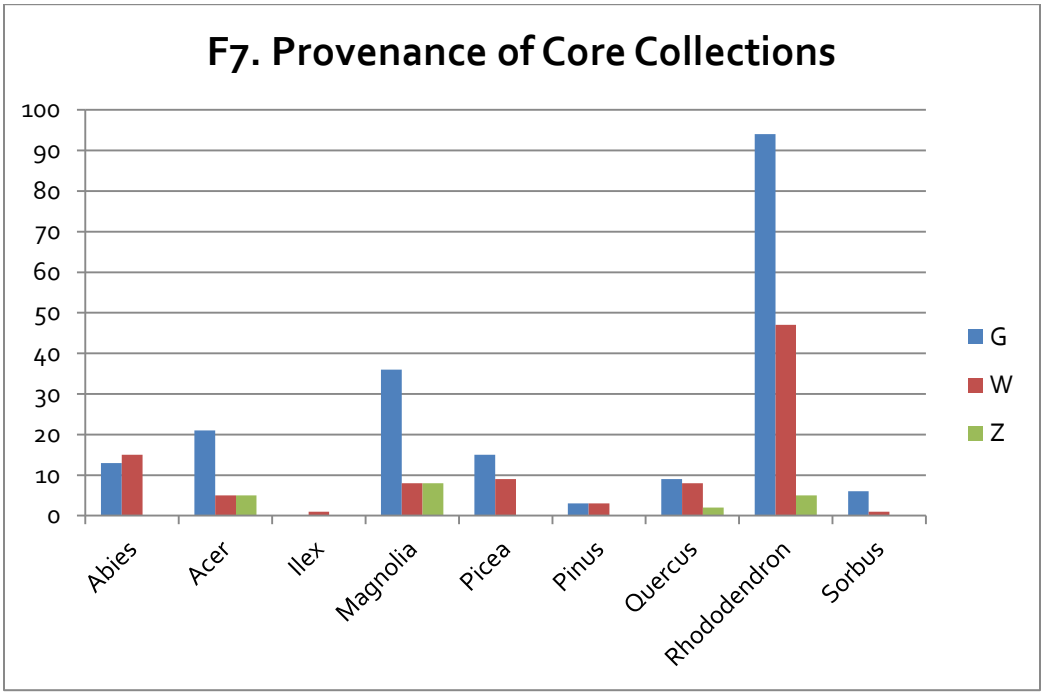

Figure 7: The provenance of all core collection accessions in the Conservation Collection. G=Garden origin, W=Wild origin, Z=1st generation garden origin.

G. Comparison between 2001 and 2012 Inventories

The last conservation inventory of the WPA collection identified 142 taxa representing 63 genera. At the time of the last inventory, many of the listed plants were ranked under criteria that predated 1994. The criteria predating version 2.3 is not clearly delineated and the rankings themselves are different than those provided since 1994, so a clear comparison is not possible. Still, many of the plants from the 2001 inventory remain part of either the Conservation or the Least Concern collections at the WPA. There are 16 exceptions, where previously listed plants no longer are listed on the IUCN or BGCI Red Lists. For these plants, the original (1998) Red Book was consulted to check for errors and further information. Of the 16 plants that were previously

considered part of the conservation collection at the WPA, 2 were identified in error: *Fuchsia procumbens,* and *Arctostaphylos densiflora* 'Harold McMinn'. While the latter species does appear on the IUCN list, the cultivar should not have been identified as a threatened species. The former does not appear in the 1998 Red Book at all. In addition, one species, *Carpenteria californica,* was not located in the Red Book due to an apparent index error. This species is currently ranked on NatureServe and is known to have limited range, so while the ranking could not be verified, it was not likely to have been identified as part of the conservation collection in error.

The remaining 13 species that were previously part of the Collection but are no longer considered so are: *Rhododendron degronianum* ssp *yakushimanum, Weigela subsessilis, Malus florentina, Betula apoiensis, Genista tenera, Davidia involucrata* var. *vilmoriniana, Ilex bioritensis, Betula globispica, Kolkwitzia amabilis, Sorbus dacica, Cupressus gigantea, Cotoneaster lucidus, Kirengeshoma palmata, Neviusia alabamensis,* and *Illicium parviflorum.* Of these species, further information was found on the North American natives through NatureServe. *Neviusia alabamensis* and *Illicium parviflorum* both have G2 (Imperiled) designations, and N2 national status. Data from the former is dated 2004, with the population trend considered stable, and the latter information is from 1999 with no updates.

Figure 8 illustrates the change in the conservation species within the core collections and *Rhododendron*. As this figure shows, the greatest change in conservation plants occurred in the genus *Rhododendron,* from fewer than 10 to 72 listed species. Surprisingly, the Pinaceae (firs, spruces, and pines) all had fewer conservation taxa in 2012 than in 2001, while all other groups stayed the same or grew in number. The

explanation for this is in the current treatment of separating out the LC plants from the bulk of the collection. For example, in 2001, *Picea asperata* var. *retroflexa* was included in the conservation assessment. For the 2012 inventory, however, this plant is identified as LC, so is no longer considered part of the conservation collection. In the 2012 conservation assessment, one *Abies*, two *Picea*, and five *Pinus* taxa that were formerly part of the conservation collection were reassigned to the LC collection. In addition to the Pinaceae, there are also reclassified *Magnolia* (2). In total, 21 taxa were reclassified during the 2012 conservation inventory.

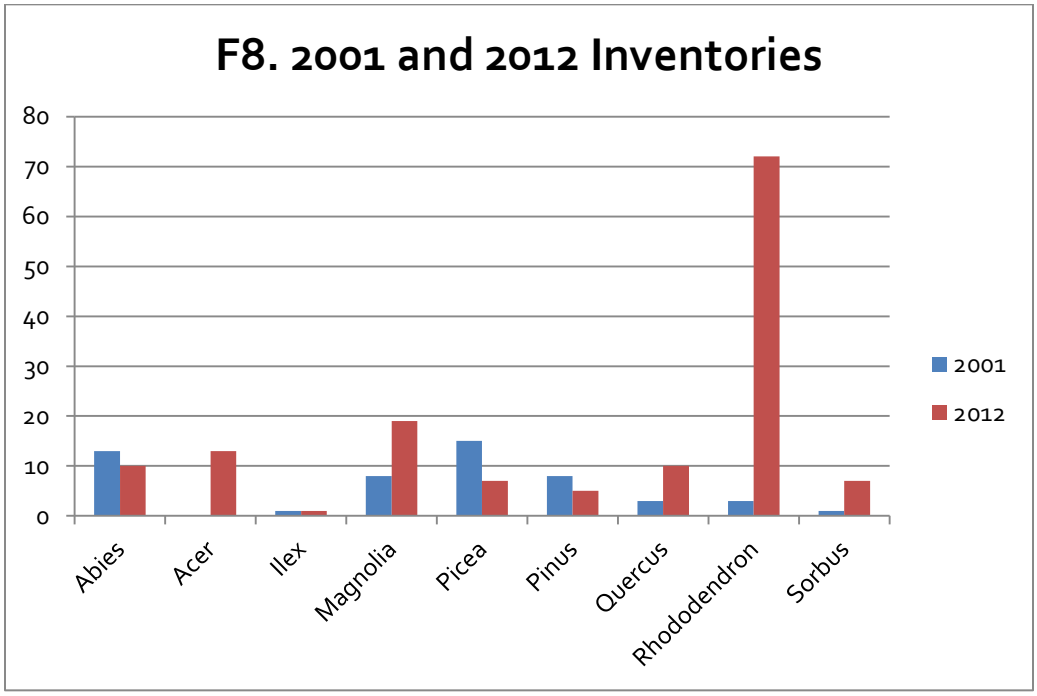

Figure 8: Comparison of the 2001 and 2012 conservation inventories for the core collections and *Rhododenderon.*

Results and Analysis: Field Checks

A total of 498 plants were checked in the field. Most plants were found throughout the WPA, with a few individuals were located on the grounds at the CUH, in the container nursery, and on the grounds of the Museum of History and Industry (MOHAI). Lastly, a handful of plants were located within or near the grounds of the Japanese Garden.

For the most part, plants were accurately notated on their corresponding grid maps. There were a few instances when plants were not located either on the maps or in the field, and are assumed to have been removed without updates to the system being made. There were also several plants that had been moved or removed during the interim period from when the inventory template was populated and the field checks were actually performed. This was to be expected because field checks took place over the four month period from May through August.

Figure 9 illustrates the breakdown in general health and appearance of the plants that were field checked.

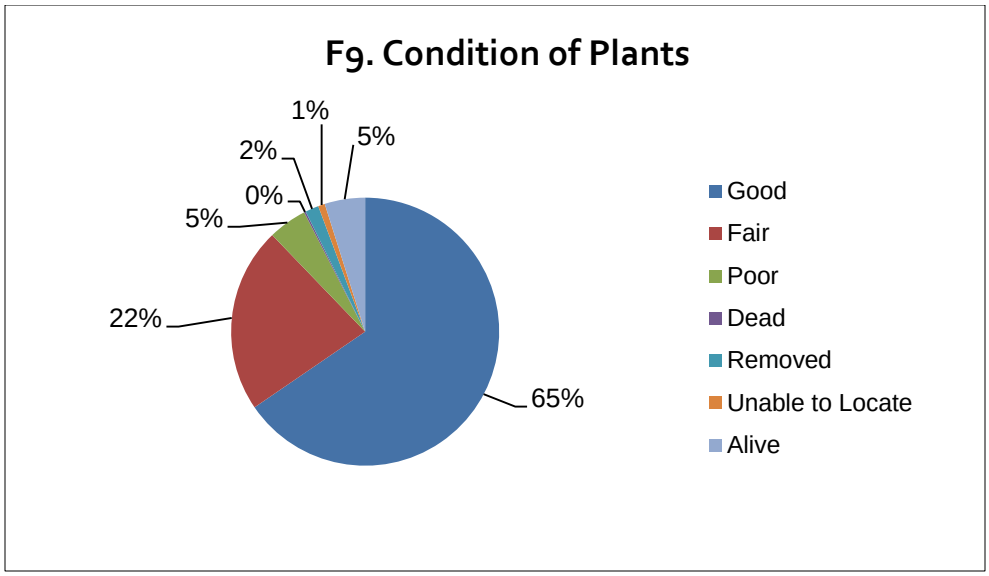

Figure 9: Conditions of plants as recorded in field checks, May-September 2012. N=498.

Overall, the collection is in good condition. Upon entry of the field check data, there is a documented history for many of the plants that are in fair or poor condition. Such history usually notes the reasons for the plant's condition, such as insect infestation or storm damage. It is worth noting that while there are guidelines for how to rank a specimen, the interpretations are still subjective. For instance, in the case of a *Fraxinus sogdiana* (NT IUCN), the specimen was spindly in appearance, with sparse older growth but new shoots, and was clearly recently planted. A review of the history, however, showed that the plant was accessioned in 1979, and had been moved multiple times due to its inability to establish and grow well. The question, then, was whether to rate it as fair, knowing what it had been through and seeing that it did have new growth and was apparently responding well to a recent relocation, or as poor due to the fact that for a specimen of that age it should really have been in better shape. In this case, it was rated as poor, because the checker felt that it should be rated by its real appearance, not how it should

look discounting its struggles to date. A rating of fair, however, would not have been inappropriate.

Lessons for Future Assessments

One concern throughout the conservation assessment was thinking of how to make future assessments easier. Fortunately, there is a new tool provided by BGCI to its member gardens just for this work. BGCI now has PlantSearch—a searchable online database of conservation species held in botanic gardens throughout North America. Not only can the public search to learn what conservation species are being protected *ex situ*, but member botanic gardens can upload their collection data and receive a response matching their conservation species against current IUCN information. Conservation information is provided, but taxonomic anomalies are noted as well, so that participating groups may all be on the same page with their plant names.

UWBG is already a member of BGCI, and is part of another online search product that allows the public to gain some information about the gardens. By utilizing the tool that BGCI is providing in PlantSearch, UWBG may better be able to manage its conservation collection without adding strain to already tight staff and budget resources. Information provided through PlantSearch can help UWBG curate its collections and make decisions regarding the accession of conservation species. The use of PlantSearch by member institutions also helps BGCI focus its conservation work. For these reasons, this service should prove to be invaluable. Future conservation assessments will still take time to perform, because of the work involved with database updating and field checks. Use of the PlantSearch database, however, should simplify and hasten the cross-

referencing and taxonomic vetting of species, and should also help address the risk of error in the inventory process.

Looking ahead to the future management of the conservation collection, perhaps the biggest challenge will be protecting sensitive species from the public. In each of the last two springs, specimens of *Araucaria araucana* (VU B1+2c) and *Jubaea chilensis* (VU A4c; B1ab(iii)) were severely vandalized. The first event was perpetrated by a fraternity harvesting materials for a tropical-themed party, and as of this writing, the instigators of the second event have not been identified. Because the WPA is not fenced in, vandalism has been a constant concern for plants and property. In this case, UWBG has turned to publicity as a tactic against future attacks.

Vandalism can also occur innocently, when well-meaning members of the public attempt to "help" an individual of a rare species by taking cuttings or seeds to propagate. In this instance, the best way the WPA species can be protected is by not disclosing the information about threatened plants. This is accomplished in the field by not printing threat information on an individual plant's tags, and also in online web portals that provide plant information to the public online. Current web portals to BG-BASE do not display information about sensitive plants to the public, but UWBG is the recipient of a 2012 grant from the Institute of Museum and Library Services to update its mapping system in the WPA, and also to develop software to enhance the ability of the public to gain information about plants in the collections online. During this work, UWBG must maintain that the location of sensitive plants is protected, because simply not stating that a plant is rare is not enough—not when anyone can do a search for a plant's name on the IUCN's web site for free. The grant proposal did include specific requirements that

sensitive species' location data will not be available online; the likelihood that these plants will remain protected is high. By modeling their new interface after those provided by other botanic gardens that house rare species, UWBG can help ensure that the rare plants in their collections are protected not only from those who would intend to do harm, but also well-meaning individuals who may cause harm inadvertently.

Conclusions

While *in situ* conservation has always been considered to be best, continued habitat loss and the additional variable of climate change impacts are placing more importance on the value of *ex situ* conservation efforts. Botanic gardens are proving to be central to these efforts by managing collections of many globally-threatened plants and educating the public on biodiversity. The University of Washington Botanic Gardens has emerged in a leader in *ex situ* conservation in botanic gardens, with a formal Conservation Policy that directs actions in programs and collections. UWBG's multi-pronged approach includes population monitoring, education, outreach, research, seed banking, and, of course, the living collection at the Washington Park Arboretum. Primary among the factors that make the WPA an excellent institution for *ex situ* conservation are a willing partnership between a respected large public university and the city, and a temperate climate that allows for many taxa to be grown well here. As part of the collections managed by UW Botanic Gardens, the WPA is an excellent example of an arboretum adapting to perform critical functions in changing times.

While an assessment of the conservation collection was 5 years overdue, the bulk of the work was in identifying IUCN and BGCI-listed species and updating the plant

records in BG-BASE. From a horticultural viewpoint, the specimens in the collection are overall in good standing, and problems are known and well-documented. The challenge for the WPA going forward will be continuing to make sure that plant records are updated and managed accordingly. Resources now online should help streamline the process, so new acquisitions can be checked against BGCI's PlantSearch or the IUCN Red List as they are accessioned. If nothing else, the availability of BGCI's PlantSearch will help make conservation plant identification much easier in future assessments.

The WPA is an amazing place that has weathered many changes in its 78 years. With its knowledgeable and dedicated staff, and the University's commitment to supporting research, education, and conservation of globally threatened species, the Arboretum will continue to be haven not only for rare trees, but people who wish to experience them firsthand. Perhaps, in the end, the Washington Park Arboretum is not so different than a fine museum after all, in that one can spend an entire day walking the grounds, and still not see everything. One must keep in mind, however, that many museums are active participants in both *in situ* and *ex situ* conservation efforts. With the conservation collection from the University of Washington Botanic Gardens inventoried and identified, and the information ready to share with similar institutions around the world, these threatened species may have better chances for survival well into the future.

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Name	Former	Current Status	Range
Abies fraseri		VU D2 ver 2.3	US (Mts VA, NC, & TN)
Abies guatemalensis	V	VU A1d ver 2.3	Guatemala, Honduras, El Salvador
Abies koreana	R	EN B2ab(ii,iii,v) ver 3.1	Korea
Abies nebrodensis	E	CR D ver 3.1	Europe (Sicily)
Abies numidica	V	CR B1ab(i,ii,iii)+2ab(i,ii,iii) ver 3.1	N Africa, Algeria
Abies pinsapo	V	EN B1ab(i,ii,iii)+2ab(i,ii,iii) ver 3.1	Europe (Spain)
Abies pinsapo var. marocana	R	EN B1ab(i,ii,iii)+2ab(i,ii,iii) ver 3.1	Morocco
Abies spectabilis		NT ver 3.1	Asia (Himalaya, Nepal, Afghanistan, India)
Abies squamata		VU A2d ver 3.1	China
Abies ziyuanensis	E	EN B1ab(iii);C2a(i) ver 3.1	China
Acer buergerianum ssp. formosanum		CR C2a(i);D BGCI	Taiwan
Acer cappadocicum ssp. lobelii		NT BGCI	Europe (S. Italy)
Acer caudatifolium		NT BGCI	Taiwan
Acer granatense		VU B1b(iii,v) BGCI	Europe (Spain, SW France, Morocco)
Acer griseum		EN A2c BGCI	China
Acer komarovii		DD BGCI	China, Korea
Acer miyabei ssp. miaotaiense		VU A2c ver 3.1	China
Acer pentaphyllum		CR C1 BGCI	China
Acer pentapotamicum		DD BGCI	China, Tibet, Sikkim
Acer pycnanthum		VU C1 BGCI	Japan
Acer sikkimense		DD BGCI	China, Himalaya, Sikkim
Acer triflorum		DD BGCI	China, Korea
Aesculus wangii		VU A1a, B1+2a, C1+2a ver 2.3	China (south Yunnan) and Vietnam
Amentotaxus formosana		CR C2b ver 2.3	Taiwan

Araucaria angustifolia		CR A1cd ver 3.1	Brazil and Argentina
Araucaria araucana	R	VU B1+2c ver 2.3	Chile, SW Argentina
Athrotaxis cupressoides		VU A1ac ver 2.3	Australia (Tasmania)
Athrotaxis selaginoides		VU A1c ver 2.3	Australia (Tasmania)
Austrocedrus chilensis	V	VU A1c ver 2.3	Chile, Andes Mtns.
Betula kirghisorum		CR B2ab(v) ver 3.1	Europe (Caucasus)
Betula tianschanica		EN A2ac; B2ab(ii,iii) ver 3.1	Asia (Uzbekistan, Kazakhstan, Kyrgyzstan)
Butia eriospatha		VU A1c ver 2.3	Brazil
Calocedrus formosana		EN B1+2b ver 2.3	Taiwan
Camellia reticulata f. simplex	V	VU B1+2c ver 2.3	China (Yunnan Province)
Cedrus libani ssp. brevifolia	V	VU D2 ver 3.1	Middle East (Leb., NW Syr., SC Turkey)
Cephalotaxus oliveri		VU A1d ver 2.3	China
Cephalotaxus wilsoniana	R	EN C2a ver 2.3	Taiwan
Chamaecyparis formosensis	R	EN A1c ver 2.3	Taiwan
Chamaecyparis lawsoniana	R	VU A1de+2e ver 2.3	US (SW OR to NW CA)
Chamaecyparis taiwanensis	V	VU A1d ver 2.3	Taiwan
Corylopsis pauciflora		DD ver 2.3	Japan, Taiwan
Cunninghamia konishii		VU A1c ver 2.3	Taiwan
Cupressus arizonica var. montana	V	VU D2 ver 2.3	Mexico (Baja California)
Cupressus arizonica var. nevadensis	R	VU D2 ver 2.3	US (Piute Mtns., CA)
Cupressus arizonica var. stephensonii	V	VU D2 ver 2.3	US (S.W. California, N. Baja California, Cuyamaca Mtns.)
Cupressus bakeri	V	VU B1+2bcd ver 2.3	US (N. California)
Cupressus bakeri ssp. matthewsii	V	VU B1+2bcd ver 2.3	US (N. California extending into Oregon)
Cupressus chengiana	V	VU A1c ver 2.3	China, Gansu (Min River Drainage), Zhouqu, Wadu, Sichuan
Cupressus chengiana var. jiangeensis	E	CR D ver 2.3	China, Szechuan, Jiange Xian
Cupressus duclouxiana	R	EN B2ab(ii,iv,v) ver 3.1	China

Cupressus goveniana	E	VU C2a ver 2.3	US (Monterey County, CA)
Cupressus goveniana var. pygmaea	E	VU C2a ver 2.3	US (Mendocino County, CA)
Cupressus guadalupensis ssp. forbesii	V	VU D2 ver 2.3	US (SW California, N Baja California)
Cupressus guadalupensis var. guadalupensis	E	CR B1+2c ver 2.3	Mexico (Guadelupe)
Cupressus macrocarpa	R	VU D2 ver 2.3	US (California)
Cupressus sargentii	R	VU C2a ver 2.3	US (W. California)
Dipteronia sinensis	R	NT BGCI	China
Fitzroya cupressoides	E	EN A1cd+2cd ver 2.3	Chile, Argentina
Franklinia alatamaha	X	EW ver 2.3	US (SE GA (not found wild since 1790))
Fraxinus sogdiana		NT ver 3.1	China, Kazakhstan, Kyrgyzstan, Tajikistan, Uzbekistan
Ginkgo biloba		EN B1+2c ver 2.3	China
Glyptostrobus lineatus	V	CR C2a(i) ver 3.1	China, Vietnam
Heptacodium miconioides		VU A1cd ver 2.3	China (Anhui, Hubei, Zhejiang)
Ilex uraiensis		EN B2ab(ii,iii,iv) ver 3.1	Taiwan
Jubaea chilensis		VU A4C, B1ab(iii) VER 3.1	Chile
Juglans regia		NT BGCI	Asia (Himalaya)
Larix decidua ssp. polonica	E/V	VU B1+2c ver 2.3	Europe (SE Poland, NW Ukraine, N Czechoslovakia)
Magnolia amoena		VU B1ab(i,ii,iii)+B2ab(i,ii,iii) BGCI	China
Magnolia biondii		DD BGCI	China
Magnolia cylindrica	V	VU B1ab(i,ii,iii)+B2ab(i,ii,iii) BGCI	China
Magnolia dawsoniana		EN B1ab(i,ii) BGCI	China (Sichuan)
Magnolia delavayi		EN B1+2c ver 2.3	China (Yunnan)
Magnolia denudata		DD	China
Magnolia ernestii		EN B1+2c ver 2.3	China (Sichuan)
Magnolia fordiana		NT BGCI	China, Vietnam
Magnolia liliiflora		DD BGCI	China

Magnolia lotungensis		EN C1 BGCI	China
Magnolia macrophylla var. ashei	R	VU B1ab(iii) BGCI	USA (SE)
Magnolia sargentiana		VU B2ab(i,ii,iv,v) BGCI	China
Magnolia schiedeana		EN B2ab(ii,iii) BGCI	Mexico
Magnolia sinensis	V	VU B1ab(i,ii,iii)+B2ab(i,ii,iii) BGCI	China
Magnolia sprengeri		DD BGCI	China (Sichuan)
Magnolia stellata		EN B1ab(i,iii) BGCI	Japan
Magnolia tamaulipana		EN B1ab(i,iii) BGCI	Mexico: Tamaulipas, Sierra Madre Oriental
Magnolia wilsonii	V	EN B1ab(i,ii,iii)+B2ab(i,ii,iii) BGCI	China
Magnolia zenii	E	CR D ver 2.3	China
Metasequoia glyptostroboides	E	CR A1c, C2a ver 2.3	China
Nothofagus glauca		VU A1cd, B1+2c ver 2.3	Chile
Ostrya rehderiana		CR D ver 2.3	China
Paulownia kawakamii		CR A1ace, B1+2abc, C2ab ver 2.3	China, Taiwan
Phoebe chekiangensis	V	VU B1+2c ver 2.3	China
Picea brachytyla	V	VU A1cd ver 2.3	China
Picea engelmannii ssp. mexicana	V	EN A1a, B1+2c ver 2.3	Mexico
Picea koyamai	E	CR B1ab(ii,iii,v) ver 3.1	Japan (Honshu), Korea, Manchuria, USSR
Picea likiangensis var. montigena	E	EN B1+2a ver 2.3	China (W Sichuan, SE Xizang, NW Yunnan)
Picea maximowiczii	V	VU B1+2c ver 2.3	Japan
Picea morrisonicola		VU A2c ver 2.3	Taiwan
Picea omorika	V	EN B1ab(i,ii,iii,v) ver 3.1	Europe (Yugoslavia)
Pinus albicaulis		VU A2ce+3ce+4ce ver 3.1	US (western), Canada (Alberta, BC)
Pinus culminicola		EN B1+2bc ver 2.3	Mexico
Pinus greggii	R	NT ver 3.1	Mexico
Pinus palustris		VU A1cde	US (VA to FL & E TX)
Pinus torreyana	I	VU C2a ver 2.3	US (California)

Pouteria splendens		CR B1ab(iii) ver 3.1	Chile
Prumnopitys andina	R	VU B2ab(ii-v) ver 3.1	Chile, Argentina
Prunus brigantina		DD ver 3.1	China
Pseudolarix amabilis	R	DD ver 2.3	China
Pseudotsuga japonica	V	VU D2 ver 2.3	Japan (southern)
Pseudotsuga wilsoniana	V	VU A1cd ver 2.3	Taiwan
Pterostyrax psilophyllus	V	VU A1cd ver 2.3	China
Quercus acerifolia		EN B1ac(iv)+2ac(iv) BGCI	US (Arkansas)
Quercus acutissima ssp. chenii		DD BGCI	China
Quercus alnifolia		VU B1ab(iii) BGCI	Europe (Cyprus (Troodos Mtns))
Quercus boyntonii	E	CR B1ab(iii) BGCI	US (Alabama, Texas)
Quercus dumosa		EN A2(c) BGCI	US (CA)
Quercus engelmannii	R	VU A2c BGCI	US (S California), Mexico (N Baja)
Quercus georgiana	E	EN B1ab(iii,iv)+2ab(iii,iv) BGCI	US (Georgia)
Quercus graciliformis		CR B1ab(iii); C2b BGCI	US (Texas)
Quercus polymorpha		NT BGCI	Mexico, Guatemala, USA (Texas)
Quercus pontica		VU B1ab(iii) BGCI	Europe (Southern Caucasus (Georgia, Turkey))
Quercus rysophylla	R	NT BGCI	Mexico
Rhododendron aberconwayi		VU D2 BGCI	China (Yunnan, Guizhou)
Rhododendron adenopodum		VU B1ab(i,iii) BGCI	China
Rhododendron amagianum		EN D BGCI	Japan (Honshu)
Rhododendron amesiae		CR B1b(i,ii,iii) BGCI	China (Sichuan)
Rhododendron aperantum		NT BGCI	China (Yunnan), Myanmar
Rhododendron arboreum f. album		DD BGCI	Nepal
Rhododendron argyrophyllum ssp. omeiense		VU D2 BGCI	China (Sichuan)
Rhododendron auriculatum		VU B1ab(ii,iii,iv,v) BGCI	China (Chongqing, Guizhou, Hubei, Shaanxi, Sichuan)

Rhododendron auritum		CR B1ab(ii,v)+2ab(ii,v) BGCI	China (Xizang)
Rhododendron bainbridgeanum		NT BGCI	China (Xizang, Yunnan), Myanmar
Rhododendron balfourianum		VU B1b(ii,iii) BGCI	China (Yunnan, Sichuan)
Rhododendron barbatum		VU B1b(ii,iii,v) BGCI	China (Xizang), India (Sikkim), Nepal, Bhutan
Rhododendron basilicum		NT BGCI	China (Yunnan), Myanmar
Rhododendron chamaethomsonii var. chamaethauma		VU D2 BGCI	China (Xizang, Yunnan)
Rhododendron concinnoides		VU D2 BGCI	India (Arunachal Pradesh)
Rhododendron coriaceum		NT BGCI	China (Xizang, Yunnan)
Rhododendron cuneatum		VU B1ab(i,iii) BGCI	China (Sichuan, Yunnan)
Rhododendron cyanocarpum		VU B2ab(i,iii); D2 BGCI	China
Rhododendron davidii		NT BGCI	China (Quizhou, Sichuan, Yunnan)
Rhododendron denudatum		NT BGCI	China (Guizhou, Sichuan, Yunnan)
Rhododendron dichroanthum ssp. apodectum		VU B2ab(i,iii) BGCI	China (Yunnan), Myanmar
Rhododendron dichroanthum ssp. dichroanthum		VU B2ab(i,iii) BGCI	China (Yunnan)
Rhododendron eclecteum		VU B1ab(i, iii) BGCI	China (Xizang, Yunnan, Sichuan), Myanmar
Rhododendron elliottii		VU D2 BGCI	India (Nagaland)
Rhododendron fletcherianum		EN D BGCI	China (Xizang)
Rhododendron galactinum		VU B1ab(i,iii) BGCI	China (Sichuan)
Rhododendron glanduliferum		VU D2 BGCI	China (Guizhou, Yunnan)
Rhododendron glaucophyllum		DD BGCI	Asia (Sikkim, Bhutan, SE Tibet)
Rhododendron hanceanum		VU D2 BGCI	China (Sichuan)
Rhododendron hemitrichotum		NT BGCI	China (Sichuan, Yunnan)
Rhododendron hemsleyanum		CR C1 BGCI	China (Sichuan)
Rhododendron hookeri		VU D2 BGCI	China (Xizang), India (Arunachal Pradesh)
Rhododendron huianum		NT BGCI	China

Rhododendron hyperythrum	E	DD BGCI	Taiwan
Rhododendron keleticum		VU D2 BGCI	China (Xizang, Yunnan), Myanmar
Rhododendron kongboense		NT BGCI	China (Xizang), Bhutan
Rhododendron lacteum		NT BGCI	China (Sichuan, Yunnan)
Rhododendron lanigerum		NT BGCI	China (Xizang), India (Arunachal Pradesh)
Rhododendron lasiostylum		VU B1ab(i,iii)+2ab(i,iii); D2 BGCI	Taiwan
Rhododendron longipes		VU B1ab (i,iii) BGCI	China (Chongqing, Sichuan, Yunnan, Guizhou)
Rhododendron lutescens		VU B1ab(iii,iv,v) BGCI	China (Guizhou, Yunnan, Sichuan)
Rhododendron macabeanum		EN B2ab(ii,iii,v) BGCI	India (Nagaland)
Rhododendron makinoi		VU B1ab(ii,iii,v)+2ab(ii,iii,v); C1 BGCI	Japan
Rhododendron mallotum		EN B1ab(ii,iii,v) BGCI	China (Yunnan), Myanmar
Rhododendron moupinense		NT BGCI	China (Guizhou, Sichuan, Yunnan)
Rhododendron mucronulatum var. ciliatum		VU C1+2a(i) BGCI	Japan (Honshu, Kyushu, Shikoku)
Rhododendron ochraceum		VU B2ab(ii,iii,v) BGCI	China (Chongqing, Sichuan, Yunnan)
Rhododendron orbiculare		VU D2 BGCI	China (Guangxi, Sichuan)
Rhododendron pemakoense		VU D2 BGCI	China (Xizang), India (Arunachal Pradesh)
Rhododendron pingianum		NT BGCI	China (Sichuan)
Rhododendron prattii		NT BGCI	China (Sichuan)
Rhododendron pseudochrysanthum		VU D2 BGCI	Taiwan
Rhododendron recurvoides		VU D2 BGCI	Asia (Myanmar)
Rhododendron ririei		VU B1ab(i,iii) BGCI	China (Sichuan)
Rhododendron sanctum		EN B1ab(iii)+2ab(iii); C1+2a(ii) BGCI	Japan
Rhododendron sanguineum ssp. didymum		VU D2 BGCI	China (Xizang), Myanmar
Rhododendron scabrifolium		DD BGCI	China (Guizhou, Sichuan, Yunnan)
Rhododendron searsiae		DD BGCI	China (Sichuan)
Rhododendron shweliense		DD BGCI	China (Yunnan)
Rhododendron sikangense var. exquisitum		VU D2 BGCI	China (Yunnan)

Rhododendron sinofalconeri		NT BGCI	China (Yunnan), Vietnam
Rhododendron smirnowii		VU B1b(i,iii) BGCI	Europe (Georgia, Turkey)
Rhododendron taliense		VU D2 BGCI	China (Yunnan)
Rhododendron tephropeplum		NT BGCI	China (Xizang, Yunnan), India (Arunachal Pradesh), Myanmar, Vietnam
Rhododendron trichanthum		VU D1+2 BGCI	China (Sichuan)
Rhododendron ungernii		Vu B1b(i,iii) BGCI	Europe (NE Turkey, Georgia)
Rhododendron vaseyi		VU B1b(iii,iv) BGCI	US (Blue Ridge Mts, NC)
Rhododendron vellereum		EN B1b(i,iii) BGCI	China (Qinghai, Xizang)
Rhododendron venator		VU D2 BGCI	China (Xizang)
Rhododendron viridescens		VU D2 BGCI	China (Xizang)
Rhododendron williamsianum		VU D2 BGCI	China (Guizhou, Xizang, Yunnan, Sichuan)
Rhododendron yungningense		VU B1ab(i,iii) BGCI	China (Yunnan, Sichuan)
Salix magnifica	V	VU A1cd ver 2.3	China
Sciadopitys verticillata	V	VU A1c+2c ver 2.3	Japan (Central and South, mtns)
Sequoia sempervirens		VU A2acd ver 3.1	US (Coast SW OR to C CA)
Sequoiadendron giganteum	V	VU A1cd ver 2.3	US (Western slope Sierra Nevadas)
Sinojackia xylocarpa		VU B1+2ce, D2 ver 2.3	China (Jiangsu)
Sorbus anglica		VU D1 ver 2.3	UK (England, SW Ireland)
Sorbus arranensis		VU D1 ver 2.3	UK (Aran Islands)
Sorbus bristoliensis		EN D ver 2.3	UK (W England; the Avon Gorge)
Sorbus eminens		VU D1 ver 2.3	UK
Sorbus leyana		CR D ver 2.3	UK (Carboniferous limestone cliffs in southern Breconshire)
Sorbus teodorii		DD ver 3.1	Europe (Finland, Latvia, Sweden)
Sorbus turkestanica		DD ver 3.1	Asia (Afghanistan, Kyrgyzstan, Tajikistan, Turkmenistan)
Syringa josikaea	V	DD ver 3.1	Europe (Hungary, Romania, SW Russia)

Taiwania cryptomerioides	V	VU A2cd ver 3.1	China, Taiwan, Upper Burma
Taxus floridana	I	CR B1ab(iii,v) ver 3.1	US (N Florida)
Taxus wallichiana		EN A2acd ver 3.1	Asia (Himalayas, Afghanistan to Sikkim, Manipua & Khasia, Vietnam)
Thuja koraiensis	R	VU B2ab(ii,iii,iv,v);C2a(i);D1 ver 3.1	Asia (N & C Korea)
Thymus camphoratus		NT ver 3.1	Europe (Portugal)
Torreya taxifolia	E	CR A2ace ver 3.1	US (Apalachicola River, NW FL to SE GA)

Appendix B: The Least Concern Species

Name	Former Status	Current Status
Abies alba		LR/lc ver 2.3
Abies amabilis		LR/lc ver 2.3
Abies balsamea		LR/lc ver 2.3
Abies bracteata	R	LR/lc ver 2.3
Abies cephalonica		LC ver 3.1
Abies cilicica		LR/lc ver 2.3
Abies concolor		LR/lc ver 2.3
Abies delavayi		LC ver 3.1
Abies fabri		LR/lc ver 2.3
Abies fargesii		LR/lc ver 2.3
Abies firma		LR/lc ver 2.3
Abies forrestii		LR/lc ver 2.3
Abies grandis		LR/lc ver 2.3
Abies holophylla		LR/lc ver 2.3
Abies homolepis		LR/lc ver 2.3
Abies kawakamii		LR/nt ver 2.3
Abies lasiocarpa		LR/lc ver 2.3
Abies mariesii		LR/lc ver 2.3
Abies nephrolepis		LR/lc ver 2.3
Abies nordmanniana		LC ver 3.1
Abies pindrow		LR/lc ver 2.3
Abies procera		LR/lc ver 2.3
Abies recurvata		LR/lc ver 2.3
Abies sachalinensis		LR/lc ver 2.3
Abies sibirica		LC ver 3.1
Abies veitchii		LC ver 3.1
Abies vejari		LR/lc ver 2.3
Acer acuminatum		LC BGCI
Acer argutum		LC BGCI
Acer barbinerve		LC BGCI
Acer campestre		LC BGCI
Acer capillipes		LC BGCI
Acer carpinifolium		LC BGCI
Acer circinatum		LC BGCI
Acer cissifolium		LC BGCI
Acer cissifolium ssp. henryi		LC BGCI
Acer coriaceifolium		LC BGCI
Acer crataegifolium		LC BGCI

Acer davidii		LC BGCI
Acer diabolicum		LC BGCI
Acer distylum		LC BGCI
Acer elegantulum		LC BGCI
Acer erianthum		LC BGCI
Acer fabri		LC BGCI
Acer flabellatum		LC BGCI
Acer heldreichii		LC BGCI
Acer henryi		LC BGCI
Acer hyrcanum		LC BGCI
Acer japonicum		LC BGCI
Acer laxiflorum		LC BGCI
Acer longipes		LC BGCI
Acer macrophyllum		LC BGCI
Acer mandshuricum		LC BGCI
Acer maximowiczianum		LC BGCI
Acer micranthum		LC BGCI
Acer monspessulanum		LC BGCI
Acer negundo ssp. californicum		LC BGCI
Acer nipponicum		LC BGCI
Acer oliverianum		LC BGCI
Acer opalus		LC BGCI
Acer palmatum		LC BGCI
Acer paxii		LC BGCI
Acer pectinatum ssp. forrestii		LC BGCI
Acer pectinatum ssp. taronense		LC BGCI
Acer pensylvanicum		LC BGCI
Acer pseudosieboldianum		LC BGCI
Acer rubrum		LC BGCI
Acer rufinerve		LC BGCI
Acer saccharinum		LC BGCI
Acer saccharum		LC BGCI
Acer sempervirens		LC BGCI
Acer shirasawanum		LC BGCI
Acer sieboldianum		LC BGCI
Acer sinense		LC BGCI
Acer spicatum		LC BGCI
Acer stachyophyllum		LC BGCI
Acer sterculiaceum ssp. franchetii		LC BGCI
Acer tataricum		LC BGCI
Acer tataricum ssp. ginnala		LC BGCI

Acer tataricum ssp. semenovii		LC BGCI
Acer tegmentosum		LC BGCI
Acer truncatum		LC BGCI
Acer tschonoskii		LC BGCI
Acer velutinum		LC BGCI
Acer wilsonii		LC BGCI
Alnus glutinosa		LC BGCI
Alnus glutinosa ssp. betuloides	R	LC ver 3.1
Arbutus glandulosa		LR/cd ver 2.3
Betula raddeana	I	LR/nt ver 2.3
Calocedrus decurrens		LR/lc ver 2.3
Caragana tragacanthoides		LC BGCI
Cathaya argyrophylla		LR/cd ver 2.3
Cedrus deodara		LR/lc ver 2.3
Celtis caucasica		LC BGCI
Cephalotaxus fortunei		LR/lc ver 2.3
Cephalotaxus harringtonia		LR/lc ver 2.3
Cercidiphyllum japonicum		LR/nt ver 2.3
Cercis canadensis		LR/lc ver 2.3
Chamaecyparis obtusa		LR/nt ver 2.3
Chamaecyparis thyoides		LR/lc ver 2.3
Cinnamomum japonicum		LR/nt 2.3
Cryptomeria japonica		LR/nt ver 2.3
Cunninghamia lanceolata		LR/lc ver 2.3
Cupressus arizonica		LR/lc ver 2.3
Cupressus arizonica var. glabra		LR/lc ver 2.3
Cupressus funebris		LR/lc ver 2.3
Cupressus lusitanica		LR/lc ver 2.3
Cupressus macnabiana	R	LR/lc ver 2.3
Cupressus sempervirens		LR/nt ver 2.3
Cycas revoluta		LC ver 3.1
Dacrycarpus dacrydioides		LR/lc ver 2.3
Darlingtonia californica		LR/lc ver 2.3
Diospyros lotus		LC ver 3.1
Diselma archeri		LR/lc ver 2.3
Eucommia ulmoides	R	LR/nt ver 2.3
Eucryphia cordifolia		LR/nt ver 2.3
Eucryphia glutinosa		LR/nt ver 2.3
Euonymus verrucosus		LC ver 3.1
Fokienia hodginsii	R	LR/nt ver 2.3

Ilex canariensis		LR/nt ver 2.3
Juniperus ashei		LR/lc ver 2.3
Juniperus californica		LR/lc ver 2.3
Juniperus chinensis		LR/lc ver 2.3
Juniperus communis		LR/lc ver 2.3
Juniperus drupacea		LR/lc ver 2.3
Juniperus excelsa		LR/lc ver 2.3
Juniperus flaccida		LR/lc ver 2.3
Juniperus horizontalis		LR/lc ver 2.3
Juniperus monosperma		LR/lc ver 2.3
Juniperus occidentalis		LR/lc ver 2.3
Juniperus osteosperma		LR/lc ver 2.3
Juniperus oxycedrus		LR/lc ver 2.3
Juniperus phoenicea		LR/lc ver 2.3
Juniperus procumbens		LR/lc ver 2.3
Juniperus rigida		LR/lc ver 2.3
Juniperus sabina		LR/lc ver 2.3
Juniperus squamata		LR/lc ver 2.3
Juniperus tibetica		LR/lc ver 2.3
Juniperus virginiana		LR/lc ver 2.3
Keteleeria davidiana		LR/lc ver 2.3
Keteleeria evelyniana		LR/lc ver 2.3
Larix decidua		LR/lc ver 2.3
Larix gmelinii		LR/lc ver 2.3
Larix kaempferi		LR/lc ver 2.3
Larix laricina		LR/lc ver 2.3
Larix lyallii		LR/lc ver 2.3
Larix occidentalis		LR/lc ver 2.3
Leitneria floridana		LR/nt ver 2.3
Libocedrus bidwillii		LR/lc ver 2.3
Liquidambar styraciflua		LR/lc ver 2.3
Liriodendron chinense	R	LR/nt ver 2.3
Magnolia campbellii		LC BGCI
Magnolia globosa		LC BGCI
Magnolia grandiflora		LC BGCI
Magnolia insignis		LC BGCI
Magnolia officinalis	V	LR/nt ver 2.3
Magnolia officinalis var. biloba	V	LR/NT ver 2.3
Magnolia pyramidata		LC BGCI
Magnolia tripetala		LC BGCI
Magnolia virginiana		LC BGCI

Mentha requienii		LC ver 3.1
Microbiota decussata	I	LC ver 3.1
Nothofagus alpina		LR/nt ver 2.3
Nothofagus dombeyi		LR/lc ver 2.3
Notospartium carmichaeliae		LR/nt ver 2.3
Notospartium glabrescens		LR/nt ver 2.3
Olearia traversii		LR/nt ver 2.3
Persea lingue		LR/nt ver 2.3
Phyllocladus aspleniifolius		LR/lc ver 2.3
Picea abies		LR/lc ver 2.3
Picea alcoquiana		LR/lc ver 2.3
Picea asperata		LR/lc ver 2.3
Picea asperata var. retroflexa	R	LR/lc ver 2.3
Picea breweriana		LR/nt ver 2.3
Picea engelmannii		LR/lc ver 2.3
Picea glauca		LR/lc ver 2.3
Picea glauca var. albertiana		LR/lc ver 2.3
Picea glehnii		LR/lc ver 2.3
Picea jezoensis		LR/lc ver 2.3
Picea likiangensis		LR/lc ver 2.3
Picea mariana		LR/lc ver 2.3
Picea meyeri	R	LR/lc ver 2.3
Picea obovata		LR/lc ver 2.3
Picea orientalis		LR/lc ver 2.3
Picea pungens		LR/lc ver 2.3
Picea rubens		LR/lc ver 2.3
Picea schrenkiana		LR/lc ver 2.3
Picea sitchensis		LR/lc ver 2.3
Picea smithiana		LR/lc ver 2.3
Picea wilsonii		LR/lc ver 2.3
Pinus aristata		LR/nt ver 2.3
Pinus arizonica		LR/lc ver 2.3
Pinus armandii		LR/lc ver 2.3
Pinus attenuata		LR/lc ver 2.3
Pinus ayacahuite		LR/lc ver 2.3
Pinus balfouriana		LR/cd ver 2.3
Pinus banksiana		LR/lc ver 2.3
Pinus brutia		LR/lc ver 2.3
Pinus bungeana	V	LC ver 3.1
Pinus canariensis		LC ver 3.1
Pinus cembra		LR/lc ver 2.3

Pinus cembra ssp. sibirica		LR/lc ver 2.3
Pinus contorta		LR/lc ver 2.3
Pinus contorta var. contorta		LR/lc ver 2.3
Pinus coulteri	R	LR/lc ver 2.3
Pinus densata		LR/lc ver 2.3
Pinus densiflora		LR/lc ver 2.3
Pinus devoniana		LR/lc ver 2.3
Pinus durangensis	R	LR/lc ver 2.3
Pinus echinata		LR/lc ver 2.3
Pinus edulis		LR/lc ver 2.3
Pinus engelmannii		LR/lc ver 2.3
Pinus flexilis		LR/lc ver 2.3
Pinus gerardiana		LR/nt ver 2.3
Pinus jeffreyi		LR/lc ver 2.3
Pinus kesiya		LR/lc ver 2.3
Pinus koraiensis		LR/lc ver 2.3
Pinus kwangtungensis	V	LR/nt ver 2.3
Pinus lawsonii		LR/lc ver 2.3
Pinus leiophylla		LR/lc ver 2.3
Pinus leiophylla ssp. chihuahuana	R	LR/lc ver 2.3
Pinus longaeva		LC ver 3.1
Pinus monophylla		LR/lc ver 2.3
Pinus monticola		LR/lc ver 2.3
Pinus morrisonicola		LR/lc ver 2.3
Pinus mugo		LR/lc ver 2.3
Pinus muricata		LR/nt ver 2.3
Pinus nigra		LR/lc ver 2.3
Pinus oocarpa		LR/lc ver 2.3
Pinus parviflora		LR/lc ver 2.3
Pinus peuce		LR/nt ver 2.3
Pinus pinaster		LR/lc ver 2.3
Pinus pinea		LR/lc ver 2.3
Pinus ponderosa		LR/lc ver 2.3
Pinus pumila		LR/lc ver 2.3
Pinus pungens		LR/lc ver 2.3
Pinus radiata		LR/cd ver 2.3
Pinus resinosa		LR/lc ver 2.3
Pinus rigida		LR/lc ver 2.3
Pinus sabiniana		LR/lc ver 2.3
Pinus strobiformis		LR/lc ver 2.3
Pinus strobus		LR/lc ver 2.3

Pinus sylvestris		LR/lc ver 2.3
Pinus tabulaeformis		LR/lc ver 2.3
Pinus taeda		LR/lc ver 2.3
Pinus taiwanensis		LR/lc ver 2.3
Pinus wallichiana		LR/lc ver 2.3
Pinus yunnanensis		LR/lc ver 2.3
Platanus orientalis		LR/lc ver 2.3
Platycladus orientalis		LR/nt ver 2.3
Podocarpus acutifolius		LR/lc ver 2.3
Podocarpus alpinus		LR/lc ver 2.3
Podocarpus lawrencei		LR/lc ver 2.3
Podocarpus macrophyllus		LR/lc ver 2.3
Podocarpus macrophyllus var. maki		LR/lc ver 2.3
Podocarpus nivalis		LR/lc ver 2.3
Podocarpus nubigenus		LR/nt ver 2.3
Populus nigra		LC ver 3.1
Pseudotsuga macrocarpa		LR/nt ver 2.3
Pseudotsuga menziesii		LR/lc ver 2.3
Puya chilensis		LC ver 3.1
Pyrus salicifolia		LR/nt ver 2.3
Quercus acutissima		LC BGCI
Quercus alba		LC BGCI
Quercus aliena		LC BGCI
Quercus arizonica		LC BGCI
Quercus berberidifolia		LC BGCI
Quercus bicolor		LC BGCI
Quercus cerris		LC BGCI
Quercus chrysolepis		LC BGCI
Quercus coccifera		LC BGCI
Quercus coccinea		LC BGCI
Quercus dentata		LR/lc ver 2.3
Quercus ellipsoidalis		LR/lc ver 2.3
Quercus emoryi		LC BGCI
Quercus falcata		LC BGCI
Quercus gambelii		LC BGCI
Quercus garryana		LC BGCI
Quercus geminata		LC BGCI
Quercus glauca		LC BGCI
Quercus ilex		LC BGCI
Quercus ilicifolia		LC BGCI
Quercus imbricaria		LC BGCI

Quercus ithaburensis		LC BGCI
Quercus laurifolia		LC BGCI
Quercus macrocarpa		LR/lc ver 2.3
Quercus marilandica		LC BGCI
Quercus michauxii		LC BGCI
Quercus muehlenbergii		LC BGCI
Quercus nigra		LC BGCI
Quercus palustris		LC BGCI
Quercus petraea		LC BGCI
Quercus phellos		LC BGCI
Quercus prinoides		LC BGCI
Quercus prinus		LC BGCI
Quercus pubescens		LC BGCI
Quercus pumila		LC BGCI
Quercus robur		LC ver 3.1
Quercus rubra		LC BGCI
Quercus rugosa		LC BGCI
Quercus serrata		LC BGCI
Quercus shumardii		LC BGCI
Quercus suber		LC BGCI
Quercus texana		LC BGCI
Quercus turbinella		LC BGCI
Quercus variabilis		LC BGCI
Quercus velutina		LC BGCI
Quercus virginiana		LC BGCI
Rehderodendron macrocarpum	V	LR/nt ver 2.3
Rhododendron adenogynum		LC BGCI
Rhododendron alabamense		LC BGCI
Rhododendron albrechtii		LC BGCI
Rhododendron ambiguum		LC BGCI
Rhododendron arborescens		LC BGCI
Rhododendron arboreum ssp. cinnamomeum		LC BGCI
Rhododendron argipeplum		LC BGCI
Rhododendron arizelum		LC BGCI
Rhododendron atlanticum		LC BGCI
Rhododendron augustinii		LC BGCI
Rhododendron aureum		LC BGCI
Rhododendron austrinum		LC BGCI
Rhododendron brachycarpum var. fauriei		LC BGCI
Rhododendron bureavii		LC BGCI

Rhododendron calendulaceum		LC BGCI
Rhododendron canescens		LC BGCI
Rhododendron caucasicum		LC BGCI
Rhododendron cerasinum		LC BGCI
Rhododendron ciliatum		LC BGCI
Rhododendron concinnum		LC BGCI
Rhododendron crinigerum		LC BGCI
Rhododendron dauricum		LC BGCI
Rhododendron davidsonianum		LC BGCI
Rhododendron degronianum ssp. heptamerum var. heptamerum		LC BGCI
Rhododendron discolor		LC BGCI
Rhododendron fastigiatum		LC BGCI
Rhododendron ferrugineum		LC BGCI
Rhododendron fictolacteum	V	LR/cd ver 2.3
Rhododendron floccigerum		LC BGCI
Rhododendron floribundum		LC BGCI
Rhododendron formosanum		LC BGCI
Rhododendron fortunei		LC BGCI
Rhododendron fulgens		LC BGCI
Rhododendron fulvum		LC BGCI
Rhododendron grande		LC BGCI
Rhododendron griffithianum		LC BGCI
Rhododendron groenlandicum		LC BGCI
Rhododendron heliolepis		LC BGCI
Rhododendron herzogii		LC BGCI
Rhododendron hirsutum		LC BGCI
Rhododendron hodgsonii		LC BGCI
Rhododendron hypoleucum		LC BGCI
Rhododendron impeditum		LC BGCI
Rhododendron intricatum		LC BGCI
Rhododendron kaempferi		LC BGCI
Rhododendron kiusianum		LC BGCI
Rhododendron kyawii		LC BGCI
Rhododendron lepidotum		LC BGCI
Rhododendron leucaspis		LC BGCI
Rhododendron luteum		LC BGCI
Rhododendron macrophyllum		LC BGCI
Rhododendron maximum		LC BGCI
Rhododendron mekongense var. mekongense		LC BGCI
Rhododendron micranthum		LC BGCI

Rhododendron molle		LC BGCI
Rhododendron montroseanum		LC BGCI
Rhododendron morii		LC BGCI
Rhododendron neoglandulosum		LC BGCI
Rhododendron nipponicum		LC BGCI
Rhododendron oldhamii		LC BGCI
Rhododendron oreodoxa		LC BGCI
Rhododendron oreotrephes		LC BGCI
Rhododendron orthocladum		LC BGCI
Rhododendron ovatum		LC BGCI
Rhododendron pentaphyllum		LC BGCI
Rhododendron periclymenoides		LC BGCI
Rhododendron ponticum		LC BGCI
Rhododendron praestans		LC BGCI
Rhododendron praevernum		LC BGCI
Rhododendron prunifolium		LC BGCI
Rhododendron quinquefolium		LC BGCI
Rhododendron racemosum		LC BGCI
Rhododendron reticulatum		LC BGCI
Rhododendron rex		LR/nt ver 2.3
Rhododendron rigidum		LC BGCI
Rhododendron ripense		LC BGCI
Rhododendron roxieanum		LC BGCI
Rhododendron rubiginosum		LC BGCI
Rhododendron rubropilosum		LC BGCI
Rhododendron rupicola		LC BGCI
Rhododendron russatum		LC BGCI
Rhododendron saluenense		LC BGCI
Rhododendron schlippenbachii		LC BGCI
Rhododendron semibarbatum		LC BGCI
Rhododendron siderophyllum		LC BGCI
Rhododendron sinogrande		LC BGCI
Rhododendron spiciferum		LC BGCI
Rhododendron sutchuenense		LC BGCI
Rhododendron telmateium		LC BGCI
Rhododendron trichocladum		LC BGCI
Rhododendron trichostomum		LC BGCI
Rhododendron vernicosum		LC BGCI
Rhododendron viscosum		LC BGCI
Rhododendron wallichii		LC BGCI
Rhododendron wardii		LC BGCI

Rhododendron weyrichii		LC BGCI
Rhododendron wightii		LC BGCI
Rhododendron wiltonii		LC BGCI
Rhododendron xanthocodon		LC BGCI
Rhododendron yedoense var. poukhanense		LC BGCI
Rhododendron yunnanense		LC BGCI
Rhopalostylis sapida		LR/cd ver 2.3
Saxegothaea conspicua	I	LR/nt ver 3.1
Schefflera taiwaniana		LR/lc ver 2.3
Sinowilsonia henryi		LR/nt ver 2.3
Sorbus tianschanica		LC ver 3.1
Taxodium distichum		LR/lc ver 2.3
Taxus baccata		LR/lc ver 2.3
Taxus brevifolia		LR/nt ver 2.3
Taxus canadensis		LR/lc ver 2.3
Taxus chinensis		LR/lc ver 2.3
Taxus cuspidata		LR/lc ver 2.3
Taxus globosa		LR/nt ver 2.3
Tetraclinis articulata		LC ver 3.1
Thuja occidentalis		LR/lc ver 2.3
Thuja plicata		LR/lc ver 2.3
Thuja standishii		LR/lc ver 2.3
Thujopsis dolabrata		LR/lc ver 2.3
Torreya californica	R	LR/cd ver 2.3
Torreya nucifera		LR/lc ver 2.3
Tsuga canadensis		LR/lc ver 2.3
Tsuga caroliniana		LR/nt ver 2.3
Tsuga chinensis		LR/lc ver 2.3
Tsuga diversifolia		LR/lc ver 2.3
Tsuga heterophylla		LR/lc ver 2.3
Tsuga mertensiana		LR/lc ver 2.3
Tsuga sieboldii		LR/lc ver 2.3
Tsuga yunnanensis		LR/lc ver 2.3
Vitis vinifera		LC BGCI

The categories

EXTINCT (EX) - A taxon is Extinct when there is no reasonable doubt that the last individual has died.
EXTINCT IN THE WILD (EW) - A taxon is Extinct in the wild when it is known only to survive in cultivation, in captivity or as a naturalised population (or populations) well outside the past range. A taxon is presumed extinct in the wild when exhaustive surveys in known and/or expected habitat, at appropriate times (diurnal, seasonal, annual), throughout its historic range have failed to record an individual. Surveys should be over a time frame appropriate to the taxon's life cycle and life form.
CRITICALLY ENDANGERED (CR) - A taxon is Critically Endangered when it is facing an extremely high risk of extinction in the wild in the immediate future, as defined by any of the criteria (A to E) as described below.
ENDANGERED (EN) - A taxon is Endangered when it is not Critically Endangered but is facing a very high risk of extinction in the wild in the near future, as defined by any of the criteria (A to E) as described below.
VULNERABLE (VU) - A taxon is Vulnerable when it is not Critically Endangered or Endangered but is facing a high risk of extinction in the wild in the medium-term future, as defined by any of the criteria (A to E) as described below.
LOWER RISK (LR) - A taxon is Lower Risk when it has been evaluated, does not satisfy the criteria for any of the categories Critically Endangered, Endangered or Vulnerable. Taxa included in the Lower Risk category can be separated into three subcategories:

1. **Conservation Dependent (cd).** Taxa which are the focus of a continuing taxon-specific or habitat-specific conservation programme targeted towards the taxon in question, the cessation of which would result in the taxon qualifying for one of the threatened categories above within a period of five years.
2. **Near Threatened (nt).** Taxa which do not qualify for Conservation Dependent, but which are close to qualifying for Vulnerable.
3. **Least Concern (lc).** Taxa which do not qualify for Conservation Dependent or Near Threatened.

DATA DEFICIENT (DD) A taxon is Data Deficient when there is inadequate information to make a direct, or indirect, assessment of its risk of extinction based on its distribution and/or population status. A taxon in this category may be well studied, and its biology well known, but appropriate data on abundance and/or distribution is lacking. Data Deficient is therefore not a category of threat or Lower Risk. Listing of taxa in this category indicates that more information is required and acknowledges the possibility that future research will show that threatened classification is appropriate. It is important to make positive use of whatever data are available. In many cases great care should be exercised in choosing between DD and threatened status. If the range of a taxon is suspected to be relatively circumscribed, if a considerable period of time has elapsed since the last record of the taxon, threatened status may well be justified.
NOT EVALUATED (NE) A taxon is Not Evaluated when it is has not yet been assessed against the criteria.

V) The criteria for Critically Endangered, Endangered and Vulnerable

CRITICALLY ENDANGERED (CR)

A taxon is Critically Endangered when it is facing an extremely high risk of extinction in the wild in the immediate future, as defined by any of the following criteria (A to E):

A) Population reduction in the form of either of the following:

1) An observed, estimated, inferred or suspected reduction of at least 80% over the last 10 years or three generations, whichever is the longer, based on (and specifying) any of the following:

a) direct observation

b) an index of abundance appropriate for the taxon

c) a decline in area of occupancy, extent of occurrence and/or quality of habitat

d) actual or potential levels of exploitation

e) the effects of introduced taxa, hybridisation, pathogens, pollutants, competitors or parasites.

2) A reduction of at least 80%, projected or suspected to be met within the next 10 years or three generations, whichever is the longer, based on (and specifying) any of (b), (c), (d) or (e) above.

B) Extent of occurrence estimated to be less than 100 km^2 or area of occupancy estimated to be less than 10 km^2, and estimates indicating any two of the following:

1) Severely fragmented or known to exist at only a single location.

2) Continuing decline, observed, inferred or projected, in any of the following:

a) extent of occurrence

b) area of occupancy

c) area, extent and/or quality of habitat

d) number of locations or subpopulations

e) number of mature individuals

3) Extreme fluctuations in any of the following:

a) extent of occurrence

b) area of occupancy

c) number of locations or subpopulations

d) number of mature individuals

C) Population estimated to number less than 250 mature individuals and either:

1) An estimated continuing decline of at least 25% within three years or one generation, whichever is longer or

2) A continuing decline, observed, projected, or inferred, in numbers of mature individuals and population structure in the form of either:

a) severely fragmented (i.e. no subpopulation estimated to contain more than 50 mature individuals)

b) all individuals are in a single subpopulation

D) Population estimated to number less than 50 mature individuals.

E) Quantitative analysis showing the probability of extinction in the wild is at least 50% within 10 years or three generations, whichever is the longer.

ENDANGERED (EN)

A taxon is Endangered when it is not Critically Endangered but is facing a very high risk of extinction in the wild in the near future, as defined by any of the following criteria (A to E):

A) Population reduction in the form of either of the following:

1) An observed, estimated, inferred or suspected reduction of at least 50% over the last 10 years or three generations, whichever is the longer, based on (and specifying) any of the following:

a) direct observation

b) an index of abundance appropriate for the taxon

c) a decline in area of occupancy, extent of occurrence and/or quality of habitat

d) actual or potential levels of exploitation
e) the effects of introduced taxa, hybridisation, pathogens, pollutants, competitors or parasites.
2) A reduction of at least 50%, projected or suspected to be met within the next 10 years or three generations, whichever is the longer, based on (and specifying) any of (b), (c), (d), or (e) above.
B) Extent of occurrence estimated to be less than 5000 km^2 or area of occupancy estimated to be less than 500 km^2, and estimates indicating any two of the following:
1) Severely fragmented or known to exist at no more than five locations.
2) Continuing decline, inferred, observed or projected, in any of the following:
a) extent of occurrence
b) area of occupancy
c) area, extent and/or quality of habitat
d) number of locations or subpopulations
e) number of mature individuals
3) Extreme fluctuations in any of the following:
a) extent of occurrence
b) area of occupancy
c) number of locations or subpopulations
d) number of mature individuals
C) Population estimated to number less than 2500 mature individuals and either:
1) An estimated continuing decline of at least 20% within five years or two generations, whichever is longer, or
2) A continuing decline, observed, projected, or inferred, in numbers of mature individuals and population structure in the form of either:
a) severely fragmented (i.e. no subpopulation estimated to contain more than 250 mature individuals)
b) all individuals are in a single subpopulation.
D) Population estimated to number less than 250 mature individuals.
E) Quantitative analysis showing the probability of extinction in the wild is at least 20% within 20 years or five generations, whichever is the longer.

VULNERABLE (VU)

A taxon is Vulnerable when it is not Critically Endangered or Endangered but is facing a high risk of extinction in the wild in the medium-term future, as defined by any of the following criteria (A to E):

A) Population reduction in the form of either of the following:
1) An observed, estimated, inferred or suspected reduction of at least 20% over the last 10 years or three generations, whichever is the longer, based on (and specifying) any of the following:
a) direct observation
b) an index of abundance appropriate for the taxon
c) a decline in area of occupancy, extent of occurrence and/or quality of habitat
d) actual or potential levels of exploitation
e) the effects of introduced taxa, hybridisation, pathogens, pollutants, competitors or parasites.
2) A reduction of at least 20%, projected or suspected to be met within the next ten years or three generations, whichever is the longer, based on (and specifying) any of (b), (c), (d) or (e) above.
B) Extent of occurrence estimated to be less than 20,000 km^2 or area of occupancy estimated to be less than 2000 km^2, and estimates indicating any two of the following:
1) Severely fragmented or known to exist at no more than ten locations.

2) Continuing decline, inferred, observed or projected, in any of the following:
a) extent of occurrence
b) area of occupancy
c) area, extent and/or quality of habitaty
d) number of locations or subpopulations
e) number of mature individuals
3) Extreme fluctuations in any of the following:
a) extent of occurrence
b) area of occupancy
c) number of locations or subpopulations
d) number of mature individuals

C) Population estimated to number less than 10,000 mature individuals and either:
1) An estimated continuing decline of at least 10% within 10 years or three generations, whichever is longer, or
2) A continuing decline, observed, projected, or inferred, in numbers of mature individuals and population structure in the form of either:
a) severely fragmented (i.e. no subpopulation estimated to contain more than 1000 mature individuals)
b) all individuals are in a single subpopulation

D) Population very small or restricted in the form of either of the following:
1) Population estimated to number less than 1000 mature individuals.
2) Population is characterised by an acute restriction in its area of occupancy (typically less than 100 km^2) or in the number of locations (typically less than five). Such a taxon would thus be prone to the effects of human activities (or stochastic events whose impact is increased by human activities) within a very short period of time in an unforeseeable future, and is thus capable of becoming Critically Endangered or even Extinct in a very short period.

E) Quantitative analysis showing the probability of extinction in the wild is at least 10% within 100 years.

THE CATEGORIES

A representation of the relationships between the categories is shown in Figure 1.

EXTINCT (EX)

A taxon is Extinct when there is no reasonable doubt that the last individual has died. A taxon is presumed Extinct when exhaustive surveys in known and/or expected habitat, at appropriate times (diurnal, seasonal, annual), throughout its historic range have failed to record an individual. Surveys should be over a time frame appropriate to the taxon's life cycle and life form.

EXTINCT IN THE WILD (EW)

A taxon is Extinct in the Wild when it is known only to survive in cultivation, in captivity or as a naturalized population (or populations) well outside the past range. A taxon is presumed Extinct in the Wild when exhaustive surveys in known and/or expected habitat, at appropriate times (diurnal, seasonal, annual), throughout its historic range have failed to record an individual. Surveys should be over a time frame appropriate to the taxon's life cycle and life form.

CRITICALLY ENDANGERED (CR)

A taxon is Critically Endangered when the best available evidence indicates that it meets any of the criteria A to E for Critically Endangered (see Section V), and it is therefore considered to be facing an extremely high risk of extinction in the wild.

ENDANGERED (EN)

A taxon is Endangered when the best available evidence indicates that it meets any of the criteria A to E for Endangered (see Section V), and it is therefore considered to be facing a very high risk of extinction in the wild.

VULNERABLE (VU)

A taxon is Vulnerable when the best available evidence indicates that it meets any of the criteria A to E for Vulnerable (see Section V), and it is therefore considered to be facing a high risk of extinction in the wild.

NEAR THREATENED (NT)

A taxon is Near Threatened when it has been evaluated against the criteria but does not qualify for Critically Endangered, Endangered or Vulnerable now, but is close to qualifying for or is likely to qualify for a threatened category in the near future.

LEAST CONCERN (LC)

A taxon is Least Concern when it has been evaluated against the criteria and does not qualify for Critically Endangered, Endangered, Vulnerable or Near Threatened. Widespread and abundant taxa are included in this category.

DATA DEFICIENT (DD)

A taxon is Data Deficient when there is inadequate information to make a direct, or indirect, assessment of its risk of extinction based on its distribution and/or population status. A taxon in this category may be well studied, and its biology well known, but appropriate data on abundance and/or distribution are lacking. Data Deficient is therefore not a category of threat. Listing of taxa in this category indicates that more information is required and acknowledges the possibility that future research will show that threatened classification is appropriate. It is important to make positive use of whatever data are available. In many cases great care should be exercised in choosing between DD and a threatened status. If the range of a taxon is suspected to be relatively circumscribed, and a considerable period of time has elapsed since the last record of the taxon, threatened status may well be justified.

NOT EVALUATED (NE)

A taxon is Not Evaluated when it is has not yet been evaluated against the criteria.

Note: As in previous IUCN categories, the abbreviation of each category (in parenthesis) follows the English denominations when translated into other languages (see Annex 2).

V. THE CRITERIA FOR CRITICALLY ENDANGERED, ENDANGERED AND VULNERABLE

CRITICALLY ENDANGERED (CR)

A taxon is Critically Endangered when the best available evidence indicates that it meets any of the following criteria (A to E), and it is therefore considered to be facing an extremely high risk of extinction in the wild:

A. Reduction in population size based on any of the following:

1. An observed, estimated, inferred or suspected population size reduction of ≥ 90% over the last 10 years or three generations, whichever is the longer, where the causes of the reduction are clearly reversible AND understood AND ceased, based on (and specifying) any of the following:

(a) direct observation
(b) an index of abundance appropriate to the taxon
(c) a decline in area of occupancy, extent of occurrence and/or quality of habitat
(d) actual or potential levels of exploitation
(e) the effects of introduced taxa, hybridization, pathogens, pollutants, competitors or parasites.

2. An observed, estimated, inferred or suspected population size reduction of ≥ 80% over the last 10 years or three generations, whichever is the longer, where the reduction or its causes may not have ceased OR may not be understood OR may not be reversible, based on (and specifying) any of (a) to (e) under A1.
3. A population size reduction of ≥ 80%, projected or suspected to be met within the next 10 years or three generations, whichever is the longer (up to a maximum of 100 years), based on (and specifying) any of (b) to (e) under A1.
4. An observed, estimated, inferred, projected or suspected population size reduction of ≥ 80% over any 10 year or three generation period, whichever is longer (up to a maximum of 100 years in the future), where the time period must include both the past and the future, and where the reduction or its causes may not have ceased OR may not be understood OR may not be reversible, based on (and specifying) any of (a) to (e) under A1.

B. Geographic range in the form of either B1 (extent of occurrence) OR B2 (area of occupancy) OR both:

1. Extent of occurrence estimated to be less than 100 km^2, and estimates indicating at least two of a-c:

a. Severely fragmented or known to exist at only a single location.
b. Continuing decline, observed, inferred or projected, in any of the following:
(i) extent of occurrence
(ii) area of occupancy
(iii) area, extent and/or quality of habitat
(iv) number of locations or subpopulations
(v) number of mature individuals.
c. Extreme fluctuations in any of the following:
(i) extent of occurrence
(ii) area of occupancy
(iii) number of locations or subpopulations
(iv) number of mature individuals.

2. Area of occupancy estimated to be less than 10 km^2, and estimates indicating at least two of a-c:
a. Severely fragmented or known to exist at only a single location.
b. Continuing decline, observed, inferred or projected, in any of the following:
(i) extent of occurrence
(ii) area of occupancy
(iii) area, extent and/or quality of habitat
(iv) number of locations or subpopulations
(v) number of mature individuals.
c. Extreme fluctuations in any of the following:
(i) extent of occurrence
(ii) area of occupancy
(iii) number of locations or subpopulations
(iv) number of mature individuals.
C. Population size estimated to number fewer than 250 mature individuals and either:
1. An estimated continuing decline of at least 25% within three years or one generation, whichever is longer, (up to a maximum of 100 years in the future) OR
2. A continuing decline, observed, projected, or inferred, in numbers of mature individuals AND at least one of the following (a-b):
(a) Population structure in the form of one of the following:
(i) no subpopulation estimated to contain more than 50 mature individuals, OR
(ii) at least 90% of mature individuals in one subpopulation.
(b) Extreme fluctuations in number of mature individuals.
D. Population size estimated to number fewer than 50 mature individuals.
E. Quantitative analysis showing the probability of extinction in the wild is at least 50% within 10 years or three generations, whichever is the longer (up to a maximum of 100 years).

ENDANGERED (EN)

A taxon is Endangered when the best available evidence indicates that it meets any of the following criteria (A to E), and it is therefore considered to be facing a very high risk of extinction in the wild:

A. Reduction in population size based on any of the following:
1. An observed, estimated, inferred or suspected population size reduction of ≥ 70% over the last 10 years or three generations, whichever is the longer, where the causes of the reduction are clearly reversible AND understood AND ceased, based on (and specifying) any of the following:
(a) direct observation
(b) an index of abundance appropriate to the taxon
(c) a decline in area of occupancy, extent of occurrence and/or quality of habitat
(d) actual or potential levels of exploitation
(e) the effects of introduced taxa, hybridization, pathogens, pollutants, competitors or parasites.
2. An observed, estimated, inferred or suspected population size reduction of ≥ 50% over the last 10 years or three generations, whichever is the longer, where the reduction or its causes may not have ceased OR may not be understood OR may not be reversible, based on (and specifying) any of (a) to (e) under A1.
3. A population size reduction of ≥nbsp;50%, projected or suspected to be met within the next 10 years or three generations, whichever is the longer (up to a maximum of 100 years), based on (and specifying) any of (b) to (e) under A1.
4. An observed, estimated, inferred, projected or suspected population size reduction of ≥ 50% over any 10 year or three generation period, whichever is longer (up to a

maximum of 100 years in the future), where the time period must include both the past and the future, and where the reduction or its causes may not have ceased OR may not be understood OR may not be reversible, based on (and specifying) any of (a) to (e) under A1.

B. Geographic range in the form of either B1 (extent of occurrence) OR B2 (area of occupancy) OR both:

1. Extent of occurrence estimated to be less than 5000 km^2, and estimates indicating at least two of a-c:

a. Severely fragmented or known to exist at no more than five locations.

b. Continuing decline, observed, inferred or projected, in any of the following:

(i) extent of occurrence

(ii) area of occupancy

(iii) area, extent and/or quality of habitat

(iv) number of locations or subpopulations

(v) number of mature individuals.

c. Extreme fluctuations in any of the following:

(i) extent of occurrence

(ii) area of occupancy

(iii) number of locations or subpopulations

(iv) number of mature individuals.

2. Area of occupancy estimated to be less than 500 km^2, and estimates indicating at least two of a-c:

a. Severely fragmented or known to exist at no more than five locations.

b. Continuing decline, observed, inferred or projected, in any of the following:

(i) extent of occurrence

(ii) area of occupancy

(iii) area, extent and/or quality of habitat

(iv) number of locations or subpopulations

(v) number of mature individuals.

c. Extreme fluctuations in any of the following:

(i) extent of occurrence

(ii) area of occupancy

(iii) number of locations or subpopulations

(iv) number of mature individuals.

C. Population size estimated to number fewer than 2500 mature individuals and either:

1. An estimated continuing decline of at least 20% within five years or two generations, whichever is longer, (up to a maximum of 100 years in the future) OR

2. A continuing decline, observed, projected, or inferred, in numbers of mature individuals AND at least one of the following (a-b):

(a) Population structure in the form of one of the following:

(i) no subpopulation estimated to contain more than 250 mature individuals, OR

(ii) at least 95% of mature individuals in one subpopulation.

(b) Extreme fluctuations in number of mature individuals.

D. Population size estimated to number fewer than 250 mature individuals.

E. Quantitative analysis showing the probability of extinction in the wild is at least 20% within 20 years or five generations, whichever is the longer (up to a maximum of 100 years).

VULNERABLE (VU)

A taxon is Vulnerable when the best available evidence indicates that it meets any of the following criteria (A to E), and it is therefore considered to be facing a high risk of extinction in the wild:

A. Reduction in population size based on any of the following:
1. An observed, estimated, inferred or suspected population size reduction of ≥ 50% over the last 10 years or three generations, whichever is the longer, where the causes of the reduction are: clearly reversible AND understood AND ceased, based on (and specifying) any of the following:
(a) direct observation
(b) an index of abundance appropriate to the taxon
(c) a decline in area of occupancy, extent of occurrence and/or quality of habitat
(d) actual or potential levels of exploitation
(e) the effects of introduced taxa, hybridization, pathogens, pollutants, competitors or parasites.
2. An observed, estimated, inferred or suspected population size reduction of ≥ 30% over the last 10 years or three generations, whichever is the longer, where the reduction or its causes may not have ceased OR may not be understood OR may not be reversible, based on (and specifying) any of (a) to (e) under A1.
3. A population size reduction of ≥ 30%, projected or suspected to be met within the next 10 years or three generations, whichever is the longer (up to a maximum of 100 years), based on (and specifying) any of (b) to (e) under A1.
4. An observed, estimated, inferred, projected or suspected population size reduction of ≥ 30% over any 10 year or three generation period, whichever is longer (up to a maximum of 100 years in the future), where the time period must include both the past and the future, and where the reduction or its causes may not have ceased OR may not be understood OR may not be reversible, based on (and specifying) any of (a) to (e) under A1.
B. Geographic range in the form of either B1 (extent of occurrence) OR B2 (area of occupancy) OR both:
1. Extent of occurrence estimated to be less than 20,000 km^2, and estimates indicating at least two of a-c:
a. Severely fragmented or known to exist at no more than 10 locations.
b. Continuing decline, observed, inferred or projected, in any of the following:
(i) extent of occurrence
(ii) area of occupancy
(iii) area, extent and/or quality of habitat
(iv) number of locations or subpopulations
(v) number of mature individuals.
c. Extreme fluctuations in any of the following:
(i) extent of occurrence
(ii) area of occupancy
(iii) number of locations or subpopulations
(iv) number of mature individuals.
2. Area of occupancy estimated to be less than 2000 km^2, and estimates indicating at least two of a-c:
a. Severely fragmented or known to exist at no more than 10 locations.
b. Continuing decline, observed, inferred or projected, in any of the following:
(i) extent of occurrence
(ii) area of occupancy
(iii) area, extent and/or quality of habitat
(iv) number of locations or subpopulations
(v) number of mature individuals.
c. Extreme fluctuations in any of the following:
(i) extent of occurrence

(ii) area of occupancy
(iii) number of locations or subpopulations
(iv) number of mature individuals.
C. Population size estimated to number fewer than 10,000 mature individuals and either:
1. An estimated continuing decline of at least 10% within 10 years or three generations, whichever is longer, (up to a maximum of 100 years in the future) OR
2. A continuing decline, observed, projected, or inferred, in numbers of mature individuals AND at least one of the following (a-b):
(a) Population structure in the form of one of the following:
(i) no subpopulation estimated to contain more than 1000 mature individuals, OR
(ii) all mature individuals are in one subpopulation.
(b) Extreme fluctuations in number of mature individuals.
D. Population very small or restricted in the form of either of the following:
1. Population size estimated to number fewer than 1000 mature individuals.
2. Population with a very restricted area of occupancy (typically less than 20 km^2) or number of locations (typically five or fewer) such that it is prone to the effects of human activities or stochastic events within a very short time period in an uncertain future, and is thus capable of becoming Critically Endangered or even Extinct in a very short time period.
E. Quantitative analysis showing the probability of extinction in the wild is at least 10% within 100 years.

1. Identify Species
   a. Run query in BG-BASE for all living accessions
      i. Import results into Excel
      ii. Sort by accession number, and remove all records that lack an accession number (removes synonyms and historic accessions)
      iii. Sort again by species name
   b. Run query in IUCN Red List for all plant species
      i. Create a user account so search can be saved and exported
      ii. Export search as .csv file, and import into Excel
   c. Visit BGCI website and locate their current available Red List publications. Download and save.
   d. Begin inventory
      i. Review the 2 Excel files (BG-BASE and IUCN). Highlight the species in common.
      ii. Review BGCI publications. Highlight the species in common on the BG-BASE file. Suggested—use an alternate color to distinguish BGCI plants, so they can be properly noted in the plant records.

2. Update Plant Records (BG-BASE)
   a. In the Names module, locate individual plant records by name number
   b. For each record:
      i. Look the species up in the Tropicos database to check correct accepted name and synonyms. Correct in BG-BASE as necessary.
      ii. Enter range information, if field is blank.
      iii. Enter current IUCN category and criteria, followed by the version of criteria used (e.g., EN A2ac; B2ab(ii,iii) ver 3.1) in the conservation status area.
      iv. For BGCI-listed plants, give the category and criteria, followed with "BGCI" (e.g., VU B1ab(i,ii,iii)+B2ab(i,ii,iii) BGCI).

3. Perform Field Checks
   a. Run query in BG-BASE to locate all plants with conservation status
   b. Import result into inventory template, in Excel
   c. Print up corresponding grid maps
   d. Locate individual plants in field and review, following the Inventory Grid Manual. In particular, note the following:
      i. General appearance of plant
      ii. Reproductive state of plant (flowering, presence of fruits, etc.)
      iii. Fall leaf color, if applicable
      iv. Horticultural notes, which may include but are not limited to the following: presence of lean and if self-corrected, twig dieback, appropriateness of planting location, overall form of plant, signs of stress or decay. Consult with horticulture staff for their desired notes.
      v. Tags on plants. Each plant should have a metal tag with a unique qualifier (letter after accession number). Some plants will have a green plastic tag

with accession number, species name, and range. Note whether tags are old, new, or missing entirely on the inventory sheet.

vi. If a plant's location on a map is incorrect, note the correction on the map.

4. Enter the data from field checks in the Plants module of BG-BASE.
    i. Create a new line item for field check information
    ii. Complete the fields for each plant

5. Enter the tag information into the inventory template already populated in Excel (old, new, missing for both plastic and metal tag columns), for use by plant records staff.

6. In order to create reports or perform an analysis of the collection, run a query in BG-BASE for all living accessions with conservation status, and import into Excel. This file will contain all the information necessary to analyze the collection.
    i. Organize the Excel spreadsheet in the following way:
        a. Cut and paste the Least Concern plants into their own sheet (The LC Collection)
        b. Copy and paste the conservation inventories for each of the core collections (*Acer, Ilex, Magnolia, Viburnum, Pinaceae,* and *Quercus*)
        c. An additional sheet that contains the entire conservation collection inventory remains

Field Check Guidelines (from the Grid Inventory Manual for UWBG, page 5)

When doing a field check it is important to note on your checklist the condition of the plant, whether it has (or needs) metal or plastic labels, and make note of anything that stands out about the plant. This may include insect damage, physical damage, cultural problems, disease, etc. When noting the condition of the plant, the following descriptions are available:

E = Excellent: very well-formed plant with foliage not disfigured.
G = Good: well-formed plant with less than 30% foliage disfigured by foliar disease or insect infestation.
F = Fair: plant slightly misshapen and/or much of the foliage disfigured (more than 30%)
P = Poor: plant extremely deformed and/or nearly defoliated, with remaining foliage disfigured by foliar disease or insect infestation.
D = Dead: plant may or may not have been removed, or stump may be present. Not necessarily reported by the crew as removed.
R = Removed: the plant was reported by the crew to be removed.
U = Unable to Locate: use this when you have determined that the plant does not exist in the field but is listed on the checklist as still being alive.

Sometimes you may not be able to locate a plant in the field. When this happens make note of it on your checklist so you can check the records and see if it was removed and some records were not updated. If you find a plant that is dead, make special note of it. You will need to ask a staff person to file a condition report so that the horticultural crew can be alerted to take appropriate action. Dead trees can be a hazard as well as an eyesore, and should be removed by the horticultural crew. You may find a situation where a plant was removed, but the stump was not ground, resulting in a resprouting plant. This should be reported in the same manner as a dead tree, and reviewed by the staff person. In case the plant was of a valuable accession that was thought to be lost, we would want to make absolutely certain that the plant is indeed of this accession, not rootstock or a volunteer, and therefore eligible to be resurrected.