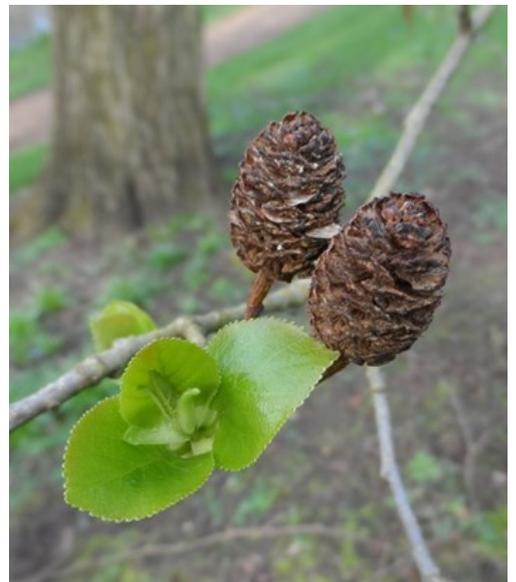


Global Survey of *Ex situ* Betulaceae Collections



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Photo credits

Front cover: Top (L-R): *Alnus pendula*, Least Concern; Wakehurst Place. Bottom (L-R): *Alnus viridis*, Least Concern. Credit: P. Bartlett; *Betula delavayi*, Data Deficient; *Alnus cordata*, Least Concern.
In text: BGCI.

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Acronyms

CR	Critically Endangered	BGCI	Botanic Gardens Conservation International
EN	Endangered	DAPC	Database of Asian Plants in Cultivation
VU	Vulnerable	FFI	Fauna & Flora International
NT	Near Threatened	GTC	Global Trees Campaign
DD	Data Deficient	GSPC	Global Strategy for Plant Conservation
LC	Least Concern	ICCP	International Conifer Conservation Programme
		IPSN	International Plant Sentinel Network
		IUCN	International Union for Conservation of Nature
		IUCN/SSC	International Union for Conservation of Nature/Species Survival Commission
		USDA	United States Department of Agriculture

Summary

Following a collaborative international effort, *The Red List of Betulaceae* was published in 2014 by Botanic Gardens Conservation International (BGCI) as part of our ongoing contributions to the Global Trees Campaign (GTC). The report contained conservation assessments of 240 Betulaceae taxa, using IUCN Red List Categories and Criteria (version 3.1). *The Red List of Betulaceae* identified 16 taxa at risk of extinction in the wild (assessed as Critically Endangered, Endangered or Vulnerable) and in need of conservation action. A further five taxa were assessed as Near Threatened. The report also highlighted that there is a lack of data available for many Betulaceae taxa (83 taxa were classified as Data Deficient) and made a call for increased research to be undertaken for these taxa.

To further determine conservation priorities, BGCI has undertaken an analysis of *ex situ* collections of Betulaceae taxa. This report contains the results of a global survey of *ex situ* Betulaceae taxa, as recorded in BGCI's PlantSearch database, and supplemented by other online *ex situ* collection databases (as detailed below).

This *ex situ* survey has identified 6394 records of accepted Betulaceae taxa from 440 institutions. Of the 16 threatened taxa (Critically Endangered, Endangered and Vulnerable), 12 taxa are reported as held in *ex situ* collections (75%). The remaining four taxa should therefore be brought into *ex situ* collections as an immediate priority. *Ex situ* conservation should be stepped up for all threatened Betulaceae taxa, as those reported as present in collections are limited to a small number of collections. Analysis is presented in the Results section of this report (page 7).

Annex 1 of this report (page 18) provides a full list of Betulaceae taxa and the number of reported *ex situ* collections per taxon, enabling identification of taxa currently absent from, or represented only in a small number of collections.

A more comprehensive understanding of the conservation status of Betulaceae (as presented in *The Red List of Betulaceae*) as well as the analysis of *ex situ* collections presented in this report, provides a strong basis to set conservation priorities.

This report also provides recommendations to strengthen *ex situ* conservation efforts for the entire Betulaceae family through methods such as increasing the genetic diversity of existing collections, as well as accessioning new taxa to collections and increasing the number of collection holdings. The report also recommends the use of collections in reintroduction and restoration programmes, to support remaining wild populations of Betulaceae taxa.

Introduction

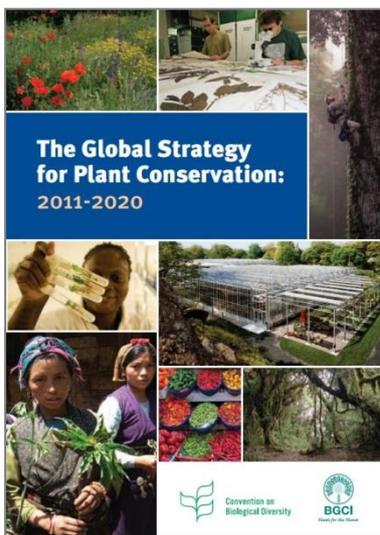
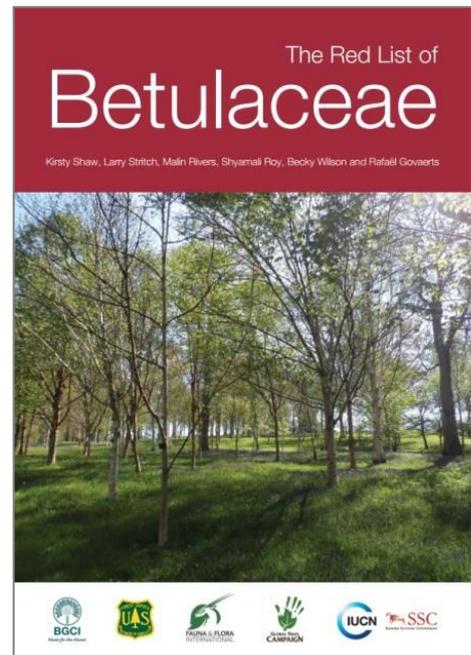
The Red List of Betulaceae (Shaw *et al.*, 2014) was produced by Botanic Gardens Conservation International (BGCI) and the USDA Forest Service in 2014, as part of BGCI's contributions to the Global Trees Campaign (GTC). Electronic copies of the report are available to download from the BGCI website (www.bgci.org) and the GTC website (www.globaltrees.org).

Betulaceae is a family containing many commercially important timber and nut producing trees. Betulaceae taxa are distributed across a large proportion of the northern hemisphere, from Canada in the West to China, Japan and Siberia in the East.

The Betulaceae family consists of six genera of trees and shrubs; *Alnus* (Alder), *Betula* (Birch), *Carpinus* (Hornbeam), *Corylus* (Hazel), *Ostrya* (Hop Hornbeam) and *Ostryopsis*. There are approximately 166 species and 240 taxa, however this number varies with taxonomic uncertainty.

There are several Betulaceae taxa which are only represented in the wild by small populations. *In situ* conservation action is a priority for these taxa to avoid their extinction. Options include habitat protection, monitoring, and propagation and reintroduction programmes to support remaining populations. Initiatives should aim to include local people to ensure sustainability of conservation measures and continued benefit from provisioning and ecosystem services provided by these species.

Alongside *in situ* conservation measures, it is also important to ensure that all threatened taxa are represented in well-managed *ex situ* collections, providing an insurance policy for wild populations and mitigating the risks posed by natural disaster. *Ex situ* options for Betulaceae taxa include seed banking, cryopreservation, as well as maintenance of living collections in botanic gardens and arboreta. To maximise conservation value, *ex situ* collections should be genetically diverse, to enable recovery and restoration programmes. *Ex situ* conservation collections support the achievement of Target 8 of the Global Strategy for Plant Conservation (GSPC) (CBD, 2012).



Global Strategy for Plant Conservation (2011-2020), Target 8:

At least 75 per cent of threatened plant species in ex situ collections, preferably in the country of origin, and at least 20 per cent available for recovery and restoration programmes

Methodology

A global survey of *ex situ* collections of Betulaceae taxa was undertaken by BGCI, building on information held within BGCI's PlantSearch Database (BGCI, 2015). The aim of the survey was to assess gaps in reported *ex situ* collections of Betulaceae and to develop a prioritised plan for the long term integrated conservation of Betulaceae taxa, with a focus on threatened taxa; Critically Endangered (CR), Endangered (EN) and Vulnerable (VU).

The survey was promoted on the BGCI website (www.bgci.org), in BGCI's e-newsletter, *Cultivate*, and survey announcements were sent out via a number of relevant listserv and mailing lists as well as over social media. Botanic gardens, arboreta and seed banks were encouraged to upload or update their collection records in BGCI's PlantSearch database.

The list of 240 Betulaceae taxa assessed in *The Red List of Betulaceae* was compared to *ex situ* collection records held on:

- BGCI's PlantSearch database (www.bgci.org/plant_search.php)
- Other online databases of *ex situ* collections:
 - ↳ Database of Asian Plants in Cultivation (DAPC) maintained by Quarryhill Botanical Garden and California Academy of Sciences (www.research.calacademy.org/research/botany/quarryhill/index.asp)
 - ↳ Additional institutional collection records not represented on PlantSearch

Duplicate collection records were removed from the analysis.

The list of 240 taxa assessed in *The Red List of Betulaceae* is based on accepted names in the *Betula* monograph (Ashburner and McAllister, 2013) and accepted names in The World Checklist of Selected Plant Families (Govaerts & Bopp, 2015). Analysis of representation of Betulaceae taxa in *ex situ* collections is based on accepted names.

Records held in PlantSearch that matched to genus level, but did not match full accepted name records (cultivars, synonyms and incorrect nomenclature) were used in the analysis of collection balance.

Unstable taxonomy, unclear synonymy, as well as incorrect identification of specimens are inherent limitations associated with surveys of this nature. This survey also relies heavily on the participation of collection holders and provision of data to BGCI's PlantSearch database. It is likely that important additional specimens will be held in private collections which are poorly represented in surveys such as this, as botanic garden, arboreta and seed banks are the main users of PlantSearch and were the main focus of the calls collection information. In addition, collections are not static and changes are not always updated by PlantSearch users.

A final caveat is that this survey assesses presence or absence of taxa in collections, but does not attempt to assess the quality of the *ex situ* collections. It is therefore not possible to determine their true conservation value and suitability for recovery and restoration programmes from this survey alone. Readers of this report are therefore encouraged to search for specific taxa of interest in the online PlantSearch database to enable identification of the most up to date information on number of collections. PlantSearch also provides the facility to contact collection holders to request further information or plant material: www.bgci.org/plant_search.php.

Results

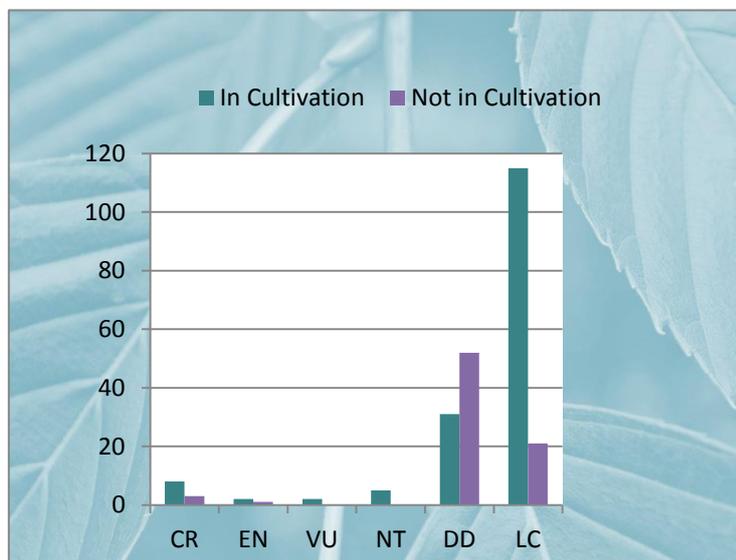
General findings

The survey identified 6394 records¹ of accepted Betulaceae taxa from 440 institutions. Analysis of these records indicates that 68% of accepted Betulaceae taxa (163 out of 240) are reported as held in *ex situ* collections.

Threatened taxa

Figure 1. Summary results – presence and absence of Betulaceae taxa reported in *ex situ* collections by IUCN Red List status

	In Cultivation	Not in Cultivation	Total
CR	8	3	11
EN	2	1	3
VU	2	0	2
NT	5	0	5
DD	31	52	83
LC	115	21	136
Total	163	77	240



Of the 16 threatened Betulaceae taxa, 12 taxa are reported as held in *ex situ* collections (75%), represented by 122 records. This indicates that the *ex situ* component of Target 8 of the GSPC is met for this family, but ideally all threatened taxa should be protected in *ex situ* collections.

Three Critically Endangered (CR) taxa are not reported as held in any *ex situ* collections; *Alnus maritima* ssp. *oklahomensis*, *Betula gynoterminalis* and *Carpinus hebestroma*.

One Endangered (EN) taxon is not reported as held in any *ex situ* collections; *Alnus maritima* ssp. *maritima*.

These taxa should be brought into *ex situ* collections as a priority. Country-level distribution information for priority taxa is provided in Table 1 below as a call to action for botanic gardens in these countries.

¹ For the purposes of this survey, a record is the presence of a single living accepted *Betulaceae* taxon within an institution and may include multiple accessions and/or individuals

All VU and NT are reported as represented in *ex situ* collections. However most of these taxa are limited to a small number of collections.

Ex situ collections, particularly of threatened taxa, should ideally be represented at multiple *ex situ* sites. Table 1 below shows that most threatened Betulaceae taxa reported as held in *ex situ* collections are limited to a small number of collections. The most well represented Betulaceae taxon reported in *ex situ* collections is the Vulnerable *Alnus subcordata* reported as held in 41 collections.

Table 1. Number of reported *ex situ* collections of threatened Betulaceae taxa (CR, EN and VU) and country-level distribution.

Species	Number of collections	Country of origin
Critically Endangered taxa		
<i>Betula chichibuensis</i>	28	Japan
<i>Ostrya rehderiana</i>	10	China
<i>Carpinus putoensis</i>	6	China
<i>Betula murrayana</i>	5	Canada, United States of America
<i>Alnus henryi</i>	3	Taiwan
<i>Ostrya chisosensis</i>	3	United States of America
<i>Alnus maritima</i> ssp. <i>georgiensis</i>	1	United States of America
<i>Carpinus tientaiensis</i>	1	China
<i>Alnus maritima</i> ssp. <i>oklahomensis</i>	0	United States of America
<i>Betula gynoterminalis</i>	0	China
<i>Carpinus hebestroma</i>	0	Taiwan
Endangered taxa		
<i>Alnus maritima</i>	36	United States of America
<i>Betula megrelica</i>	8	Georgia
<i>Alnus maritima</i> ssp. <i>maritima</i>	0	United States of America
Vulnerable taxa		
<i>Alnus subcordata</i>	41	Azerbaijan, Iran
<i>Corylus colchica</i>	2	Georgia
Near Threatened taxa		
<i>Betula medwediewii</i>	43	Georgia, Turkey, Iran, Azerbaijan, Armenia
<i>Betula tianschanica</i>	36	China, Kazakhstan, Kyrgyzstan, Mongolia, Tajikistan, Uzbekistan
<i>Betula globispica</i>	21	Japan
<i>Betula calcicola</i>	7	China
<i>Betula bomiensis</i>	5	Tibet

Data Deficient and Least Concern taxa

Of the 83 taxa assessed as Data Deficient (DD) in *The Red List of Betulaceae*, 52 taxa are not reported as represented in *ex situ* collections. There is taxonomic debate surrounding many of these taxa and they may therefore be listed in *ex situ* collection databases under different names. Seven of the DD taxa not reported in collections are recently described taxa (described since 2010) so are less likely to be found in collections, at least under that taxon name, compared to taxa described long ago. 24 of the DD taxa not reported in collections originate from China. It is possible that some of these taxa are found in Chinese botanic gardens that to date have not provided collection information to PlantSearch or other consulted databases.

Of the 136 taxa assessed as Least Concern (LC), 21 are not reported as found in *ex situ* collections. Ten of those taxa are found in China and were assessed as Least Concern on the Chinese Red List (CAS, 2014), but little or no additional information was available on distribution or threats. The lack of information available for these taxa may explain their absence from collections, and some may be represented in Chinese botanic gardens that to date have not provided collection information to consulted databases.

Although collection information held in BGCI's PlantSearch database and other consulted databases is not complete, it is the best information available and highlights that many DD and LC taxa reported as held in collections are represented by a small number of collections. Target 8 of the GSPC highlights the preference for *ex situ* collections to be held in the country of origin. An initial analysis of distribution information indicates that many taxa are held in collections far from their natural range. This can hinder the value of collections for use in restoration programmes. The results also highlight a need to encourage provision of more comprehensive collection data to PlantSearch from regions where many of the DD taxa occur, predominantly China and Japan.

Genus level analysis

Alnus

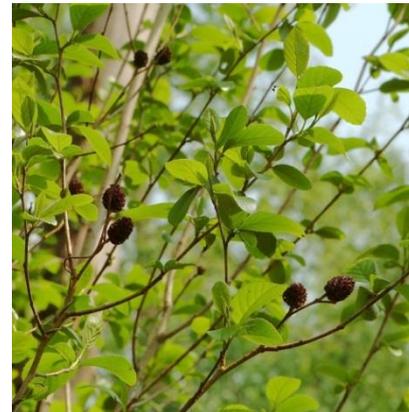
Of the 58 *Alnus* taxa, 45 (or 78%) are reported as found in *ex situ* collections. *Alnus*, commonly called Alders, are popular ornamental trees due to their attractive catkins and cones.



Alnus pendula, LC,
Korea & Japan



Alnus henryi, CR,
Taiwan



Alnus maritima ssp. *georgiensis*,
CR, U.S.A

Betula

Of the 79 *Betula* taxa, 58 (or 73%) are reported as represented in *ex situ* collections. *Betula*, commonly called Birch, are popular ornamental trees and shrubs because of their unique bark and attractive catkins.



Betula chichibuensis, CR, Japan



Betula megrelica, EN, Georgia

Carpinus

There are 63 *Carpinus* taxa, 29 (or 46%) of which are reported as found in collections. Many *Carpinus* taxa, commonly known as Hornbeams, have attractive deeply ribbed leaves and are used in hedging.



Carpinus betulus, LC, Europe to Iran

Corylus

85%, or 22 of the 26 *Corylus* taxa are reported as represented in collections. The entire *Corylus* genus, or the Hazels, produce edible nuts known as hazelnuts or cobnuts.



Corylus sieboldiana var. *mandshurica*, LC
Siberia to Japan

Ostrya

Of the 11 *Ostrya* taxa, seven (or 64%) are reported as found in collections. This includes the Critically Endangered *Ostrya chisosensis*, reported as found in three *ex situ* collections and also protected *in situ* in Big Bend National Park, Texas.



Ostrya carpinifolia, LC, Europe, Caucasus, Turkey, Lebanon

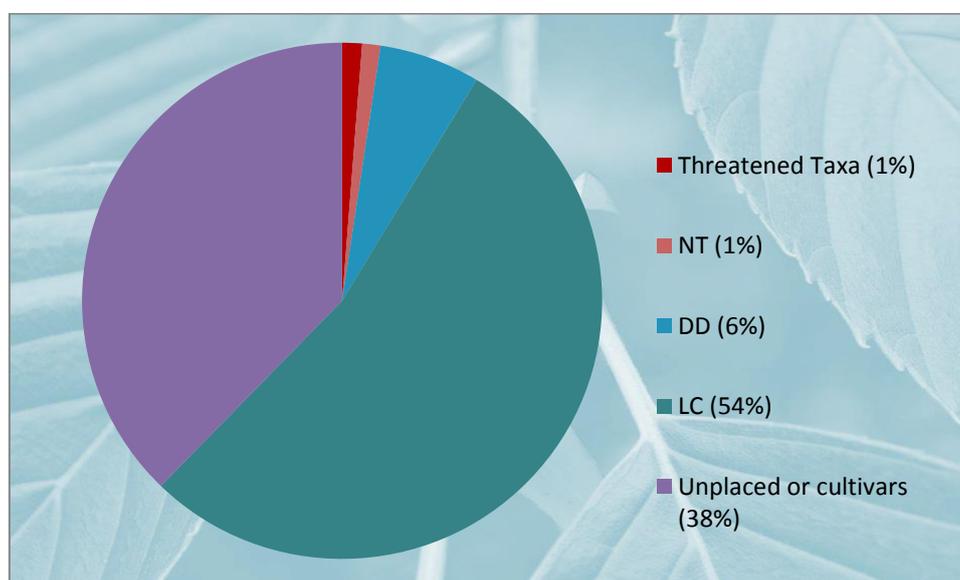
Ostryopsis

Ostryopsis is a genus with only three taxa, two of which are represented in *ex situ* collections. The species that is not held in a collection is *Ostryopsis intermedia* (DD). As *Ostryopsis* only contains three taxa, all should be conserved in *ex situ* collections as a priority, to mitigate the risk of losing the entire genus.

Collection balance

65% of Betulaceae records (6394 out of 9862 records consulted²) represent accepted names (following the taxonomy used in *The Red List of Betulaceae*). Only 1% or 122 records represent threatened taxa (Critically Endangered, Endangered or Vulnerable) and 1% represent Near Threatened taxa. 54% of the records (5289 records) represent Least Concern taxa. 38% represent cultivars (1691 records) or unplaced records (2030 records) which hold limited value to conservation.

Figure 2. Balance of Betulaceae collections



² This analysis includes records held in PlantSearch that matched to genus level, but did not match full accepted name records (cultivars, synonyms and incorrect nomenclature). Only accepted name records (full match to accepted name) were included from DAPC and other consulted databases

Comparison with other families

BGCI and GTC have previously carried out several *ex situ* surveys of different taxonomic groups. Table 2 shows the percentage of each group's taxa found in collections.

Taxonomic group (number of taxa)	% of taxa in collections
<i>Zelkova</i> (6)	100%
Conifers (879)	85%
Aceraceae (191)	79%
Betulaceae (240)	68%
<i>Rhododendron</i> (1157)	67%
<i>Quercus</i> (216)	62%
Magnoliaceae (247)	48%

Table 2. Comparison of taxonomic groups that have been the subject of GTC *ex situ* surveys.

Recommendations and the way forward

Collection focus

To be of greatest direct conservation value, available resources should be used to maintain threatened taxa (CR, EN, VU) in *ex situ* collections. Whilst the 75% *ex situ* goal of Target 8 of the GSPC is met for Betulaceae, analysis shows that a large part of Betulaceae collections focus on Least Concern taxa and cultivars. An increased focus on threatened taxa in collections would improve conservation efforts.

The four threatened taxa which are currently not reported as held in *ex situ* collections (*Alnus maritima* ssp. *oklahomensis*, *Betula gynoterminalis*, *Carpinus hebestroma* and *Alnus maritima* ssp. *maritima*) should be brought into *ex situ* collections as a matter of urgency. Ideally this should be a coordinated effort between botanic gardens or similar institutions in the region as sharing of material between collections increases the security of the holdings. A good example of a collaborative collecting and conservation programme for trees is the International Conifer Conservation Programme (ICCP). More information about the ICCP can be found here: www.rbge.org.uk/science/genetics-and-conservation/international-conifer-conservation-programme.

If managed well, non-threatened and cultivar collections can provide indirect conservation value, through education and research programmes.

Identification of taxa and use of current nomenclature

It is clear from the number of unplaced records in PlantSearch that improved identification of Betulaceae taxa already in collections is required, alongside updating of labelling and records to align with current nomenclature. There have been various taxonomic revisions of the Betulaceae family which likely contributes to the high number of unplaced records. Collectors and collection holders are advised to contact experts to verify their collections.

Ensuring collections are genetically viable

This survey has not attempted to investigate genetic diversity or source of collections, but the following guidelines are applicable when establishing any *ex situ* collection.

Target 8 of the GSPC calls for 20% of *ex situ* collections to be made available for recovery and restoration programmes, helping to ensure the survival of taxa *in situ* as well as in back-up collections. Wild collected material that captures genetic diversity enables *ex situ* collections to be used for such programmes.

Efforts should be made to adhere to the following guidance (adapted from Guerrant, *et al.*, 2004) as far as possible:

For species with 50 or fewer populations, collect from as many populations as resources allow, up to all 50. For species with more than 50 populations, collect from as many populations as is practical, up to 50.

For populations with 50 or fewer individuals, collect from all known individuals; for populations with more than 50 individuals, collect from 50. This represents the ideal sample meant to serve the broad range of expected purposes, but it is recognised that in practice, and especially for very threatened species, sample sizes will often be much smaller than these benchmark guidelines.

It is essential to not damage natural populations or hinder natural regeneration when collecting wild material, again particularly important for threatened taxa with small remaining populations. As a benchmark figure for seed collection, no more than 20% of available seed should be collected. For further guidance on seed collection for threatened tree taxa, please consult GTC brief 5: *How to collect seeds from threatened tree species*, available from the GTC website (www.globaltrees.org/resources/resource-type/practical-guidance).

Further analysis of genetic potential in existing Betulaceae collections would help assess current availability of material for restoration and further inform collection planning.

Type of material

Seed banking is a good option for *ex situ* collections of trees, as this enables collections to capture a large amount of genetic diversity, but requires minimal space and resources to manage. This is only relevant for the Betulaceae taxa with orthodox seeds. It is recommended that taxon specific research is undertaken to determine the appropriate *ex situ* conservation measure, particularly for threatened species.

Multiple *ex situ* collections

Many of the threatened taxa, if found in *ex situ* collections, are only represented in a small number of collections. Having multiple *ex situ* collections is crucial in reducing the risk of loss from natural disaster, pests or diseases, etc. *Ex situ* collections can be important resources in studying the effects of climate change and the movement of pests and diseases across international borders. Sharing information internationally is critical for mitigating current and potential threats to plant survival. A good of this is BGCI's International Plant Sentinel Network. More information can be found at www.plantsentinel.org.

Curation and maintenance of collections

It is essential to collect data and maintain associated records for *ex situ* collections. This includes herbarium vouchers and photographs to enable correct identification, as well as GPS readings to enable propagated material to be reintroduced to the source location in future. Numbering and

labelling of collections is essential to ensure each accession is linked to its associated data and of maximum potential value for recovery programmes.

As with data management, horticultural management of collections is essential to ensure individuals are not lost unnecessarily. This is particularly important for threatened taxa.

Use of material in recovery and restoration programmes

When planning recovery programmes, in depth planning is essential. Involvement of local communities, botanic gardens and conservation partners is advised, to help identify and manage the threats to natural populations, and to ensure actions are sustainable. GTC brief 9: *How to plant and establish threatened trees in the wild*, provides further guidance (available at: www.globaltrees.org/resources/resource-type/practical-guidance).

A recovery programme is being developed by GTC for the Endangered Georgian endemic *Betula megrelica*, in collaboration with partners in country and experts from Stone Lane Gardens in the UK, following its assessment in *The Red List of Betulaceae* and publication on the IUCN Red List of Threatened Species. You can find more information about this project on the GTC website: www.globaltrees.org/projects.

Education programmes

Botanic gardens and other public facing organisations are key in encouraging broader public interest and engagement with the conservation of threatened species. This can be achieved through labelling and interpretation signs, highlighting the threats to specific species, as well as through literature, websites and social media. BGCI US's Care for the Rare programme (www.bgci.org/usa/CareForTheRare) offers free interpretation resources and a sign library.

Enhancing collection data

The accuracy of surveys such as this one is limited by the number of botanic gardens contributing data to PlantSearch, the quality of data, and the regularity that collections are updated. Botanic gardens are therefore encouraged to provide data to PlantSearch and ensure their collections records are regularly updated to enable surveys such as this to provide the most accurate assessment of conservation progress as possible. Whilst the PlantSearch database has its own inherent limitations, work is ongoing to improve the database, and it remains the best tool available for measuring *ex situ* conservation progress at the global level.

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Annex 1: IUCN assessed Betulaceae taxa with number of reported ex situ collections and IUCN Red List status

Taxon Name	Number of <i>ex situ</i> collections	IUCN Status	Taxon Name	Number of <i>ex situ</i> collections	IUCN Status
<i>Alnus acuminata</i>	10	LC	<i>Alnus incana</i> ssp. <i>kolaensis</i>	0	DD
<i>Alnus acuminata</i> ssp. <i>acuminata</i>	0	LC	<i>Alnus incana</i> ssp. <i>rugosa</i>	30	LC
<i>Alnus acuminata</i> ssp. <i>arguta</i>	4	LC	<i>Alnus incana</i> ssp. <i>tenuifolia</i>	21	LC
<i>Alnus acuminata</i> ssp. <i>glabrata</i>	1	LC	<i>Alnus japonica</i>	82	LC
<i>Alnus cordata</i>	91	LC	<i>Alnus jorullensis</i>	7	LC
<i>Alnus cremastogyne</i>	10	LC	<i>Alnus jorullensis</i> ssp. <i>jorullensis</i>	3	DD
<i>Alnus djavanshirii</i>	0	DD	<i>Alnus jorullensis</i> ssp. <i>lutea</i>	0	DD
<i>Alnus dolichocarpa</i>	0	DD	<i>Alnus lanata</i>	9	DD
<i>Alnus fauriei</i>	20	DD	<i>Alnus mairei</i>	0	DD
<i>Alnus ferdinandi-coburgii</i>	6	LC	<i>Alnus mandshurica</i>	9	LC
<i>Alnus firma</i>	49	DD	<i>Alnus maritima</i>	36	EN
<i>Alnus formosana</i>	14	LC	<i>Alnus maritima</i> ssp. <i>georgiensis</i>	1	CR
<i>Alnus glutinosa</i>	174	LC	<i>Alnus maritima</i> ssp. <i>maritima</i>	0	EN
<i>Alnus glutinosa</i> ssp. <i>antitaurica</i>	0	DD	<i>Alnus maritima</i> ssp. <i>oklahomensis</i>	0	CR
<i>Alnus glutinosa</i> ssp. <i>barbata</i>	17	DD	<i>Alnus matsumurae</i>	10	LC
<i>Alnus glutinosa</i> ssp. <i>betuloides</i>	6	DD	<i>Alnus maximowiczii</i>	51	DD
<i>Alnus glutinosa</i> ssp. <i>glutinosa</i>	3	LC	<i>Alnus nepalensis</i>	24	LC
<i>Alnus glutipes</i>	0	DD	<i>Alnus nitida</i>	8	LC
<i>Alnus hakkodensis</i>	0	DD	<i>Alnus oblongifolia</i>	9	LC
<i>Alnus henryi</i>	3	CR	<i>Alnus orientalis</i>	19	DD
<i>Alnus hirsuta</i>	75	LC	<i>Alnus paniculata</i>	0	DD
<i>Alnus incana</i>	102	LC	<i>Alnus pendula</i>	21	LC
<i>Alnus incana</i> ssp. <i>incana</i>	10	LC	<i>Alnus rhombifolia</i>	40	LC

Taxon Name	Number of <i>ex situ</i> collections	IUCN Status
<i>Alnus rubra</i>	69	LC
<i>Alnus serrulata</i>	65	LC
<i>Alnus serrulatoides</i>	4	DD
<i>Alnus sieboldiana</i>	23	DD
<i>Alnus subcordata</i>	41	VU
<i>Alnus trabeculosa</i>	17	LC
<i>Alnus vermicularis</i>	0	DD
<i>Alnus viridis</i>	62	LC
<i>Alnus viridis ssp. crispa</i>	29	LC
<i>Alnus viridis ssp. fruticosa</i>	10	LC
<i>Alnus viridis ssp. sinuata</i>	19	LC
<i>Alnus viridis ssp. viridis</i>	13	LC
<i>Betula alleghaniensis</i>	140	LC
<i>Betula alnoides</i>	23	LC
<i>Betula ashburneri</i>	4	LC
<i>Betula baschkirica</i>	0	DD
<i>Betula bomiensis</i>	5	NT
<i>Betula calcicola</i>	7	NT
<i>Betula celtiberica</i>	13	DD
<i>Betula chichibuensis</i>	28	CR
<i>Betula chinensis</i>	43	LC
<i>Betula cordifolia</i>	14	LC
<i>Betula coriaceifolia</i>	1	DD
<i>Betula corylifolia</i>	24	DD
<i>Betula costata</i>	75	LC
<i>Betula cylindrostachya</i>	4	LC
<i>Betula dahurica</i>	26	LC

Taxon Name	Number of <i>ex situ</i> collections	IUCN Status
<i>Betula dahurica var. dahurica</i>	0	LC
<i>Betula dahurica var. okuboi</i>	0	DD
<i>Betula dahurica var. parvifolia</i>	0	DD
<i>Betula delavayi</i>	14	DD
<i>Betula ermanii</i>	107	LC
<i>Betula ermanii var. ermanii</i>	5	LC
<i>Betula ermanii var. lanata</i>	4	LC
<i>Betula falcata</i>	0	DD
<i>Betula fargesii</i>	6	DD
<i>Betula fruticosa</i>	34	LC
<i>Betula glandulosa</i>	43	LC
<i>Betula globispica</i>	21	NT
<i>Betula gmelinii</i>	1	LC
<i>Betula grossa</i>	63	LC
<i>Betula gynoterminalis</i>	0	CR
<i>Betula honanensis</i>	0	DD
<i>Betula humilis</i>	94	LC
<i>Betula insignis</i>	13	LC
<i>Betula insignis ssp. fansipanensis</i>	0	DD
<i>Betula insignis ssp. insignis</i>	0	LC
<i>Betula karagandensis</i>	0	DD
<i>Betula klokovii</i>	1	DD
<i>Betula kotulae</i>	0	DD
<i>Betula lenta</i>	146	LC
<i>Betula luminifera</i>	26	LC
<i>Betula maximowicziana</i>	108	LC
<i>Betula medwediewii</i>	43	NT

Taxon Name	Number of <i>ex situ</i> collections	IUCN Status
<i>Betula megrelica</i>	8	EN
<i>Betula michauxii</i>	7	LC
<i>Betula microphylla</i>	22	LC
<i>Betula murrayana</i>	5	CR
<i>Betula nana</i>	119	LC
<i>Betula nigra</i>	167	LC
<i>Betula occidentalis</i>	72	LC
<i>Betula papyrifera</i>	166	LC
<i>Betula pendula</i>	194	LC
<i>Betula pendula</i> ssp. <i>mandshurica</i>	4	LC
<i>Betula pendula</i> ssp. <i>szechuanica</i>	2	DD
<i>Betula pendula</i> var. <i>pendula</i>	12	LC
<i>Betula populifolia</i>	112	LC
<i>Betula potamophila</i>	0	DD
<i>Betula potaninii</i>	27	LC
<i>Betula psammophila</i>	0	DD
<i>Betula pubescens</i>	128	LC
<i>Betula pubescens</i> var. <i>fragrans</i>	0	DD
<i>Betula pubescens</i> var. <i>golitsinii</i>	0	DD
<i>Betula pubescens</i> var. <i>litwinowii</i>	2	DD
<i>Betula pubescens</i> var. <i>pubescens</i>	19	LC
<i>Betula pubescens</i> var. <i>pumila</i>	4	DD
<i>Betula pumila</i>	9	LC
<i>Betula raddeana</i>	56	LC
<i>Betula saksarensis</i>	0	DD
<i>Betula saviczii</i>	0	DD
<i>Betula schmidtii</i>	63	DD

Taxon Name	Number of <i>ex situ</i> collections	IUCN Status
<i>Betula skvorsovii</i>	0	DD
<i>Betula sunanensis</i>	0	DD
<i>Betula tianschanica</i>	36	NT
<i>Betula utilis</i>	100	LC
<i>Betula utilis</i> ssp. <i>albosinensis</i>	4	DD
<i>Betula utilis</i> ssp. <i>occidentalis</i>	8	LC
<i>Betula utilis</i> ssp. <i>utilis</i>	22	LC
<i>Betula utilis</i> var. <i>jacquemontii</i>	68	DD
<i>Betula wuyiensis</i>	0	DD
<i>Betula zinserlingii</i>	0	DD
<i>Carpinus betulus</i>	193	LC
<i>Carpinus caroliniana</i>	165	LC
<i>Carpinus caroliniana</i> ssp. <i>caroliniana</i>	3	LC
<i>Carpinus caroliniana</i> ssp. <i>virginiana</i>	19	LC
<i>Carpinus chuniana</i>	0	LC
<i>Carpinus cordata</i>	82	LC
<i>Carpinus cordata</i> var. <i>chinensis</i>	7	LC
<i>Carpinus cordata</i> var. <i>cordata</i>	0	LC
<i>Carpinus cordata</i> var. <i>mollis</i>	0	LC
<i>Carpinus dayongiana</i>	0	DD
<i>Carpinus eximia</i>	3	DD
<i>Carpinus faginea</i>	0	DD
<i>Carpinus fangiana</i>	16	LC
<i>Carpinus fargesiana</i>	17	LC
<i>Carpinus fargesiana</i> var. <i>fargesiana</i>	0	LC
<i>Carpinus fargesiana</i> var. <i>hwai</i>	0	LC
<i>Carpinus firmifolia</i>	0	LC

Taxon Name	Number of <i>ex situ</i> collections	IUCN Status
<i>Carpinus hebestroma</i>	0	CR
<i>Carpinus henryana</i>	27	LC
<i>Carpinus henryana</i> var. <i>henryana</i>	0	DD
<i>Carpinus henryana</i> var. <i>oblongifolia</i>	0	DD
<i>Carpinus henryana</i> var. <i>simplicidentata</i>	6	DD
<i>Carpinus japonica</i>	117	DD
<i>Carpinus kawakamii</i>	24	LC
<i>Carpinus kawakamii</i> var. <i>kawakamii</i>	0	DD
<i>Carpinus kawakamii</i> var. <i>minutiserrata</i>	0	DD
<i>Carpinus kweichowensis</i>	1	LC
<i>Carpinus laxiflora</i>	58	DD
<i>Carpinus lipoensis</i>	0	DD
<i>Carpinus londoniana</i>	4	LC
<i>Carpinus londoniana</i> var. <i>lanceolata</i>	0	DD
<i>Carpinus londoniana</i> var. <i>latifolius</i>	0	LC
<i>Carpinus londoniana</i> var. <i>londoniana</i>	0	LC
<i>Carpinus londoniana</i> var. <i>xiphobracteata</i>	0	DD
<i>Carpinus luochengensis</i>	0	DD
<i>Carpinus mengshanensis</i>	0	DD
<i>Carpinus microphylla</i>	0	DD
<i>Carpinus mollicoma</i>	1	LC
<i>Carpinus monbeigiana</i>	8	LC
<i>Carpinus omeiensis</i>	7	DD
<i>Carpinus orientalis</i>	75	LC
<i>Carpinus orientalis</i> ssp. <i>macrocarpa</i>	0	DD
<i>Carpinus orientalis</i> ssp. <i>orientalis</i>	0	LC
<i>Carpinus paohsingensis</i>	0	DD

Taxon Name	Number of <i>ex situ</i> collections	IUCN Status
<i>Carpinus polyneura</i>	15	LC
<i>Carpinus polyneura</i> var. <i>polyneura</i>	0	DD
<i>Carpinus polyneura</i> var. <i>sunpanensis</i>	0	DD
<i>Carpinus polyneura</i> var. <i>tsunyahensis</i>	0	DD
<i>Carpinus pubescens</i>	6	LC
<i>Carpinus purpurinervis</i>	0	DD
<i>Carpinus putoensis</i>	6	CR
<i>Carpinus rankanensis</i>	5	LC
<i>Carpinus rupestris</i>	0	LC
<i>Carpinus shensiensis</i>	18	LC
<i>Carpinus shimenensis</i>	0	DD
<i>Carpinus tientaiensis</i>	1	CR
<i>Carpinus tropicalis</i>	0	LC
<i>Carpinus tropicalis</i> ssp. <i>mexicana</i>	0	DD
<i>Carpinus tropicalis</i> ssp. <i>tropicalis</i>	0	LC
<i>Carpinus tsaiana</i>	0	LC
<i>Carpinus tschonoskii</i>	58	LC
<i>Carpinus turczaninowii</i>	46	LC
<i>Carpinus viminea</i>	18	LC
<i>Corylus americana</i>	141	LC
<i>Corylus avellana</i>	175	LC
<i>Corylus avellana</i> var. <i>avellana</i>	2	LC
<i>Corylus avellana</i> var. <i>pontica</i>	3	DD
<i>Corylus chinensis</i>	67	LC
<i>Corylus colchica</i>	2	VU
<i>Corylus colurna</i>	174	LC
<i>Corylus cornuta</i>	72	LC

Taxon Name	Number of <i>ex situ</i> collections	IUCN Status
<i>Corylus cornuta</i> ssp. <i>californica</i>	22	LC
<i>Corylus cornuta</i> ssp. <i>cornuta</i>	4	LC
<i>Corylus fargesii</i>	28	LC
<i>Corylus ferox</i>	14	LC
<i>Corylus ferox</i> var. <i>ferox</i>	0	LC
<i>Corylus ferox</i> var. <i>tibetica</i>	8	LC
<i>Corylus heterophylla</i>	5	LC
<i>Corylus heterophylla</i> var. <i>heterophylla</i>	3	LC
<i>Corylus heterophylla</i> var. <i>sutchuenensis</i>	10	LC
<i>Corylus jacquemontii</i>	15	DD
<i>Corylus maxima</i>	38	LC
<i>Corylus potaninii</i>	0	DD
<i>Corylus sieboldiana</i>	49	LC
<i>Corylus sieboldiana</i> var. <i>mandshurica</i>	31	LC
<i>Corylus sieboldiana</i> var. <i>sieboldiana</i>	0	DD
<i>Corylus wangii</i>	1	DD

Taxon Name	Number of <i>ex situ</i> collections	IUCN Status
<i>Corylus wulingensis</i>	0	LC
<i>Corylus yunnanensis</i>	6	LC
<i>Ostrya carpinifolia</i>	136	LC
<i>Ostrya chisosensis</i>	3	CR
<i>Ostrya japonica</i>	57	LC
<i>Ostrya knowltonii</i>	4	LC
<i>Ostrya multinervis</i>	0	LC
<i>Ostrya rehderiana</i>	10	CR
<i>Ostrya trichocarpa</i>	0	LC
<i>Ostrya virginiana</i>	156	LC
<i>Ostrya virginiana</i> ssp. <i>guatemalensis</i>	0	LC
<i>Ostrya virginiana</i> ssp. <i>virginiana</i>	2	LC
<i>Ostrya yunnanensis</i>	0	DD
<i>Ostryopsis davidiana</i>	15	LC
<i>Ostryopsis intermedia</i>	0	DD
<i>Ostryopsis nobilis</i>	5	DD

Annex 2: Participating institutions

The following 440 institutions are gratefully thanked for their contribution of data to this report:

Adkins Arboretum; Alpengarten auf dem Schachen; Alpengarten Patscherkofel; Alpengarten Villacher Alpe; Annapolis Royal Historic Gardens; Arboreto di Arco - Parco Arciduale; Arboretum and Botanic Garden, University of Bergen; Arboretum at Kutztown University; Arboretum at Penn State, The; Arboretum at the University of California, Santa Cruz; Arboretum at the University of California, Santa Cruz - seed bank; Arboretum des Grands-Murcins; Arboretum Freiburg-Günterstal; Arboretum Groenendaal - Flemish Forest Department - Houtvesterij Groenendaal; Arboretum Kirchberg; Arboretum Kostelec, Czech Agricultural University of Prague; Arboretum Mustila; Arboretum National des Barres (et Fruticetum Vilmorinianum); Arboretum Novy Dvur; Arboretum of Nanjing Forestry University; Arboretum of The Barnes Foundation; Arboretum Oudenbosch; Arboretum Střední lesnické školy; Arboretum Waasland; Arboretum Wespelaar; Arnold Arboretum of Harvard University, The; Atlanta Botanical Garden; Auckland Botanic Gardens; Baker Arboretum; Bakuriani Alpine Botanical Garden; Bamboo Brook Outdoor Education Center; Bangladesh Agricultural University Botanic Garden; Bartlett Tree Research Laboratories Arboretum; Batumi Botanical Garden; Bayard Cutting Arboretum; Belmonte Arboretum; Benmore Botanic Garden; Bergius Botanic Garden; Berkshire Botanical Garden; Betty Ford Alpine Gardens; Bibliotheque Centrale; Bickelhaupt Arboretum; Biodôme de Montréal - Botanical Garden; Birmingham Botanical Gardens and Glasshouses; Birr Castle Demesne; Bishop Museum - Checklist of Cultivated Plants of Hawai'i; Blue Mountains Botanic Garden, Mount Tomah; Bokrijk Arboretum; Boone County Arboretum; Botanic Garden Meise; Botanic Garden of Petrozavodsk State University; Botanic Garden of Poltava National Pedagogical University; Botanic Garden of Rostock University; Botanic Garden of Smith College, The; Botanic Garden of Tver State University; Botanic Garden, Delft University of Technology; Botanic Gardens of Adelaide; Botanical Garden - Center of Ecological and Astronomy Education of SBPEI "Vorobievoy Gory"; Botanical Garden - Institute of the Volga State Technological University / Ботанический сад Марийск; Botanical Garden Gorky State University; Botanical Garden of Chelyabinsk State University / Ботанический сад Челябинского г. унив.; Botanical Garden of Pyatigorsk State Pharmaceutical Academy; Botanical Garden of Tartu University; Botanical Garden of the University of Zagreb; Botanical Garden of the V.L. Komarov Botanical Institute / Ботанический институт им. В.Л.Комарова; Botanical Garden of Vilnius University; Botanical Garden University of Duesseldorf; Botanical Garden, Natural History Museum of Denmark; Botanical Garden-Institute, Ufa Research Center / Ботанического сада-института УИЦ РАН; Botanical Gardens and Museum of Oulu University; Botanische Gärten der Universität Bonn; Botanische Tuin De Kruidhof; Botanische Tuin Groningen "Domies Toen"; Botanischer Garten der Carl von Ossietzky-Universität Oldenburg; Botanischer Garten der Friedrich-Schiller-Universität; Botanischer Garten der J.W. Goethe-Universität; Botanischer Garten der Johannes Gutenberg-Universität Mainz; Botanischer Garten der Justus-Liebig Universität Giessen; Botanischer Garten der Martin-Luther-Universität; Botanischer Garten der Philipps-Universität Marburg; Botanischer Garten der Ruhr-Universität Bochum; Botanischer Garten der Technischen Universität Darmstadt; Botanischer Garten der Technischen Universität Dresden; Botanischer Garten der Universität; Botanischer Garten der Universität des Saarlandes; Botanischer Garten der Universität Bern; Botanischer Garten der Universität Erlangen – Nürnberg; Botanischer Garten der Universität Freiburg; Botanischer Garten der Universität Karlsruhe (TH); Botanischer Garten der Universität Kiel; Botanischer Garten der Universität Osnabrück; Botanischer Garten der Universität Ulm; Botanischer Garten der Universität Zurich; Botanischer Garten der Westfälischen Wilhelms Universität; Botanischer Garten Ernst-Moritz-Arndt-Universität; Botanischer Garten und Botanisches Museum Berlin-Dahlem; Botanischer Versuchs- und Lehrgarten; Bowman's Hill Wildflower Preserve; Brenton Arboretum, The; Brisbane Botanic Gardens; Brooklyn Botanic Garden; Brookside Gardens; Buckland Abbey; Bundaberg Botanic Gardens; C. M. Goethe Arboretum; Cambridge University Botanic Garden; Catalogue of Medicinal Plants of Ukrainian Botanic Gardens and Parks; Catalogue of Rare Plants of Ukrainian Botanic Gardens and Parks; Center for Plant Conservation - Bogor Botanic Gardens; Center for Plant Conservation (USA); Central Botanical Garden; Central Siberian Botanical Garden / Центральный сибирский ботанический сад СО РАН; Chanticleer Foundation; Charles R. Keith Arboretum, The; Charles University Botanic Garden (Botanická zahrada University Karlovy); Chester M. Alter Arboretum; Chicago Botanic Gardens; Christchurch Botanic Gardens; Cincinnati Zoo and Botanical Gardens – CryoBioBank; Cleveland Botanical Garden; Coastal Maine Botanical Gardens; Connecticut College Arboretum; Conservatoire Botanique National du Brest; Conservatoire Botanique Pierre Fabre; Conservatoire et Jardin botaniques de la Ville de Genève; Conservatoire et Jardins Botaniques de Nancy; Core Facility Botanical Garden; Cornell Plantations; Cowichan Lake Research Station Arboretum; Crosby Arboretum, The;

Davidson College Arboretum; Dawes Arboretum, The; Dawyck Botanic Garden; Dendrological Park; Dendropark of the Northern Research Institute of Forestry; Denver Botanic Gardens; Desert Botanical Garden; Desert Botanical Garden - Seed Bank; Devonian Botanic Garden; Dixon Gallery and Gardens, The; Dixon National Tallgrass Prairie Seed Bank at Chicago Botanic Garden; Dominion Arboretum and Central Experimental Farm; Donald E. Davis Arboretum; Dow Gardens; Dr. P. Font i Quer Arboretum of Lleida Botanic Garden; Duke Farms; Dunedin Botanic Garden; DuPage Forest: Forest Preserve District of DuPage County; Durham University Botanic Garden; Dutch Open Air Museum / Nederlands Openluchtmuseum; Ecojardin del CIEco; Eden Project, The; Elisabeth C. Miller Botanical Garden; Eloise Butler Wildflower Garden & Bird Sanctuary; Eötvös Loránd University Botanic Garden; Fellows Riverside Gardens; Fernwood Botanical Garden and Nature Preserve; Florida Botanical Gardens; Foellinger-Freimann Botanical Conservatory; Forrest Deane Native Plant Botanic Garden; Forstbotanischer Garten der Technischen Universität Dresden; Forstbotanischer Garten Eberswalde; Forstbotanischer Garten und Arboretum; Fort Worth Botanic Garden; Frederik Meijer Gardens & Sculpture Park; Frelinghuysen Arboretum; Gardens at SIUE, The; Gardens of Fanshawe College and A.M. Cuddy Gardens; Gareev Botanical Garden of the National Academy of Sciences, Kyrgyzstan; Garvan Woodland Gardens; Genbank Bayern Arche; Ghent University Botanic Garden; Giardino Botanico Alpino alle Viotte di M. Bondone; Giardino Botanico Friuli "Cormor"; Gibraltar Botanic Gardens; Glasgow Botanic Gardens; Gradina Agrobotanica; Gradina Botanica a 'Anastasiu Fatu', Iasi; Gradina Botanica Targu Mures; Grapevine Botanical Gardens at Heritage Park; Great Lakes Forestry Centre Arboretum; Green Bay Botanical Garden; Green Spring Gardens; Greenwood Gardens; Grugapark und Botanischer Garten der Stadt Essen; Hangzhou Botanical Garden; Harmas de Fabre; Harriet Irving Botanical Gardens; Helsinki University Botanic Garden; Henry Schmierer Arboretum; Hergest Croft Gardens; Hershey Gardens; Hessische Landesanstalt für Forsteinrichtung; Hidden Lake Gardens; Historische Tuin Aalsmeer; Hof ter Saksen Arboretum; Holden Arboretum, The; Hortus Botanicus Amsterdam; Hortus Botanicus Reykjavikensis; Hortus Haren; Howick Arboretum; Hoyt Arboretum; Hunan Forest Botanical Garden; Huntington Botanical Gardens; Huntington Botanical Gardens - Seed Bank; Huntsville Botanical Garden; il Giardino della Minerva; Incheon Arboretum; International Forest Line Arboretum; Istituto e Orto Botanico dell'Università di Pavia; Jade Garden Natural Arboretum; Jangheung Natural Arboretum; Jardí Botànic de Barcelona; Jardí Botànic de la Universitat de València; Jardí Botànic de Sollers; Jardim Botânico da Madeira; Jardim Botânico da Universidade de Coimbra; Jardim Botânico da Universidade de Lisboa; Jardim Botânico da Universidade de Trás-os-Montes e Alto Douro; Jardim Botânico da Universidade do Porto; Jardim Botânico do Faial; Jardín Botánico "Carlos Thays"; Jardín Botánico Atlántico de Gijón; Jardín Botánico Francisco Javier Clavijero; Jardín Botánico Nacional; Jardin Botanique Camifolia; Jardin Botanique Alpin de la Jaïsiniá; Jardin Botanique de la Ville de Caen; Jardin Botanique de la Ville de Lyon; Jardin Botanique de l'Université de Strasbourg; Jardin Botanique de Marnay sur Seine; Jardin botanique de Neuchâtel; Jardin botanique de Paris; Jardin Botanique et Arboretum Henri Gaussen; Jardin Botanique Exotique "Val Rahmeh"; Jardin Botanique Yves Rocher; Jardin des Plantes de Paris et Arboretum de Chevreloup; Jardin des Serres d' Auteuil; Jardins des Plantes de l'Université; JC Raulston Arboretum; Jerusalem Botanical Gardens; Kalmthout Arboretum; Keum Kang Arboretum; Knightshayes; Kobe Municipal Arboretum; Korea Botanic Garden; Kurpark Bad Bellingen; Lady Bird Johnson Wildflower Center - seed bank; Landis Arboretum; L'Arboretum de Chevreloup.; Lauritzen Gardens; Les Jardins Suspendus; Leuven Botanic Garden; Lewis Ginter Botanical Garden; Living Desert Zoo and Gardens; Ljubljana University Botanic Garden; Logan Botanic Garden; Longwood Gardens; Los Angeles County Arboretum and Botanic Garden; Lushan Botanical Garden; Lyme Park; Lystigardur Akureyrar; M.M. Gryshko National Botanical Garden; Main Botanical Garden, Russian Academy of Sciences; Maribor University Botanic Garden; Masaryk University Faculty of Medicine Medicinal Herbs Centre; Matthaei Botanical Gardens & Nichols Arboretum; Maymont Foundation; Meadowlark Botanical Gardens; Memorial University Botanical Garden; Memphis Botanic Garden; Mendocino Coast Botanical Gardens; Mercer Botanic Gardens; Millennium Seed Bank; Milner Gardens and Woodland; Minnesota Landscape Arboretum; Missouri Botanical Garden; Missouri State Arboretum; Montreal Botanical Garden / Jardin botanique de Montréal; Moore Farms Botanical Garden; Morden Arboretum Research Station; Morris Arboretum, The; Morton Arboretum, The; Moscow State University Botanical Garden / Ботанический сад Московского государственного университета; Mount Auburn Cemetery; Mount Lofty Botanic Garden; Mount Usher Gardens; Mountain Botanical Garden of the Dagestan Scientific Centre / Горный ботанический сад ДНЦ РАН; Mountain Horticultural Crops Research & Extension Center; Mountain Top Arboretum; Mt. Cuba Center; Musée et Jardins Botaniques Cantonaux; Nanjing Botanical Garden Mem. Sun Yat-sen; National Arboretum Canberra; National Botanic Garden of Latvia; National Botanic Garden of Wales; National Botanic Gardens, Glasnevin; National Botanical Garden of Georgia; National Plant Germplasm System - USDA-ARS-NGRL; National Rhododendron Garden; National Tree Seed Centre; Nebraska Statewide Arboretum; Neuer Botanischer Garten der Universität Göttingen; New Brunswick Botanical Garden; New England Wild Flower Society - Garden in the Woods; New York Botanical Garden, The; Niagara Parks Botanical Gardens and School of Horticulture, The; Norfolk Botanical Garden; North Carolina Arboretum, The; Northwest Trek Wildlife Park; Novosibirsk Dendropark; Oekologisch-Botanischer Garten Universität Bayreuth; Ogród Botaniczny Uniwersytetu

Wroclawskiego; Oklahoma City Zoo and Botanical Gardens; Orto Botanico - Università degli Studi di Catania; Orto Botanico "Carmela Cortini" - Università di Camerino; Orto Botanico "Giardino dei Semplici"; Orto Botanico dell'Università di Ferrara; Orto Botanico di Bergamo "Lorenzo Rota"; Orto Botanico di Perugia; Orto Botanico Università degli Studi di Padova; Oxford University Botanic Garden; Paignton Zoo Environmental Park; Palacky University Botanic Garden; Palmengarten der Stadt Frankfurt am Main; Parque Botânico da Tapada da Ajuda; Patterson Garden Arboretum; Peavy Arboretum; Philodassiki Botanic Garden; Pine Lodge Pinetum; Planting Fields Arboretum State Historic Park; Polly Hill Arboretum, The; Pukekura Park; Purdue Arboretum, The; Pyunggang Botanical Garden; Quarryhill Botanical Garden; Queens Botanical Garden; Rancho Santa Ana Botanic Garden; Rancho Santa Ana Botanic Garden - Seed Bank; Reading Public Museum and Arboretum, The; Real Jardín Botánico Juan Carlos I; Real Jardín Botánico, CSIC; Red Butte Garden and Arboretum; Reiman Gardens; Research Institute of Subtropical Forestry (Zhejiang); Rio Grande Botanic Garden; Riverview Horticultural Centre Society, The; Rogów Arboretum of Warsaw University of Life Sciences; Royal Botanic Gardens Kew (Wakehurst); Royal Botanic Gardens, Kew; Royal Botanic Gardens, Melbourne; Royal Botanical Gardens, Ontario; Royal Horticultural Society's Garden, Harlow Carr; Royal Horticultural Society's Garden, Hyde Hall; Royal Horticultural Society's Garden, Rosemoor; Royal Horticultural Society's Garden, Wisley; Royal Roads University Botanical Gardens; Royal Tasmanian Botanical Gardens; Royal Veterinary and Agricultural University Arboretum; Sakhalin Botanical Garden / Сахалинский ботанический сад ДВО РАН; San Diego Zoo Botanical Gardens; San Diego Zoo Safari Park; San Francisco Botanical Garden; Santa Barbara Botanic Garden; Sarah P. Duke Gardens; Scientific Plant Production Centre "Botanica" of Uzbek Academy of Sciences; Scott Arboretum of Swarthmore College, The; Seeds of Success (SOS); Sentier de Decouverte; Shanghai Botanical Garden; Shanghai Chenshan Botanical Garden; Shaw Nature Reserve of the Missouri Botanical Garden; Sheffield Botanical Gardens; Sherwood Fox Arboretum; Siberian Botanical Garden of Tomsk State University / Сибирский Ботанический сад ТГУ; Sister Mary Grace Burns Arboretum; Smith-Gilbert Gardens; Smithsonian National Zoological Park; Spring Grove Cemetery and Arboretum; St. Andrews Botanic Garden; St. Kilda Botanic Garden; State Arboretum of Virginia (Orland E. White Arboretum); State Botanical Garden of Georgia, The; Station Alpine du Lautaret; Stavanger Botanic Garden; Stichting Botanische Tuin Kerkrade; Stichting Botanische Tuin van Steyl Jochum-Hof; Taltree Arboretum & Gardens; Tasmanian Arboretum Inc; Tatton Garden Society/Quinta Arboretum; The B.M. Kozo-Polyansky Botanical Garden of Voronezh State University; The Balkan Botanic Garden at Kroussia Mountains; The Greenland Arboretum; The Harris Garden; The John F. Kennedy Arboretum; The National Pinetum Bedgebury; The Sir Harold Hillier Gardens; The Tree Register of the British Isles; The University of Guelph Arboretum; Thwaite Gardens, University of Hull Botanic & Experimental Garden; Timaru Botanic Garden; Toledo Botanical Garden; Toronto Botanical Garden; Toronto Zoo; Trees Atlanta; Trinity College Botanic Garden; Trompenburg Gardens & Arboretum; Tyler Arboretum; UC Davis Arboretum; Ukrainian National Forestry University Botanic Garden; United States Botanic Garden; United States National Arboretum; University of Aarhus Botanical Institute; University of British Columbia Botanical Garden; University of California Botanical Garden at Berkeley; University of Delaware Botanic Gardens; University of Idaho Arboretum & Botanical Garden; University of Liverpool Botanic Gardens (at Ness); University of Oslo Botanical Garden; University of Turku - Botanical Garden; University of Uppsala Botanic Garden; University of Washington Botanic Gardens; University of Wisconsin-Madison Arboretum; Utrecht University Botanic Gardens; V.N. Sukachev Institute of Forest of SB RAS; Vanderbilt University Arboretum; VanDusen Botanical Garden; W. J. Beal Botanical Garden; Warsaw University Botanic Garden; Wellington Botanic Garden; Wentworth Castle Gardens; Westonbirt, The National Arboretum; Willowood Arboretum; Wind River Canopy Crane Research Facility; Winkworth Arboretum; Wuhan Botanic Garden; Xishuangbanna Tropical Botanical Garden, CAS; Yerevan Botanic Garden; Yew Dell Botanical Gardens; Yorkshire Arboretum.