

# The Red List of Betulaceae

Kirsty Shaw, Larry Stritch, Malin Rivers, Shyamali Roy, Becky Wilson and Rafaël Govaerts







**BOTANIC GARDENS CONSERVATION INTERNATIONAL (BGCI)** is a membership organization linking botanic gardens in over 100 countries in a shared commitment to biodiversity conservation, sustainable use and environmental education. BGCI aims to mobilize botanic gardens and work with partners to secure plant diversity for the well-being of people and the planet. BGCI provides the Secretariat for the IUCN/SSC Global Tree Specialist Group.



**THE USDA FOREST SERVICE** is entrusted with 193 million acres of national forests and grasslands. The missions of the agency is to sustain the health, diversity and productivity of the Nation's forests and grasslands to meet the needs of present and future generations.



**FAUNA & FLORA INTERNATIONAL (FFI)**, founded in 1903 and the world's oldest international conservation organization, acts to conserve threatened species and ecosystems worldwide, choosing solutions that are sustainable, are based on sound science and take account of human needs.



**THE GLOBAL TREES CAMPAIGN** is undertaken through a partnership between FFI and BGCI, working with a wide range of other organizations around the world, to save the world's most threatened trees and the habitats in which they grow through the provision of information, delivery of conservation action and support for sustainable use.



**THE IUCN/SSC GLOBAL TREE SPECIALIST GROUP** forms part of the Species Survival Commission's network of over 7,000 volunteers working to stop the loss of plants, animals and their habitats. SSC is the largest of the six Commissions of IUCN – The International Union for Conservation of Nature. It serves as the main source of advice to the Union and its members on the technical aspects of species conservation. The aims of the IUCN/SSC Global Tree Specialist Group are to promote and implement global red listing for trees and to act in an advisory capacity to the Global Trees Campaign.

**Published by Botanic Gardens Conservation International.**

Descanso House, 199 Kew Road,  
Richmond, Surrey, TW9 3BW, UK.

© 2014 Botanic Gardens Conservation International

Printed by the USDA Forest Service.

Printed on 100% Post-Consumer Recycled Paper.

Design: USDA Forest Service

Recommended citation: Shaw, K., Stritch, L., Rivers, M., Roy, S., Wilson, B. and Govaerts, R. (2014) The Red List of Betulaceae. BGCI. Richmond. UK.

ISBN-10: 1-905164-58-0

ISBN-13: 978-1-905164-58-5

**AUTHORS**

All authors are members of the IUCN / SSC Global Trees Specialist Group

**Kirsty Shaw** is Conservation Officer at BGCI.

**Larry Stritch** is a National Botanist at the USDA Forest Service.

**Malin Rivers** is Red List Manager at BGCI.

**Shyamali Roy** and **Becky Wilson** are interns at BGCI working on the Global Trees Campaign.

**Rafaël Govaerts** is Senior Checklist Compiler at the Royal Botanic Gardens, Kew and facilitates the compilation and peer-review of the World Checklist of Selected Plant Families.

The Red List of

# Betulaceae

Kirsty Shaw, Larry Stritch, Malin Rivers, Shyamali Roy,  
Becky Wilson and Rafaël Govaerts

2014



## CONTENTS

Acknowledgements	3
Acronyms	3
Foreword	4
Introduction	5
Distribution	5
Information Collection for Conservation Assessment	6
Results of the Evaluation	7
Conservation and Research Priorities	8
References	13
<b>GLOBALLY THREATENED BETULACEAE TAXA</b>	15
Betulaceae Taxa Evaluated as Data Deficient	32
Betulaceae Taxa Evaluated as Least Concern	37
References	54
ANNEX I	
IUCN Red List Categories and Criteria (Version 3.1)	65

## ACKNOWLEDGEMENTS

The authors would like to thank the many experts from the around the world who contributed information and have undertaken assessments for this global evaluation of Betulaceae taxa.

Members of the IUCN/SSC Global Tree Specialist Group and the BGCI network were particularly helpful in providing information on taxa present

in their particular regions and facilitating the involvement of additional experts. Particular thanks go to Dr. Sudipto Chatterjee (TERI University, India) for providing information on Himalayan taxa. Thanks also Rebecca Hsu (Taiwan Forestry Research Institute) for assisting with the assessments of Taiwanese taxa. The authors would also like to thank Paul Bartlett (Stone Lane Gardens, UK) and members of

the IUCN/SSC Caucasus Plant Red List Authority for providing information to support the assessments of taxa from the Caucasus region.

The authors are very grateful to Fondation Franklinia for supporting BGCI's red listing work. Finally thanks to the United States Department of Agriculture (USDA) Forest Service for design work and printing of this report.

## LIST OF ACRONYMS

<b>AOO</b>	Area of occupancy
<b>ASL</b>	Above sea level
<b>BGCI</b>	Botanic Gardens Conservation International
<b>EOO</b>	Extent of occurrence
<b>FFI</b>	Fauna & Flora International
<b>GIS</b>	Geographical Information System
<b>GSPC</b>	Global Strategy for Plant Conservation
<b>GTC</b>	Global Trees Campaign
<b>GTSG</b>	IUCN/SSC Global Tree Specialist Group
<b>IUCN</b>	International Union for the Conservation of Nature
<b>SSC</b>	Species Survival Commission
<b>SIS</b>	Species Information Service
<b>USDA</b>	United States Department of Agriculture

## FOREWORD

The Betulaceae, the birches, alders, hazels, hornbeams, hop hornbeams and *Ostryopsis*, include some commercially important timber and nut producing trees. Several species of *Betula* are ecologically dominant in cold-temperate Northern Hemisphere forests and tundra, while some species of *Alnus*, *Carpinus* and *Corylus* form smaller pure stands or are major components of forest, scrub forest or forest understorey. In these more northern forests, to a large extent in formerly glaciated areas, there are no, or hardly any, relict endangered species. Other species of all genera are components of warm-temperate to tropical forests and relicts of the Arcto-Tertiary forests in which such species were much more prominent and widely distributed (Crane and Stockey 1987; Collinson 2000; Manchester and Tiffney 2001). It is among these that we find the rare and threatened species, largely in the well known refugia on low latitude mountain ranges in Japan, Korea, south China and Taiwan, the Caucasus/Caspian region, and southern parts of eastern North America.

This Red List report, the 10th in a series produced by the IUCN/SSC Global Tree Specialist Group, provides the results of a global conservation assessment for the family Betulaceae. It highlights the relatively small number of taxa that qualify as globally threatened using the IUCN Red List categories and criteria.

In the Betulaceae the taxonomy in several genera is confused, so it can be difficult to determine conservation status. However, it should usually be possible to differentiate between very distinct paleoendemics deserving of conservation effort, and taxa which are probably minor variants of common, widely distributed species which will not usually justify significant conservation effort (Ashburner and McAllister 2013).

In some cases mere forms (e.g. *Betula oycoviensis* and *B. lenta* f. *uber*) or minor variants of common species have been red listed in the past and considerable resources spent on their conservation, while equally distinctive populations have not been considered because they have not been named (e.g. the tetraploid Greek population of *A. glutinosa*). Lack of information on little known species, mainly from less studied parts of the world, is a major issue, and this list highlights these and should stimulate those cultivating such species to ensure they maintain breeding populations until certain that the wild populations are secure.

Ideally the taxonomy of Betulaceae would be resolved first, before deciding conservation priorities, but this can take a long time (Landrum, 2003), and it is essential that this Red List report is published sooner rather than later to draw attention to those species requiring attention. In this family some of these species may be of potential economic significance as well as being worthy of conservation for their own sake. This is likely to apply to species of *Alnus* because of their value in reclamation due to their nitrogen fixing properties. Some shrubby species (e.g. *A. faurei*, *A. sieboldiana*) seem to be much more drought tolerant than is usually realised and could be ideal as nurse species for timber trees. Alder species appear to be cross-compatible with respect to symbiont *Frankia* strains, all species developing effective nodules in UK soils.

Conservationists often insist that large populations are required to maintain the genetic diversity of a species but, with large woody plants, maintaining such living collections is often not possible except for species of value in forestry. Fortunately seed of species of Betulaceae is usually fairly long-lived in storage.

Though inbreeding depression is always a potential problem (Kuser 1983; Coates 1992; De Smet 1993), there are many instances where very small numbers of individuals have given rise to huge populations following introductions—as long as populations have been able to expand rapidly, lack of initial genetic diversity does not seem to have been a problem (Taggart *et al.* 1990; Meffert 1999; Merilä 1996; Jackson, *et al.* 2004). Self-compatible inbreeders such as some rare Betulaceae may already have suffered the consequences of inbreeding but still survived, perhaps following purging of deleterious genes (Byers and Waller 1999). With rare species it is clearly essential with self-incompatible species, and probably desirable with self-compatible ones (Kuser 1983), that more than one clone is maintained in cultivation in a garden to ensure seed production. Far too many gardens grow single plants of such threatened species as curators try to find space for as many different species as possible. However, to conserve the genetic variation of variable species it certainly requires the survival of a larger number of individuals than can usually be maintained in cultivation, species often being represented in cultivation by a tiny fraction of their variation in the wild (Jeffrey, 1982; Brodie *et al.* 1998). This is why conservation of wild populations is always preferable where possible.

I hope that this report will stimulate increased conservation action for those species that are identified as globally threatened. At the same time we need to find more information for those that are recorded as Data Deficient. A combination of ex situ and in situ measures should ensure that no species of the Betulaceae becomes extinct.

Hugh McAllister, author The Genus *Betula*: A taxonomic revision.

## INTRODUCTION

The Betulaceae family comprises trees and shrubs from six genera; *Alnus* (Alder), *Betula* (Birch), *Carpinus* (Hornbeam), *Corylus* (Hazel), *Ostrya* (Hop Hornbeam) and *Ostryopsis*. There are approximately 166 species, the exact number of species and infraspecific taxa varying with taxonomic uncertainty.

The largest genus is *Betula*. According to the recently published monograph for this species, there are 40–50 recognised species (Ashburner and McAllister, 2013), the World Checklist of Selected Plant Families recognises 62 species (Govaerts, 2014). The smallest genus is *Ostryopsis* with only 3 recognised species. Further details on the taxonomy used for these assessments are presented on page 7.

*Betula* and *Alnus* are closely related. Their chromosome numbers are multiples of 14, but *Carpinus*, *Ostrya* and *Ostryopsis* are multiples of 8, and *Corylus* 11. Due to their distinctiveness from *Betula* and *Alnus*, the latter four genera were previously placed in a separate family: Corylaceae. There is now wide agreement to place them in the Betulaceae family.

### DISTRIBUTION

The Betulaceae family includes taxa distributed across a large proportion of the northern hemisphere, from Canada in the West to China, Japan and Siberia in the East. In northerly climes, dwarf varieties dominate, such as the Dwarf Birch *Betula nana*, found mainly in the Arctic tundra region. A few species spread south of the Equator, found in Central America and northern parts of Southern America.

The family comprises taxa that have large natural distributions and are common across their range, such as *Betula pendula* and *Corylus avellana*. However, some taxa are restricted to a very small area with low population numbers, the most restricted being known only from a single tree, as is the case for *Carpinus putoensis*.

The altitudinal range of the family is 0 m to approximately 4,500 mm ASL.

### Uses of Betulaceae

**Ornamental value**—A number of Betulaceae taxa are known for their ornamental value. *Betula*, for example, are valued by gardeners and landscapers and found widely in private and public gardens due to their attractive foliage, catkins, autumnal colours and bark. The bark of *Betula* trees sets them apart from other genera in the family and occurs in a variety of colours including white, and varying shades of pink, yellow, orange, red and brown. The bark can be shiny and peels from the trunk of some taxa. Popular cultivars include; *B. pendula* ‘Tristis’ (a weeping form with white bark), *B. ermanii* ‘Polar Bear’ (with white bark) and *B. albosinensis* ‘Pink Champagne’ (with pink/red bark).

*Alnus* have ornamental value for their attractive catkins and cones, and glossy foliage. They are also popular because they are hardy and can survive well in damp or wet sites. *A. glutinosa*, *A. incana* and *A. cordata* are the most common species found in cultivation. Some taxa, such as *A. cordata*, have spread readily from garden collections and have become well established beyond their natural range.

*Carpinus* species are popular for their attractive deeply ribbed leaves and are often used in hedging.

**Hazelnut production**—All *Corylus* taxa produce edible nuts, known as hazelnuts or cobnuts. They therefore provide a valuable food source to wildlife. The European hazelnut (*C. avellana*) is the most economically valuable of the *Corylus* taxa and is the only *Corylus* species that is cultivated for its nuts. It produces the highest quality nut and produces the greatest yield of all *Corylus* species. Hazelnuts from other species such as *C. americana*, *C. heterophylla*, *C. jacquemontii* and *C. colurna* are harvested from the wild and sold in local markets.

The global market for *C. avellana* is dominated by Turkey which is the biggest worldwide producer, followed by Italy and the US (Molnar, 2011). In rural parts of the Black Sea region (including Turkey) hazelnut production is a key factor in maintaining social, economic and environmental sustainability. Although production of hazelnuts fluctuates yearly depending on climatic conditions, commercial production is increasing as a whole. The average farm-gate value of the U.S. crop in the past three years was about \$63 million with a processed value of \$160 million (USDA, 2012). The hazelnut economy directly and indirectly supports eight million people (Molnar, 2011).

**Medicinal properties**—Many species of the genera *Alnus* and *Betula* have been used as traditional herbal medicines. They have a wide variety of medicinal applications. Leaf teas were often used as a skin wash to soothe insect bites and skin irritations and also as a diuretic to treat urinary tract infections and as a treatment for rheumatism and gout (Tilford, 1997). *Betula* leaves have also been used on the scalp to reduce hair loss and dandruff and *Betula* bark can be used to make a drink said to purify the blood (American Cancer Society, 2008). Some species, especially *Betula lenta*, contain methyl salicylate,

(continued on next page)

**Uses of Betulaceae** (continued from previous page)

or oil of wintergreen, which in the past was distilled from the twigs and used as an anti-inflammatory.

The bark of many *Alnus* and *Betula* species contains the compounds lupeol and betulin which have been shown to be effective in fighting a variety of cancers, and scientists are now researching the potential use to treat the herpes virus, hepatitis and HIV-1 viral replication (Sati *et al.*, 2011).

**Timber**—A number of Betulaceae taxa are used for timber. Species of particular economic importance for their timber include *A. rubra*, *A. glutinosa* and *B. pendula*.

Birch timber is straight grained, strong and durable, making it useful for plywood and furniture. *B. pendula* and *B. populifolia* for example, are both grown for production of high quality plywood.

*Alnus* timber is very durable underwater, making it particularly useful for deep foundations of buildings and bridge poles. *A. cordata* for example has been used as foundation poles for houses in Venice.

The wood of *Carpinus* species has minor economic importance. It is a hardwearing wood and uses include mallet heads, tool handles and other small wooden objects. The timber also has attractive swirls in the grain and a smooth finish, making it very useful for furniture making.

*Ostrya knowltonii* and *O. virginiana* are often used to make durable items such as fence posts and tool handles as their timber is hard and tough.

**Other uses**—A number of other uses exist, which have varied in economic and social importance over time. For example, sap extracted from birch trees, usually *Betula lenta*, *B. pendula* or *B. papyrifera*, can be drunk as a tonic, it can be fermented into Birch beer or wine or it can be concentrated to make a birch syrup. Birch tar is extracted from the bark using high temperatures and has been used as an adhesive in weapon and tool making, and in the repairing and waterproofing of ceramic vessels (Tiilikkala *et al.*, 2010). Birch tar is also an astringent ingredient in ointments for eczema and psoriasis (Stone Lane Gardens, 2014). The papery bark from many birch species can be used to waterproof roofs, make canoes and in India it replaced parchment as the primary writing medium for manuscripts. The coppiced stems of *Corylus* had great economic importance in the past, used for basket making, thatching, wood fuel and wattles (Royal Forestry Society, 2014).

Over-exploitation of wild populations can pose a threat to Betulaceae taxa. Sustainable harvesting methods and replanting must be carried out to ensure human use of these 'useful' taxa does not threaten their survival in the wild. The most economically

important Betulaceae taxa, including *Betula pendula* for timber and *Corylus avellana* for hazelnut production, are widely cultivated to supply demand.

Betulaceae taxa also play a valuable ecosystem role. White barked birches in particular are good pioneer species and can rapidly colonise cleared areas, preventing soil erosion and paving the way for re-establishment of previous forest cover. They are "regarded as the weed trees of the landscape" in northern latitudes (Ashburner and McAllister, 2013), but despite this seemingly negative assertion, it also highlights a great potential for the use of such species in reforestation and restoration projects. Many taxa can also withstand low nutrient levels, sandy soils and wet habitats, including bogs, thereby occupying ecological niches unsuitable for other tree species.

The ability of many Betulaceae taxa to grow at high altitudes also means they serve a vital role in watershed protection and soil stabilisation. Conservation of wild populations is particularly important in highland areas so this important ecosystem service is not lost. *Alnus* species are nitrogen fixing, improving soil conditions and supporting growth of other species. Habitat conservation is essential to ensure the survival of Betulaceae taxa in the wild, and is of particular importance in low nutrient, highland and delicate ecosystems such as peat bogs.

**INFORMATION COLLECTION FOR CONSERVATION ASSESSMENT**

This publication represents the first attempt to undertake a conservation assessment of all known taxa within the Betulaceae family. At the time of production of this work, only 15 Betulaceae species were published on the

IUCN Red List of Threatened Species (IUCN Red List, [www.iucnredlist.org](http://www.iucnredlist.org)), many of which were assessed in *The World List of Threatened Trees* (Oldfield, *et al.*, 1998) and are now out of date. In this publication 240 up to date taxa assessments are presented.

**Taxonomy**

A complete taxonomic revision of the Betulaceae family has not been undertaken. It is important to note that it is not the intention of this publication to resolve taxonomic issues for Betulaceae taxa.

The recently published *Betula* monograph (Ashburner and McAllister, 2013) was a



very valuable resource for this assessment. The assessments presented in this publication for *Betula* taxa follow the taxonomy presented by Ashburner and McAllister, with additional assessments presented for a small number of *Betula* taxa, recognised as accepted species but not verified by the authors of (and therefore not included in) the recent *Betula* monograph as they did not see any material. Taxonomy for other genera (and accepted *Betula* taxa not included in the Ashburner and McAllister publication) follows The World Checklist of Selected Plant Species (<http://apps.kew.org/wcsp/home.do>) (Govaerts, 2014).

Conservation assessments were undertaken for all accepted Betulaceae species in the *Betula* monograph and the World Checklist of Selected Plant Families. Assessments are also undertaken for accepted infraspecific taxa with varying distribution to the parent species. When an infraspecific taxon has a similar distribution, population and threat status to the parent species, a separate assessment is not presented for the infraspecific taxon. It was not attempted to undertake conservation assessments for all recognised infraspecific taxa, as very limited information is available and taxonomy is uncertain for many of these taxa.

Table 1 shows the number of species and infraspecific taxa per genus assessed in this Red List report.

**TABLE 1: NUMBER OF SPECIES AND INFRASPECIFIC TAXA PER GENUS ASSESSED IN THIS RED LIST REPORT**

Genus	No. of species assessed	No. of infraspecific taxa assessed	Total no. of taxa assessed
<i>Alnus</i>	38	20	58
<i>Betula</i>	60	19	79
<i>Carpinus</i>	40	23	63
<i>Corylus</i>	16	10	26
<i>Ostrya</i>	9	2	11
<i>Ostryopsis</i>	3	0	3
<b>Total</b>	<b>166</b>	<b>74</b>	<b>240</b>

### Information collection and assessment methodology

Assessments were undertaken using the IUCN Red List Categories and Criteria (version 3.1, see Annex I for details). Assessments presented here provide summary information of full assessments that have been undertaken and entered into the IUCN Species Information Service (SIS) for review and publication on the online IUCN Red List of Threatened Species. Full assessments were undertaken by Kirsty Shaw, Shyamali Roy and Becky Wilson from BGCI, Larry Stritch from the USDA Forest Service and supported by experts (see detail in individual assessments and acknowledgements section).

Information was collected from published literature, including national flora, national Red Data books and journal articles. To supplement this, herbarium specimen databases, online plant information databases, including Tropicos, NatureServe, The Plant List, and other online data from reputable sources, were also consulted. A full reference list for the assessments is presented on pages 54 - 64.

In addition to a thorough review of available literature, experts were contacted to obtain and verify information for the taxa assessed. Experts were identified through the BGCI network and the IUCN/SSC Global Tree Specialist Group (GTSG) and authors of consulted literature were also contacted. This communication is referenced as pers. comm.

This publication includes distribution maps for threatened taxa. As most threatened taxa are known only from a single or small number of localities and small population numbers, maps are presented as point data rather than polygons. Distribution maps could not be produced for Data Deficient taxa as data points are not available for many of these taxa. Maps are not included for Least Concern taxa in this report.

### RESULTS OF THE EVALUATION

240 Betulaceae taxa have been assessed; 166 species and 74 infraspecific taxa (subspecies and varieties).

The results of the assessments are summarised in Table 2. This indicates that of the 240 Betulaceae taxa assessed, only 16 are threatened with extinction in the wild according to the IUCN Red List Categories and Criteria (Critically Endangered, Endangered and Vulnerable).

**TABLE 2: NUMBER OF TAXA PER IUCN CATEGORY ASSESSED IN THIS REPORT**

Conservation Status	Number of Betulaceae taxa
Critically Endangered (CR)	11
Endangered (EN)	3
Vulnerable (VU)	2
Near Threatened (NT)	5
Data Deficient (DD)	83
Least Concern (LC)	136
<b>Total</b>	<b>240</b>

An additional 5 taxa are assessed as Near Threatened. If action is not taken to address the threats facing the remaining populations of these taxa, they are likely to qualify within a threatened category in the near future.

A high number of taxa are assessed as Data Deficient, 83 taxa. There is taxonomic debate surrounding many of these taxa. There is a great need for further

study to determine which of these are true taxa and to gather sufficient information to carry out full conservation assessments. Further information about Data Deficient taxa is presented on pages 32 - 36.

A high number of taxa are assessed as Least Concern, 136 taxa. The majority of these taxa have wide distributions, and there are no known threats impacting these taxa to the extent that conservation action is required to ensure they do not become threatened in future. More information about the Least Concern taxa is presented on pages 37 - 53.

## CONSERVATION AND RESEARCH PRIORITIES

This global assessment of Betulaceae can be used to guide future conservation action for these taxa. Urgent action is required for taxa assessed as Critically Endangered. The remaining populations of these taxa are very small. For example, the population of *Ostrya rehderiana* is reported to have reduced rapidly, there are only 5 remaining individuals in the wild and no conservation programme is reported to be in place for this species. Critically Endangered taxa are at great risk of extinction in the near future and conservation action must be increased to ensure the survival of all Critically Endangered taxa.

Conservation action is also required for taxa assessed as Endangered, Vulnerable and Near Threatened. If the threats currently impacting on these species persist or worsen their populations will decline and the risk of extinction to these taxa will increase.

Globally threatened taxa are presented on pages 15 - 31.

### Call for action: Data Deficient taxa

A large number of taxa have been assessed as Data Deficient, 83 taxa. Although some information is available on the distribution of these species, very little or no additional information is available to carry out a full conservation assessment.

The majority of these taxa are reported to have limited ranges and there is taxonomic uncertainty concerning whether these are in fact separate species, or varieties or subspecies of other species.

Field research is required for the large number of taxa assessed as Data Deficient to determine distribution, population numbers, threats facing these taxa and to resolve taxonomic uncertainties. This should be carried out as a matter of urgency and full Red List assessments undertaken as soon as possible, so threatened taxa are added to the list of priority taxa for conservation concern.

As there are overlaps in reported distribution of many Data Deficient taxa, this information can be used to plan field surveys to obtain increased information on multiple taxa at once, thereby increasing output without needing increased budget and effort.

As an insurance policy, all Data Deficient taxa should be considered under threat until sufficient information is available to fully assess their conservation status, or taxonomic uncertainty is resolved.

Known distribution information and additional known information is provided for Data Deficient taxa on pages 32 - 36.

*In situ* conservation (protection within the natural habitat of a taxon) should be a priority for threatened taxa. Target 7 of the Global Strategy for Plant Conservation (GSPC) calls for 75% of known threatened plant species conserved *in situ* by 2020. Some threatened taxa are reported to exist in protected areas, for example *Ostrya chisosensis* which occurs in Big Bend National Park, Oklahoma, U.S.A., and some are known to be subject to less formal *in situ* protection, such as the Critically Endangered *Carpinus putoensis*; the remaining individual of this species is located near a temple, is revered as an icon and is fenced with an information panel provided for visitors. However, *in situ* conservation action is not yet reported for many of the taxa listed as threatened here.

*In situ* conservation efforts help to protect the habitat of the taxa and the flora and fauna that are part of the same ecosystem. *In situ* efforts are therefore a good long term conservation option. It is recommended that some level of *in situ* protection be put in place for all taxa listed as threatened in this publication.

*Ex situ* conservation is well recognised as an important security measure against extinction, especially for taxa represented by very small wild populations. By ensuring taxa are represented in well-managed and secure *ex situ* collections, if wild populations are lost due to threats imposed by humans or natural disasters, the taxon will not be lost completely.

Target 8 of the GSPC calls for 75% of threatened plant species in *ex situ* collections by 2020. Botanic gardens and arboreta play a valuable role in *ex situ* conservation. While some threatened Betulaceae taxa are reported as held in well-managed *ex situ* collections, it is recommended that *ex situ* conservation efforts are increased for all taxa listed as threatened in this publication.

BGCI's PlantSearch database is the only tool for measuring progress towards Target 8 of the GSPC at the global level. Following on from this report, BGCI will undertake a survey using data held in BGCI's PlantSearch database to determine how well represented threatened Betulaceae taxa are in *ex situ* collections. This will help to further determine conservation priorities.

For *ex situ* collections to be of maximum value to conservation they should consist of material of wild origin and be genetically representative of wild populations. Collection management will also ideally involve propagation programmes to cultivate a supply of material for reintroduction and restoration programmes. Propagation programmes are extremely important for taxa that have high ornamental value and whose wild populations are subject to over-exploitation. Producing a supply of material for sale will reduce pressure on wild populations.

All conservation approaches will be of increased value if accompanied by awareness-raising and environmental education programmes, particularly aimed at communities living locally to threatened wild populations or reintroduction sites. The involvement of local people in conservation activities helps ensure the sustainability of efforts and ensure long term survival of these taxa in their natural habitats. This will also work towards achieving Target 14 of the GSPC which calls for the importance

### GardenSearch

BGCI's GardenSearch database is the only global source of information on the world's botanical institutions. GardenSearch allows users to search over 3,000 profiles to locate botanic gardens, arboreta, zoos, and similar organization with specific resources and expertise. GardenSearch is a valuable tool for connecting researchers, collaborators, and the general public to botanical resources available in gardens worldwide. GardenSearch also provides a web presence for small institutions that do not have their own website, connecting them to the global conservation community. [www.bgci.org/garden\\_search.php](http://www.bgci.org/garden_search.php)

### PlantSearch

BGCI's PlantSearch database is the only global database of plants in cultivation, and is free to contribute to and access. PlantSearch connects around 2,000 researchers and horticulturists to collections every year. Locations and gardens are not publicly revealed, and requests can be made via blind email messages. PlantSearch is an easy way for *ex situ* collections to contribute to broader *ex situ* assessments such as this conifer survey. By uploading a taxa list to PlantSearch, collection holders can not only connect their collections to the global botanical community, but also find out the conservation value of their taxa including the number of locations each taxon is known globally and current global conservation status.

It is important for *ex situ* collections to share accurate data more broadly and keep it updated. PlantSearch relies on collection holders to upload up-to-date taxa lists on an annual basis to ensure accuracy and enhance usability of the data. [www.bgci.org/plant\\_search.php](http://www.bgci.org/plant_search.php)

of plant diversity and the need for its conservation to be incorporated into communication, education and public awareness programmes.

*Integrated Conservation of Tree Species by Botanic Gardens: A Reference Manual* provides a step-by-step guide to achieving best practice in integrated conservation and is a valuable resource for botanic gardens and the wider conservation community.

It is hoped that this Red List of Betulaceae is a useful reference for botanic gardens, *in situ* conservation organisations and other conservation stakeholders, such as policy makers and

funding bodies who play an important role in deciding the future of these taxa. Although this global assessment has highlighted a great need for increased research for many Betulaceae taxa, the current information available has been enough to define current conservation and research priorities.

It is hoped that by providing up to date conservation assessments of this family that conservation action will increase for the most threatened Betulaceae taxa. It is also hoped that this report is a useful resource for generating further interest and further funding to carry out field research to address current knowledge gaps.

### Case Study 1: A successful Conservation Project, *Betula lenta* f. *uber*.

Taxonomic debate exists for this taxon. First described as a subspecies of *B. lenta* by Ashe it was later elevated to species level (*B. uber*) by M.L. Fernald (U.S. Fish & Wildlife Service, 2005). In 2004, Ashburner and McAllister published an article stating it to be a forma of *B. lenta* based on genetic tests undertaken at Ness Botanic Gardens, University of Liverpool, UK. This report follows the taxonomy of the recent *Betula* monograph (Ashburner and McAllister, 2013) which treats this taxon as a forma of *B. lenta*. A separate conservation assessment is therefore not included in this report, however *Betula lenta* f. *uber* is still considered “well worthy of conservation” (Ashburner and McAllister, 2013) and is an example of a successful conservation plan.

*Betula lenta* f. *uber* is only found in Smyth County, Virginia U.S., on the banks of Cressy Creek. It was almost driven to extinction by habitat degradation from agriculture and logging activities, however thanks to a successful recovery plan most of its populations are now stable. After its initial discovery in 1918 by Ashe, the birch was not seen in the wild for almost 60 years. It was thought to be extinct until the rediscovery of 41 individuals by Ogle in 1975 (U.S. Fish & Wildlife Service, 1994).

Subsequent wild searches of the surrounding area found no additional populations. It is now known that the

only naturally occurring population grows within a narrow strip of highly disturbed, second growth forest along a 1,500 m stretch of floodplain in Cressy Creek. The population occurs on both private and public land and is almost entirely surrounded by agricultural land.

Within a few years of its re-discovery the population numbers decreased rapidly, by 1977 only 26 trees remained (U.S. Fish & Wildlife Service, 2005). In response a “*Betula uber* Protection, Management and Research Coordinating Committee” was formed. This committee was the driving force behind *Betula uber* becoming the first tree in the US to be given protected status under the U.S. Endangered Species Act (ESA). To prevent this species from disappearing again, fences were erected to reduce the threat of vandalism and theft and competing vegetation was cleared from potential seed sources. Thanks to these recovery efforts, the first and only documented case of natural reproduction occurred in 1981, producing 81 seedlings.

Seeds were also collected from mature individuals, germinated in greenhouses and kept in cultivation for a few growing seasons. In 1984, significant work began, involving the planting of greenhouse seedlings on U.S. Fish & Wildlife Service property, to increase numbers. Out-planting occurred at 20 plots within Cressy Creek drainage, with

5 new populations established each year for 4 years. Each newly established population consisted of 96 individuals and was monitored and managed by the USDA Forest Service.

In an important effort to increase *ex situ* collections as well as reduce theft, the US National Arboretum produced and distributed 50 seedlings to other arboreta, private nurseries and botanic gardens. By 1994, 19 of the 20 populations were considered self-sufficient and *Betula uber* was down listed from endangered to threatened under the ESA. In 1991, populations peaked to 1,400 individuals (U.S. Fish & Wildlife Service, 1994).

Although the single natural population is still declining (only eight mature individuals remain), as of 2003 there are nearly 1,000 cultivated trees in botanic gardens and the wild thanks to the work of the protection committee, including the U.S. Fish & Wildlife Service, USDA Forest Service and individual researchers (U.S. Fish & Wildlife Service, 2005).

The lack of natural regeneration and only one true natural population means that *Betula uber* still listed as threatened in the U.S. under the ESA. Full recovery for this taxon now relies on successful natural reproduction and survival of the 20 cultivated populations growing in Cressy Creek.



### Case Study 2: Stone Lane Gardens: The UK National Collection of *Betula* and *Alnus*

Stone Lane Gardens is a small woodland garden tucked away in a corner of Dartmoor National Park, in Devon, England. Stone Lane Gardens holds the UK National Collections of birch (*Betula*) and alder (*Alnus*) trees. Most specimens are wild collected.

The garden began life in the early 1970s when Kenneth Ashburner began planting the Birch and alder he was collecting. Ashburner was considered one of the leading experts in *Betula* and his garden was also a place of study. Ashburner died in 2010 with his great work to produce a monograph of the genus *Betula*, un-finished. Fortunately his co-author and great friend Dr. Hugh McAllister battled on with the book and thanks to his efforts 'The genus *Betula*: A taxonomic revision of birches' was published in 2013 (Ashburner and McAllister, 2013).

Stone Lane Gardens is now a charity, the role of which is to conserve the

existing National Collections and maintain the garden for the enjoyment and education of the public, as well as adding new trees to the collections and continuing research of birch and alder taxa.

The National Collection of Birch includes several species that are rarely seen *ex situ*. For example, *Betula delavayi* is a small shrub from China that can struggle with the UK climate. *Betula chichibuensis* is a Japanese multi-stemmed small shrubby tree to 6 m that is considered Critically Endangered. *Betula lenta* forma *uber* (Box 2) is a localised mutation from Virginia. Stone Lane Gardens has several provenances of the multi-stemmed shrub *Betula ashburneri*, which was first recognised as distinct in 1997.

*Betula megrelica* is a very rare and understudied species growing in isolation in north west Georgia. In 2013, the Rufford Foundation supported

the Garden Manager of Stone Lane Gardens, Paul Bartlett, to undertake a conservation project in north west Georgia, which generated the information for the conservation assessment of *B. megrelica* presented in this publication.

Probably the most important feature of Stone Lane Gardens' collections lies in knowing the provenance of their trees. This is of great value to botanists and scientists, who need non-hybridised genetic material (mostly wild-collected) to study. Stone Lane Gardens has supplied living material from *Betula* taxa to the British Museum for a study of birch tars. The gardens currently provide living birch material to the Biological Sciences department of Queen Mary University of London for a variety of molecular studies led by Dr. Richard Buggs.

Contributed by Paul Bartlett, Stone Lane Gardens, Devon. [www.stonelanegardens.com](http://www.stonelanegardens.com)



*Betula ermanii* growing at Stone Lane Gardens, UK. Least Concern (Pollet, C.)

### Case Study 3: An increasing threat to birch trees: The Bronze Birch Borer

The Bronze Birch Borer (*Agrilus anxius*) is a serious pest of Birch trees. This wood-boring beetle is native to North America, more common in warmer parts but present in small numbers as far north as Alaska. The adults are slender, metallic beetles, greenish-bronze in colour and about 10 mm in length (Williamson and Pellitteri, 2003). The females lay their eggs in cracks and crevices in the bark of Birch trees and within a week the white, segmented grubs emerge and chew through the bark. Eventually the larvae disrupt the phloem tissue, reducing the amount of food transported from the leaves to the roots. The damaged root system cannot supply the leaves with enough water and the leaves in the upper canopy turn yellow and become sparse. This may lead to branch dieback, which further reduces the ability of the tree to produce food and will likely result in tree death. The mature larvae overwinter in the bark before emerging as adults the following spring. The exit holes of the adult beetle are a distinctive D shape (Williamson and Pellitteri, 2003).

Bronze Birch Borers are known to attack all species of birch, however some species are more susceptible than others. *Betula nigra*, native to North

America, is the most resistant species, but other American birches are less resistant: *B. papyrifera*, *B. populifolia*, *B. lenta* and *B. alleghaniensis* are commonly attacked. The European and Asian birches, especially *B. pendula* and *B. utilis*, have little resistance and are effectively impossible to grow in the US (Wawryznski *et al*, 2009).

Bronze Birch Borers are not capable of successfully attacking healthy trees. They primarily attack birches that are weakened or stressed by drought, old age, insect defoliation, soil compaction, or injury. Healthy trees are able to produce callus tissue around the feeding gallery of the larvae which prevents further feeding (Katovich *et al*, 2003).

Management of this pest should therefore involve practices that promote healthy, vigorous birch tree growth. The ideal locations for birch trees are sites where the soil remains cool and moist and the trees receive full or partial sunlight on their leaves most of the day. Trees should be mulched and watered regularly, and injury to the tree should be avoided. Trees that have been infested should be cut down and destroyed before adults emerge in the spring (Katovich *et al*, 2003).

As the Bronze Birch Borer is a native insect to North America it should be viewed as a normal component of the birch ecosystem in North America and one that can be managed if environmental conditions remain the same. However, changes in climate and the continued global trade of trees and timber mean that it is possible that this pest could be introduced to other parts of the world. Birch species found elsewhere in the world have no resistance to this pest, and without the natural predators and environmental conditions that keep the Bronze Birch Borer in check in its natural range it has the potential to cause devastating loss.

*Living ex situ collections can provide a vital monitoring network for the effects and spread of pests and diseases. In 2013, the International Plant Sentinel Network was launched: a jointly led initiative by BGCI and the UK Department of Environment Food and Rural Affairs (DEFRA) working with botanic gardens and arboreta around the world to provide guidance on diagnosis, monitoring and surveying of plant pests and diseases. Find out more at: <http://www.bgci.org/ourwork/ipsn/>*

## REFERENCES

- American Cancer Society (2008)** *White Birch*. Accessed: March 2014, <http://www.cancer.org/treatment/treatmentsandsideeffects/complementaryandalternativemedicine/herbsvitaminsandminerals/white-birch>
- Ashburner, K. & McAllister, H.A. (2013)** *The Genus Betula: A Taxonomic Revision of Birches*. Kew Publishing, Kew
- Ashburner, K. & McAllister, H.A. (2004)** Plate 487. *Betula lenta* f. *uber*. Betulaceae. *Curtis's Botanical Magazine*. **21**: 54–60
- BGCI (2014)** GardenSearch online database. Accessed: 2014, [www.bgci.org/garden\\_search.php](http://www.bgci.org/garden_search.php)
- BGCI (2014)** PlantSearch online database. Accessed: 2014, [www.bgci.org/plant\\_search.php](http://www.bgci.org/plant_search.php)
- Brodie, S., Cheek, M., & Staniforth, M. (1998)** *Trochetiopsis ebenus*. *Curtis's Botanical Magazine* **15** (1): 27–36
- Byers, D.L. & Waller, D.M. (1999)** Do plant populations purge their genetic load? Effects of population size and mating history on inbreeding depression. *Annual Review of Ecology and Systematics*. **30**: 479–513
- Coates, D.J. (1992)** Genetic consequences of a bottleneck and spatial genetic structure in the triggerplant *Stylidium coroniforme* (Stylidiaceae). *Heredity* **69**: 512–520
- Collinson, M.E. (2000)** Cenozoic evolution of modern plant communities and vegetation. In Culver, S.J. & Rawson, P.F. (eds.) Biotic response to global change: The last 145 million years. 223–243. Cambridge University Press. Cambridge
- Crane PR, & Stockey RA. (1987)** *Betula* leaves and reproductive structures from the Middle Eocene of British Columbia. *Canadian Journal of Botany* **65**: 2490–2500
- De Smet, K. (1993)** Cheetahs teetered on the brink in the ice age. *New Scientist* **138** (Issue 1875): 16
- Elton, C.S. (1958)** *The ecology of invasions by animals and plants*. London. Methuen
- Fang, J., Wang, Z., & Tang, Z. (2009)** *Atlas of woody plants in China*. Beijing. Higher Education Press
- Falk, D.A. & Holsinger, K.E. (1991)** eds. *Genetics and conservation of rare plants*. Centre for Plant conservation. Oxford University Press
- Govaerts, R. (2014)** *The World Checklist of Selected Plant Families*. Accessed: 2013/2014, <http://www.kew.org/wcsp/>
- Hosie, R.C. (1963)** *Native trees of Canada*. Canada Department of Forestry, Bulletin 61
- IUCN (2014)** *International Union for Conservation of Nature (IUCN) Red List of Threatened Species*. Accessed:2014 [www.iucnredlist.org](http://www.iucnredlist.org)
- Jackson, D.B., Fuller R.J. & Campbell, S.T. (2004)** Long-term population changes among breeding shorebirds in the Outer Hebrides, Scotland, in relation to introduced hedgehogs (*Erinaceus europaeus*) *Biological Conservation* **117**: 151–166
- Jeffrey, C. (1982)** *Rhododendron* and classification—a comment. *Rhododendrons with Magnolias and Camellias, Yearbook 1982/3*. Royal Horticultural Society, London
- Jeon, J.I., Chang, C-S, Chen, Z-D. & Park, T.Y. (2007)** Systematic aspects of foliar flavonoids in subsect. *Carpinus* (*Carpinus*, Betulaceae). *Biochemical Systematics and Ecology*. **35**: 606–613
- Katovich, S.A., Munson, A.S., Ball, J. & McCullough. (2003)** *Bronze birch borer. Forest Insect & Disease Leaflet*. U.S. Department of Agriculture Forest Service. Accessed: March 2014, <http://www.na.fs.fed.us/spfo/pubs/fidls/bbb/bbb.htm>
- Kuser, J. (1983)** Inbreeding depression in *Metasequoia*. *Journal of the Arnold Arboretum* **64**: 475–481
- Landrum, L.R. (2003)** What has happened to descriptive systematics? What would make it thrive? *Systematic Botany* **26**(2): 438–442
- Lucas, G. & Synge, H. (1978)** *The IUCN plant red data book. Betula uber* (Ashe) Fernald p. 83–84. IUCN, Morges. Switzerland
- Manchester, S.R. & Tiffney, B.H. (2001)** Integration of paleobotanical and neobotanical data in the assessment of phytogeographic history of Holarctic Angiosperm clades. *International Journal of Plant Sciences*. **162**(6): 19–27
- Meffert, L.M. (1999)** How speciation experiments relate to conservation biology. *Bioscience* **49** (9): 701–711
- Meng, A., He, Z., Li, J. & Xu, L.. (2004)** Chromosome numbers of two threatened species of Betulaceae. *Plant Science Journal* **22**(2): 171–173
- Merilä, J., Björklund, M., & Baker, A.J. (1996)** The successful founder: genetics of introduced *Carduelis chloris* (greenfinch) populations in New Zealand. *Heredity* **77**: 410–422

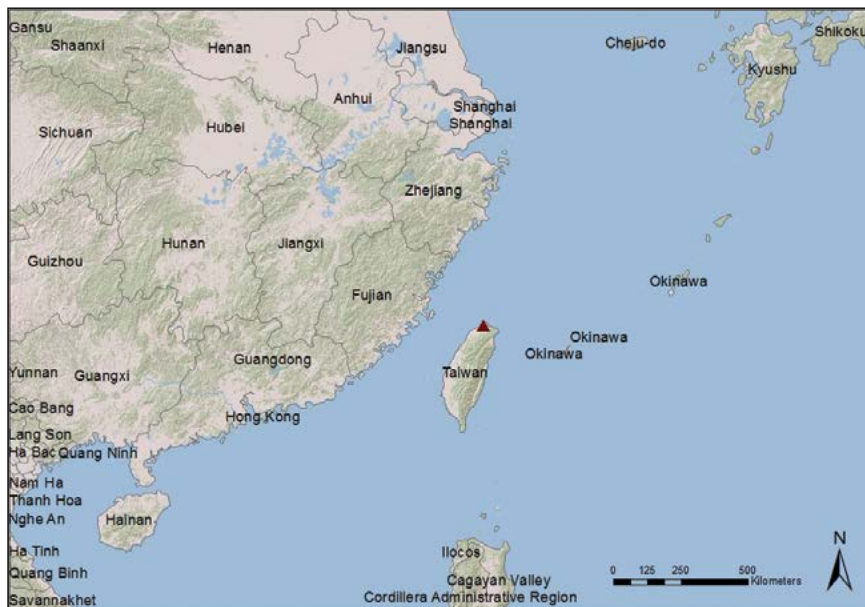


- Molnar, T. J. in Kole, C (Eds.). (2011)** *Wild Crop Relatives: Genomic and Breeding Resources: Forest Trees*. Springer-Verlag, Berlin Heidelberg
- Nagamitsu, T., Kawahara, T. & Kanazashi, A. (2006a)** Endemic dwarf birch *Betula apoiensis* (Betulaceae) is a hybrid that originated from *B. ermanii* and *B. ovalifolia*. *Plant Species Biology* 21: 19–29
- Nielsen, D.G., Muilenburg, V.L. & Herms, D.A. (2011)** Interspecific variation of Asian, European, and North American Birches (*Betula* spp.) to Bronze Birch Borer (Coleoptera: Buprestidae). *Environmental Entomology* 40:(3): 648–653
- Petit, R.J. & Hampe, A. (2006)** Some evolutionary consequences of being a tree. *Annual Review of Ecology, Evolution and Systematics* 37: 187–214
- Royal Forestry Society (2014)** *Hazel*. Accessed: March 2014, <http://www.rfs.org.uk/learning/hazel>
- Santamour, F.S. (1978)** Interspecific hybridisation in *Carpinus*. *Metropolitan Tree Improvement Alliance (METRIA) Proceedings* 1: 73–79
- Sati, S.C., Sati, N. & Sati, O.P. (2011)** Bioactive constituents and medicinal importance of genus *Alnus*. *Pharmacognosy Review*, 5: 174–83
- Skvortsov, A. K. (1968)** *Willows of Russia and adjacent countries: taxonomical and geographical revision*. English translation by I.N. Kadis, (ed. A.G. Zinovjev) (1999). University of Joensuu, Finland
- Stone Lane Gardens. Medical uses.** Accessed: March 2014, <http://stonelanegardens.com/wp-content/static/2011/09/Medicine-uses-for-Birch.pdf>
- Taggart, J.B., McNally, S.F. & Sharp, P.M. (1990)** Genetic variability and differentiation among founder populations of the pitcher plant (*Sarracenia purpurea* L.) in Ireland. *Heredity* 64: 177–183
- Tiilikkala, K., Fagernas, L., & Tiilikkala, J. (2010)** History and Use of Wood Pyrolysis Liquids as Biocide and Plant Protection Product. *The Open Agriculture Journal* 4: 111–118
- Tilford, G.K. (1997)** *Edible and Medicinal Plants of the West*, Mountain Press Publishing, Missoula
- United States Department of Agriculture (USDA) (2012)** Tree Nuts: World Markets and Trade. *USDA Foreign Agricultural Service Circular Series*. Accessed: October 2012, <http://usda.mannlib.cornell.edu/usda/fas/treenutwm//2010s/2012/treenutwm-10-26-2012.pdf>
- U.S. Fish and Wildlife Service (1994)** *Reclassification of the Virginia Round-Leaf Birch (Betula Uber) From Endangered to Threatened*. Federal Register, 59 FR 59173
- U.S. Fish and Wildlife Service (2005)** *Virginia round leaf birch (Betula Uber)*. Northeast Region U.S. Fish and Wildlife Service, Hadley, MA. Accessed: March 2014, <http://www.fws.gov/northeast/pdf/vabirch.pdf>
- Wawrzynski, P., Krischik, V. & Katowich, S. (2009)** *Bronze Birch Borer*. Accessed: April 2014, <http://www.extension.umn.edu/garden/insects/find/bronze-birch-borer/>
- Williamson, R.C. & Pellitteri, P.J. (2003)** *Birch disorder: Bronze birch borer*. Accessed: April 2014, <http://barron.uwex.edu/files/2011/08/bronze-birch-borer.pdf>
- Witcher, I.N. & Wen, J. (2001)** Phylogeny and biogeography of *Corylus* (Betulaceae): inferences from ITS sequences. *Systematic Botany* 26(2): 283–298
- Zare, H. & Amini, T. (2012)** A review of the genus *Alnus* Gaert. in Iran, new records and new species. *Iranian Journal of Botany* 18(1): 10–21



## GLOBALLY THREATENED BETULACEAE TAXA

*Alnus henryi* C.K.Schneid.



CR D (PE)  
Province of China (Taiwan: Tanshui)

*Taxonomic note:* There is some debate over the acceptance of this species. Further studies may show that it is conspecific with *Alnus formosana*. The only major difference between the two species appears to be one of phenology: *A. formosana* flowers in spring, while *A. henryi* flowers in autumn. Until genetic analysis has been carried out, it should be considered threatened. It is treated as an 'uncertain species' in the *Flora of Taiwan* (2nd ed.).

This species is endemic to Taiwan, reported to only occur in the Tanshui region of the island.

There are conflicting reports in available literature about this species. The

Chinese Red List, for example, lists this species as Least Concern, but consultation with local experts has confirmed that this species is very rare.

Some references suggest this species is common within its range, but it is more likely that the commonly occurring *Alnus* is *A. formosana*. Recent surveys of the reported distribution area have not found this species and it is therefore flagged as Possibly Extinct. A lack of herbarium specimens and taxonomic uncertainty mean that this species was last recorded for certain in the wild in 1916 when the type specimen was collected. If this species is still present in Taiwan remaining population size is estimated to be fewer than 50 mature individuals.

This species is reported as held in *ex situ* collections, although very rare in cultivation, but it is thought that reported collections are in fact *A. formosana* rather than *A. henryi*.

Flooding and typhoons are common in the distribution area and may present a threat to this species.

*Alnus henryi* is a deciduous tree that grows to 20 m, with yellowish green branchlets. Leaves are glabrous and ovate or elliptic in shape. The tree is dioecious: the male inflorescence is catkin-like and the female inflorescence is sessile. It flowers in autumn and fruits in late autumn. Woody cones contain nutlets with papery wings. It is reported to be a pioneer species.

*Refs:* 11, 42, 74, 77, 91, 94, 99, 133, 208

*Alnus maritima* (Marshall) Muhl. ex Nutt.



*Alnus maritima*

EN B2ab(ii,iii,iv)  
United States (S Delaware, NW Georgia, SE Maryland, SC Oklahoma)

*Taxonomic note:* There was some debate over the acceptance of the three subspecies, but recent genetic studies have concluded that there are three geographically disjunct subspecies of *Alnus maritima*.

Endemic to the United States, *Alnus maritima* (Seaside Alder) is a very disjunctly distributed tree species, with populations so widely separated that they are considered distinct subspecies. The distinct genetic identity of each subspecies, the reduced genetic diversity within each subspecies and the lack of gene flow among populations within each region mean that it is important to protect all populations to conserve the genetic diversity and long-term viability

of the species. Despite its name, in all locations Seaside Alder only occurs in fresh water tidal and non-tidal systems.

The combined area of occupancy of the fragmented subspecies populations is estimated to be less than 500 km<sup>2</sup>. A combination of threats impact upon the *Alnus maritima* complex, including climate change, grazing and low genetic diversity, which are projected to cause decline in area of occupancy, quality of habitat and number of subpopulations.

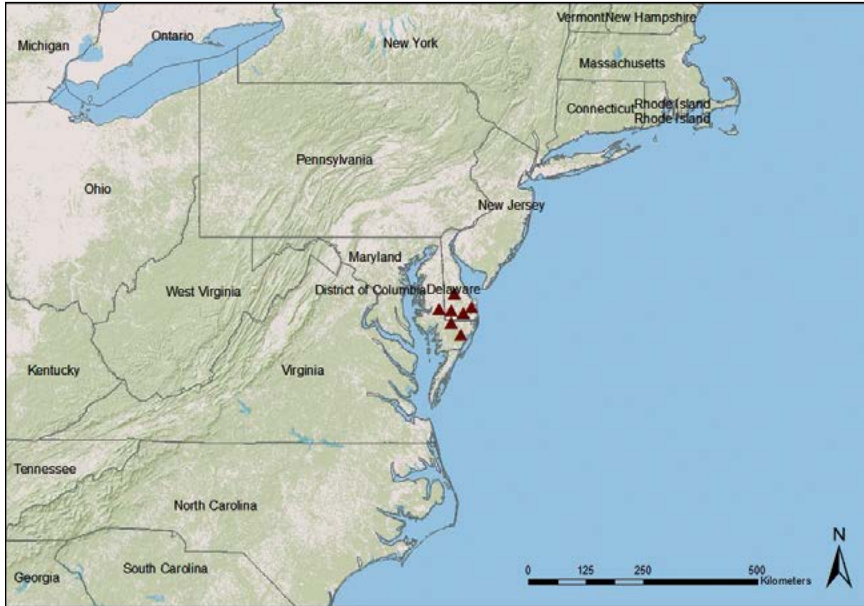
*Alnus maritima* is a multi-stemmed large shrub or small tree, with smooth, light grey bark. It has simple elliptical leaves with a leathery texture and a singly serrated margin. This species has vivid yellow, floral catkins and brown cone-like fruits which release the water-dispersed seeds. This species is the only autumn blooming member

of its genus native to North America, all others bloom in spring. This characteristic is shared with two old-world *Alnus* species: *Alnus nitida* and *Alnus nepalensis*. This means that the nearest extant relatives of *Alnus maritima* are in southern Asia.

This species has a NatureServe ranking of Vulnerable. The reasons for this are its scattered range (small areas of Oklahoma, southwestern Delaware and adjacent eastern Maryland, and one areas in Georgia), with few sites overall. This species was listed as Rare in Delaware and Maryland, and Vulnerable in Oklahoma in the 1997 IUCN Red List of Threatened Plants and LR/nt in the World List of Threatened Trees in 1998.

*Refs:* 44, 63, 70, 74, 88, 103, 104, 129, 133, 134, 143, 155, 162, 173, 183, 184, 185, 201, 208, 222, 224, 236

*Alnus maritima* subsp. *maritima*



There is 3,136.8 km<sup>2</sup> of water. Obviously the actual extent of occurrence is much less than this number, thus *A. maritima* subsp. *maritima* meets criterion B1, extent of occurrence less than 5,000 km<sup>2</sup>.

Although the population appears stable, climate change poses a significant threat to the population in the future. The Intergovernmental Panel on Climate Change (IPCC) is projecting significant increases in sea level by the end of the 21<sup>st</sup> century due to global warming causing expansion of global sea water and increased melting of glaciers and ice sheets. This rise in sea level will lead to salt water intrusion into current fresh water tidal systems and will lead to local extirpation of *A. maritima* subsp. *maritima* populations.

EN B1ab(i,ii,iii,iv)  
United States (Delaware, Maryland)

*Alnus maritima* subsp. *maritima* populations are located in the Delmarva Peninsula in Delaware and Maryland. In Maryland (Dorchester, Somerset, Wicomico and Worcester Counties) and western Sussex County, Delaware, this subspecies is found in the upper reaches and tributaries of the Choptank, Nanticoke, Pocomoke and Wicomico rivers. In eastern Sussex

County, Delaware this taxon occurs on small ponds formed by the damming of small creeks. This taxon only occurs in open sunny areas, in shaded areas this subspecies is replaced with *Alnus serrulata*.

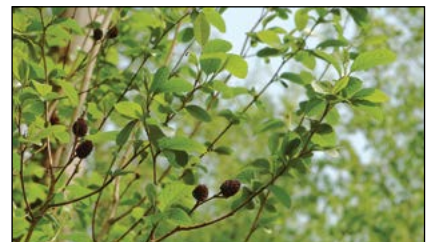
Due to a lack of monitoring of this subspecies the extent of occurrence and area of occupancy is unknown. As a substitute the total km<sup>2</sup> of water area in the five counties where this subspecies occurs was calculated.

There are currently no active conservation measures in place for this subspecies. The most practical conservation measure that should be implemented is *ex situ* conservation and seed collection from the whole range of the subspecies to preserve potential local adaptability and overall genetic diversity.

This taxon has not yet been ranked (G3TNR) on NatureServe.

Refs: 70, 88, 104, 133, 143, 183, 184, 185, 201, 222

*Alnus maritima* subsp. *georgiensis* J.A.Schrad. & W.R.Graves



*Alnus maritima* subsp. *georgiensis* (Nourse, H & C)

United States (Georgia: Bartow County)  
CR B1ab(i,ii,iii,iv,v)+B2ab(i,ii,iii,iv,v)

This subspecies, commonly known as Georgia Alder, is known only from the east end of Drummond Swamp in Bartow County, Georgia and has an extent of occurrence of 0.5–0.7 km<sup>2</sup> and occupies an area of only 0.14 km<sup>2</sup>. It is a



shrub with many stems originating from the base and is found in open, standing water of a sag pond. The population here is currently stable but its location adjacent to agricultural lands where cattle are grazed is threatening this species. The runoff from these fields is decreasing the water quality leading to eutrophication. Climate change is also predicted to cause population decline or extirpation from this site. A lack of genetic diversity, lack of seedling recruitment and other potential stochastic events could also lead to population decline.



*Alnus maritima* subsp. *georgiensis* (Nourse, H & C)

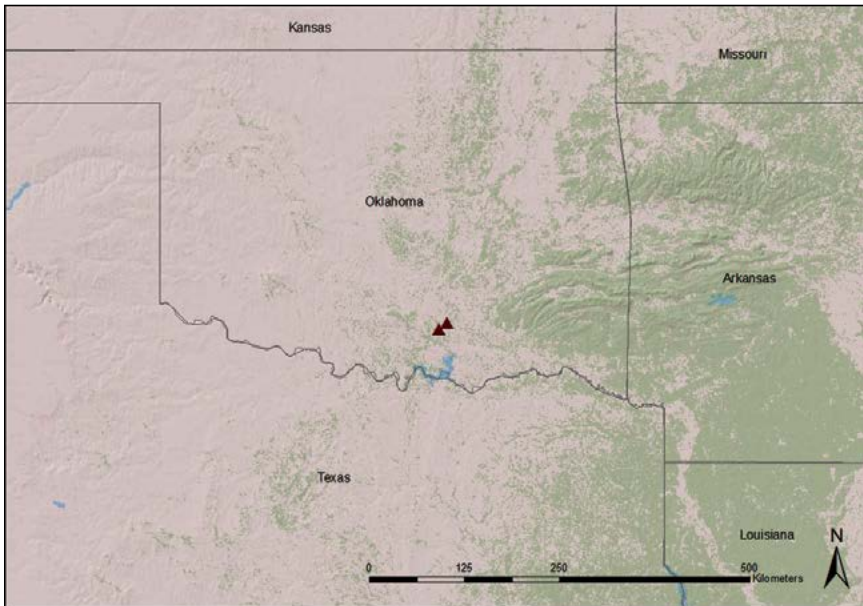
Three experimental research populations have been established on protected land to study the ability to establish additional populations of this species. *Ex situ* collections have been established at the Atlanta Botanical

Garden and the State Botanical Garden of Georgia. *Ex situ* seed collections have also been made.

This taxon is ranked G3T1 (Critically imperiled) on NatureServe (ref 143).

Refs: 63, 103, 104, 129, 133, 134, 143, 162, 183, 184, 222

*Alnus maritima* subsp. *oklahomensis* J.A. Schrad. & W.R. Graves



The extent of occurrence is 9.8 km<sup>2</sup> and the area of occupancy is 2.97 km<sup>2</sup>.

Although these two subpopulations appear stable at this point in time, a threat from climate change is inferred, along with decreasing volumes of water in the local aquifer. A lack of genetic diversity and no known recruitment from seed and/or stochasticity will lead to a decrease in population numbers with a concurring decrease in habitat quality. This taxon is therefore categorised as Critically Endangered.

*In situ* conservation is being pursued to protect populations on both the Blue River and Pennington Creek and a graduate student is currently conducting research on the establishment of this species on an island in the Blue River to determine if out-planting is a viable conservation action.

This taxon has not yet been ranked (G3TNR) on NatureServe (ref 143).

Refs: 70, 104, 133, 143, 173, 183, 184, 185, 222

Assessor: Stritch, L.

CR B1ab(i,ii,iii,iv,v)+B2ab(i,ii,iii,iv,v)  
United States (Oklahoma)

*Alnus maritima* subsp. *oklahomensis* (Oklahoma Alder) is the most distinct of the three subspecies, with narrower leaves and larger trunks and canopies. This subspecies is known from only one

population with two subpopulations; one occurring along Pennington Creek in Johnston County and the other along the Blue River in Johnston and Pontotoc Counties. In both locations this subspecies occurs in shallow water at the edges of the river in open sunny areas between 208 m and 215 m ASL.



*Alnus subcordata* C.A.Mey.



Since precise population reduction data is not available this is a preliminary assessment and does not alter the 2005 assessment. Further population information is needed to make a full assessment.

Loss of forest cover in the distributional area of this species is reported to lead to increased waterlogging in the bottom of valleys, where this species often occurs. However, it is reported that this species might be one of few native tree species that can persist in these new environmental conditions and outcompete the exotics. As a result, active afforestation using *A. subcordata* is being considered as an option to restore the new waterlogged degraded areas in the forest.

VU A2c  
Azerbaijan, Islamic Republic of Iran

This species has a small distribution. This species was evaluated as VU A2c in a provisional assessment undertaken during a tree Red Listing workshop held in Tbilisi, Georgia, 26–28 September 2005, due to a reported population size reduction of at least 30% over the last

three generations and an extent of occurrence of less than 35,000 km<sup>2</sup>.

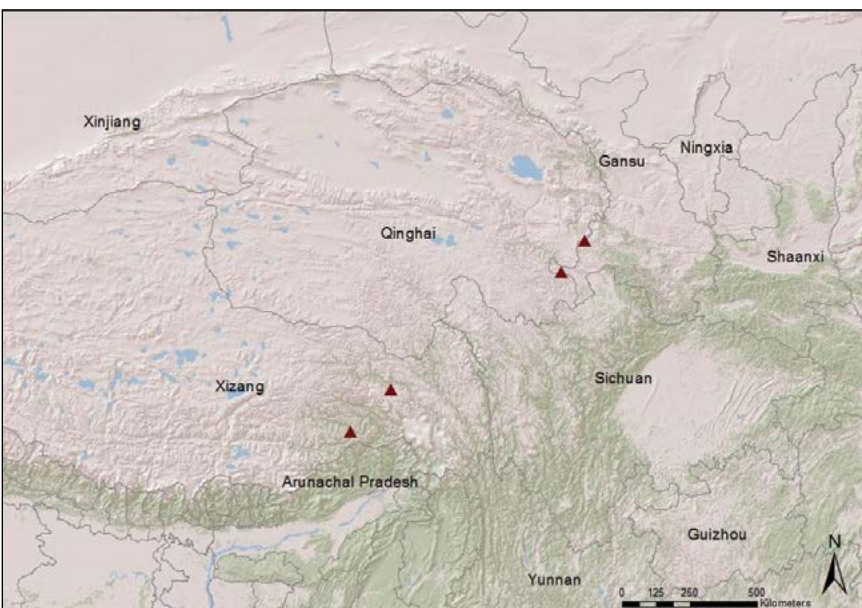
Part of the range of this species, in the Hyrcanian forest of Iran, is subject to deforestation for agriculture, road construction, overgrazing and fires. The decline in area of occupancy, extent of occurrence and/or quality of habitat is therefore predicted to be continuing.

*Alnus subcordata* is a fast growing species, growing to 25 m tall. It is found in mixed damp woodland, or as a pioneer species following floods or land-slides.

Refs: 15, 74, 133, 136, 208, 256

Assessor: IUCN/SSC Caucasus Plant Red List Authority

*Betula bomiensis* P.C.Li



NT  
China (Xizang)

*Taxonomic note:* *B. delavayi*, *B. bomiensis*, *B. calcicola* and *B. potaninii* taxa are sometimes confused. However they are separable by their visible morphological characters, ploidy and geographical distribution.

A small tree to 8 m, this species grows in the margins of broad-leaved forests or dry scrub. *B. bomiensis* is reported to be a little known species. It is known only from the type and three other collections and a small number of cultivated specimens exist as a result of these collections.

The data points available for this species give an extent of occurrence

greater than the threshold for it to be considered Vulnerable, but the area the species occupies within this range is likely very small (<2,000 km<sup>2</sup>), as inferred from a low number of reported sightings or collected specimens. It is therefore assessed as Near Threatened.

This species may qualify for a higher threat category under criterion B due to the fragmented nature of the population (again inferred from limited collections or reported sightings within its range)

and projected continuing decline in area, extent and quality of habitat as a result of deforestation which is a high threat in Tibet (B2ab(iii)).

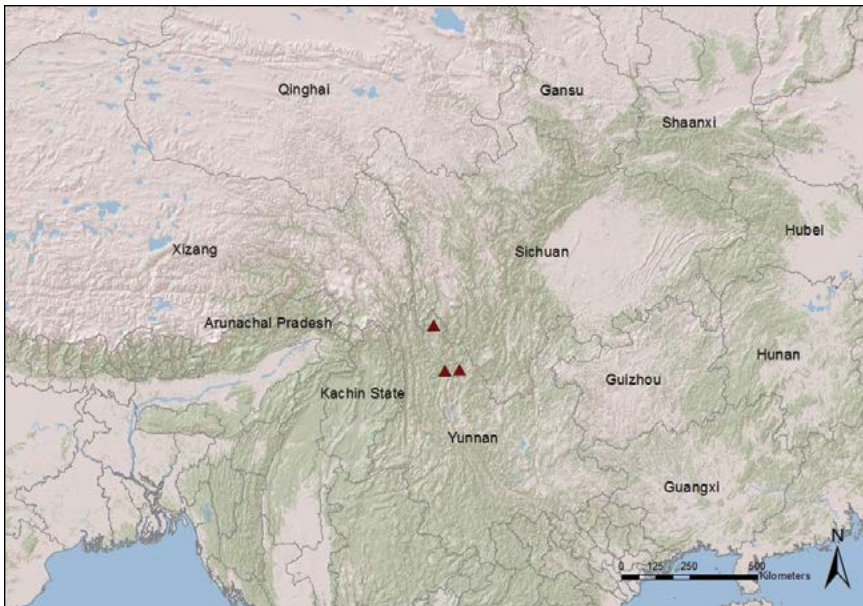
This species is not assessed on the Chinese Red List. Further field research is required to verify if this species qualifies in a higher threat category.

This species has been cultivated at Liverpool University Botanic Gardens, UK. It is self-incompatible, therefore

successful establishment in cultivation will depend on the maintenance of at least one breeding population to provide viable seed for distribution. Cuttings taken from seedlings root easily and viable seed which comes true is produced where the different clones are grown together. This species would benefit from increased conservation action through *in situ* and *ex situ* conservation.

Refs: 5, 74, 77, 99, 133, 208

**Betula calcicola** (W.W.Sm.) P.C.Li



Range in Yunnan. A shrub generally 1–2 m tall, this species forms thickets on damp limestone rocks and cliffs. Possible threats include habitat fragmentation and deforestation due to rapid development in Yunnan; however the Lijiang Shan is reported to be one of the best preserved areas of China.

The data points available for this species give an extent of occurrence within the threshold for this species to be considered Vulnerable (under criterion B1b(iii)). However, there are limited data points available and the extent of occurrence could be higher than represented by the available data points. The full range of this species is still estimated to be small and potential threats have been identified. It is therefore assessed as Near Threatened. Further field research is required to verify if this species qualifies in a higher threat category.

This species is not assessed on the Chinese Red List.

Refs: 5, 42, 74, 75, 99, 133, 207, 208

NT  
China (SW Sichuan?,\* NW Yunnan)

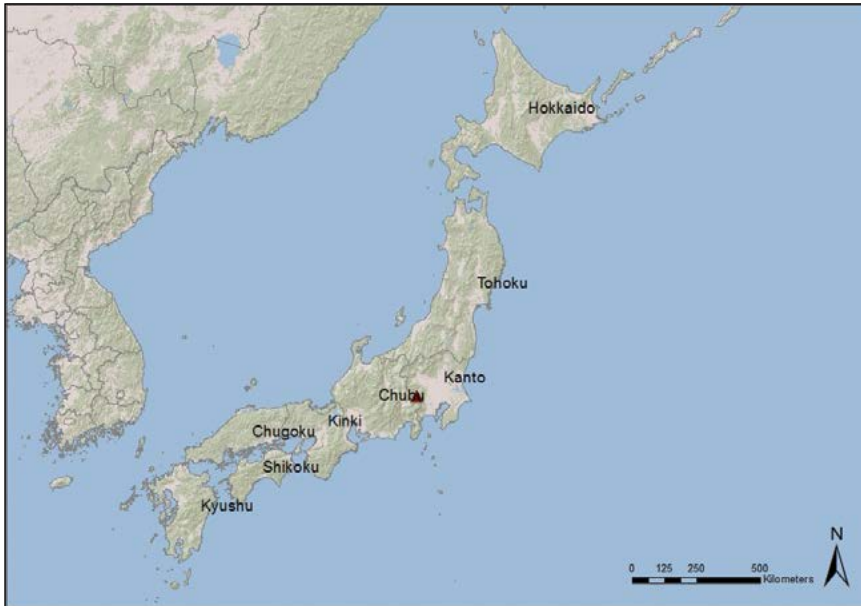
*Taxonomic note:* B. delavayi, B. bomiensis, B. calcicola and B. potaninii taxa are sometimes confused.

*However they are separable by their visible morphological characters, ploidy and geographical distribution.*

This species is only known for certain only from Yulong Shan, in the Lijiang

\* If occurrence in a location is uncertain, the location is followed by a question mark (?).



*Betula chichibuensis* H.Hara*Betula chichibuensis*

CR B1ab(iii)+B2ab(iii); D  
Japan (Honshu: Chichibu)

Endemic to Japan, this species occurs only on the island of Honshu. It has a very small extent of occurrence, confined to the Chichibu area in the mountains of Central Honshu on Mount Kamo-san, near Tano-Gun, in Gunma Prefecture. It occurs as subpopulations and the area of occupancy is estimated to be very low (<10 km<sup>2</sup>). The population was reported to have reduced to just 21 remaining individuals in the wild in 1993. This species has no close living relatives anywhere else in the world, is considered a relict species and is likely to be of very ancient origin. Deforestation and habitat degradation are also evident in the Chichibu District, presenting a threat to the survival of this species. This species is reported to be a conservation priority by Ashburner and McAllister.

This species grows in limestone outcrops. Although young immature plants appear to be relatively shade tolerant, mature trees are very intolerant of shade. The species also appears

to be fairly tolerant of wet soils and is relatively drought tolerant, at least once established.

The small population and restricted distribution of *B. chichibuensis* make it susceptible to natural disaster or disease. The species is also self-incompatible, requiring two individuals to be close enough to cross-pollinate one another, making seed production uncertain in small populations. Wild collected seed has also shown very low viability (less than 1%).

However, when several clones are grown close together in cultivation seed viability is high. In 1986, seeds were collected from trees growing on Mount Kamo-san and sent to Ness Botanic Gardens, University of Liverpool, UK. Eight clones from the original seeds are now in cultivation, and have been distributed to arboreta and botanic gardens in Europe and North America. Seedlings from the original wild-collected seeds showed considerable variability in habit characteristics and most have flowered and fruited freely.

As this species is easily propagated by cuttings, it is possible for commercial reproduction to occur from a single plant, and for one, self-incompatible clone to dominate the cultivated market of this species in the future. Care should be taken to maintain genetic diversity of this species.

*Betula chichibuensis* grows as a multi-stemmed shrub or small tree up to 10 m in height. Its bark is brown and its leaves are soft, green and ovate in shape. This species is monoecious with creamy yellow male catkins and red female catkins with tufts of violet styles. Flowering occurs May to June. The fruiting catkins are short, upright and contain wingless seeds.

This species is assessed as Endangered in the Red List of Threatened Plants of Japan. This species was assessed as Rare in the 1997 IUCN Red List of Threatened Plants.

Refs: 5, 11, 74, 77, 132, 133, 141, 208, 236, 259

**Betula globispica** Shirai



NT  
Japan (C and SC Honshu)

The species is endemic to Japan and is only found in the Chubu (central) and Kantō (eastern) districts of the island of Honshu. The total distribution area of the two regions where this species is reported to be found is c. 110,000 km<sup>2</sup>. Much of this area is mountainous, which is the habitat type that this species

prefers, however, it is reported to be rare within its range and to exist as small subpopulations. The area of occupancy is therefore estimated to be approaching the threshold value for qualifying as Vulnerable (i.e. nearly 2,000 km<sup>2</sup>). Presence on mountain areas means these subpopulations may be genetically isolated.

This species is susceptible to drought, even as a relatively well-established tree.

Its existence as small populations also makes these populations susceptible to human activities, such as land clearance. Future decline in area of occupancy, and loss of subpopulations, are therefore projected. Field research is required to verify the current distribution of this species, and determine if it should already be placed within a threat category.

This species is very rare in cultivation. It is self compatible and can be propagated easily by seed, although seedlings are susceptible to slugs and drought.

*B. globispica* is a very distinct relict species from Honshu with no close living relatives anywhere else in the world. A tree to 21 m it is found on steep mountain slopes and rocky outcrops. It prefers very heavy clay which, although wet, does not become waterlogged.

This species was assessed as Rare in the 1997 IUCN Red List of Threatened Plants. This species is reported to be a conservation priority by Ashburner and McAllister. It is assessed here as Near Threatened, almost qualifying as Vulnerable under criterion B2ab(ii,iv).

Refs: 5, 74, 133, 154, 208, 222, 236

**Betula gynoterminalis** Y.C. Hsu & C.J. Wang



CR D (PE)  
China (NW Yunnan: Gongshan Drungzu Nuzu Zizhixian)

Endemic to China, this is an apparently distinct species known only from a single specimen in the herbarium in Kunming. The specimen was collected from 2,600 m ASL in the mixed, broadleaved forests of Drungzu Nusu Zizhixian near Gongshan, east of Lijiang in northwest Yunnan. This species is assessed as Critically Endangered on the Chinese Red List. This species is assessed as Critically Endangered here due to a very small population size, likely to be less than 50 mature individuals left in the wild, and is flagged as possibly extinct as there is no record of the species since the type specimen was



collected in 1956. Field studies are required to determine if this species still exists in the wild and if so, to determine population size and whether it is found in other localities. There is no record of field surveys having found this species since the initial type specimen was collected.

The forests of northwest Yunnan are under threat from increased timber collection for fuelwood and building

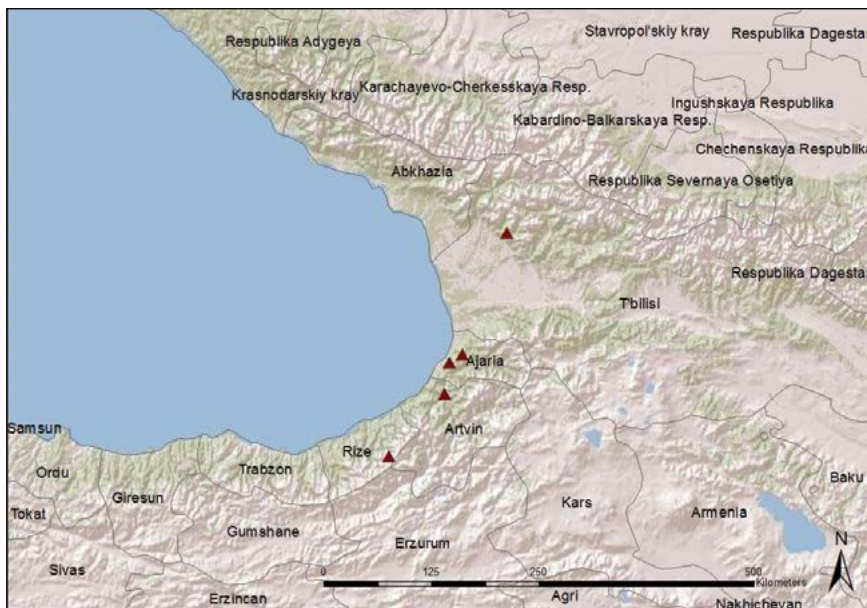
supplies, and loss of habitat due to increasing development. If populations do remain, it is likely they are under increasing threat. If populations of this species are located, both *in situ* and *ex situ* conservation actions should be taken.

*Betula gynoterminalis* appears to have a unique morphology, probably most closely related to *B. delavayi* and *B. calcicola*. It is a small tree to 7 m with dark

purple branches. The large ovate leaves are very hairy on the underside with prominent veins and serrated margins. The nutlets have very narrow wings and the fruiting catkins are pendulous and borne terminally, which is unusual for a birch. This species flowers between June and July and fruits between July and August.

Refs: 5, 42, 74, 99, 133

### *Betula medwediewii* Regel



*Betula medwediewii* on Mt Tbeti in Adjara, Georgia. Near Threatened (Bartlett, P., Stone Lane Gardens)

NT

Georgia, Turkey-in-Asia, Islamic Republic of Iran?, Azerbaijan?, Armenia?

A relict species confined to the Caucasus Mountains, *Betula medwediewii* is distributed in the western Transcaucasus and the adjacent mountains of north-eastern Turkey. This species is found growing in Adjara in south-western Georgia, on Mount Jvari in western Georgia and in the provinces of Rize and Artvin (formally Çoruh Vilayet) in north-eastern Turkey. This species is reported as rare across its range, especially in Georgia where populations are very small, fragmented and unstable. Presence in Iran, Azerbaijan and Armenia has not been confirmed.

This species is found on sub-alpine mixed forests and open hillsides at elevations between 600–2,400 m ASL. This species is heavily over-grazed from wild and domestic animals. Grazing causes damage to both the trees and seeds, and has the risk of reducing natural reproduction. Poor forest management and uncontrolled logging are also major problems in the regions where this tree is found.

This species is deep rooted and drought tolerant, but has very specific growing requirements. It is not shade tolerant and struggles to compete with fast growing trees or shrubs as it is slow growing. This species prefers a limestone based soil. This limits its range to cleared ground above the tree-line where there is little competition and the right soil.

However, it cannot survive too high because of the harsh winter climate at high altitudes within its range.

*Betula medwediewii* nearly meets the threshold for qualifying as Vulnerable under criterion B1ab. This species was evaluated as Vulnerable under criterion B1ab(iii,v) in the Red List of the Endemic Plants of the Caucasus, based on a provisional assessment undertaken during a Global Tree Specialist Group workshop in Tbilisi in 2005. The updated assessment evaluating this species

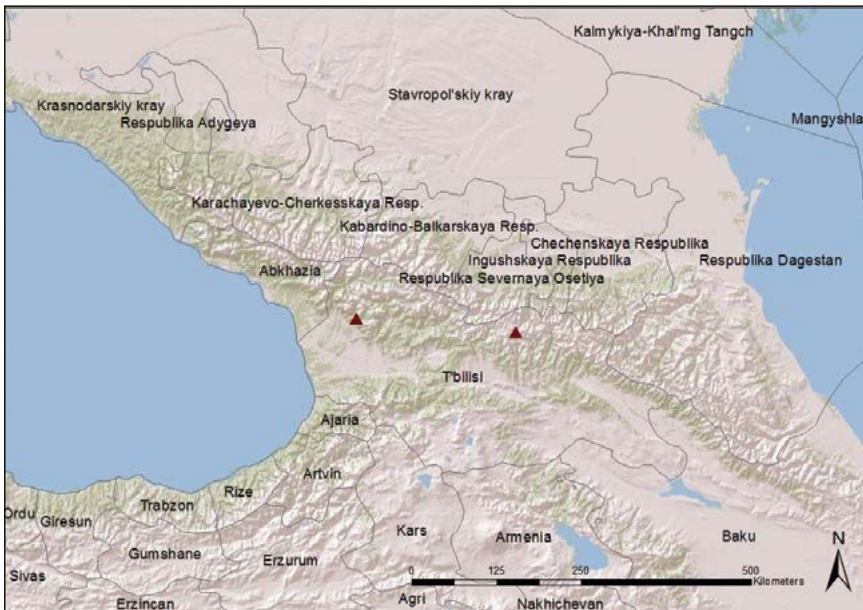
as Near Threatened is based on more recent distribution information and has been verified by members of the IUCN/SSC Caucasus Plant Red List Authority.

*Betula medwediewii* is occasionally grown in arboreta and a few large gardens in Europe. Seed has been obtained from Çoruh and Borçka Districts in Turkey and from Mt Migaria region in the Caucasus. As yet no propagation or reintroduction programs have been set up for this species.

This multi-stemmed spreading shrub grows up to 5 m tall. It has metallic, reflective bark with conspicuous lenticels and large ovate to circular, deeply veined, dark green leaves. Male flowers are catkin-like and very long, female flowers are inconspicuous. Fruiting catkins are yellow, large, upright and persistent with brown scales.

Refs: 5, 9, 11, 30, 52, 54, 74, 110, 133, 192, 208, 222, 255

***Betula megrelica* Sosn.**



region of the Caucasus mountain range. This species is rare across its range.

It was previously known from one specimen taken from Mt Migaria in 1934 by D.Sosnovsky. In 2013, two populations were located on Mount Migaria and Mount Jvari in the Mingrelia region. The population on Mount Jvari was estimated to spread for 3 km along the north face of the ridge, covering an area of 3.0 km x 0.5 km. The population on Mount Migaria is estimated to spread over a potential area of 2.0 km x 0.5 km. Estimates suggest there may be up to 8 fragmented subpopulations and suitable habitat in nearby areas has been identified. These new potential subpopulations would increase the extent of occurrence, area of occupancy and total population, but all are estimated to remain low (EOO < 5,000 km<sup>2</sup>, AOO < 500 km<sup>2</sup>). If no other subpopulations are identified this species would qualify as Critically Endangered. Further field study is needed to verify distribution and population size.

EN B1ab(i,ii,iii,v)+2ab(i,ii,iii,v)  
W Georgia (Mt. Migaria, Mt. Jvari)

*Betula megrelica* is a relict species endemic to Georgia, found only on two mountains in the Mingrelia (Samegrelo)

There is an observed continuing decline in the area, extent and quality of habitat and number of mature individuals, as a result of wood extraction for fuel and grazing. The main threat to this species is overgrazing from livestock and wild animals, which causes damage to the trunk and stems. Shrubs growing at lower elevations are more at risk from overgrazing. Other threats include poor forest management and uncontrolled logging. Although this species is located within the Samegrelo Planned Protected



*Betula megrelica* growing on Mt Jvari, Georgia. Endangered (Bartlett, P., Stone Lane Gardens)



*Betula megrelica* growing on Mt Migaria, Georgia. Endangered (Bartlett, P., Stone Lane Gardens)



Area, there seems at present little to no control on the use or misuse of the resources on the ground. This species has very specific habitat requirements. The habitat must be high enough to suppress the growth of taller species, steep enough to avoid damage from grazing livestock, the aspect is between north and east, and on limestone.

This species is fairly rare in cultivation, reported to only occur in the University of Liverpool Botanic Gardens, Wakehurst Place and Stone Lane Gardens, all of which are in the UK. There are no known propagation or reintroduction

programmes set up for this species at present, however recent research in Georgia has been essential in improving the understanding of this rare species. Identifying that *B. megrelica* has a restricted, niche habitat makes it susceptible to damage and destruction by both man-made and natural events. Future conservation work aims to propagate seedlings collected from the Mingrelia region for possible use in a reintroduction programme and further explore the region for more populations.

*Betula megrelica* is a small shrub, 1–4 m in height, with several main

stems radiating from just above soil level. These stems are often horizontal or even downward curving. It has a similar appearance to *B. medwediewii* but has much smaller, narrower leaves and smaller fruiting catkins. At high elevations it forms dense thickets and dwarf forests on grassy slopes. It can also be found growing from the sides of rock outcrops with little soil. At lower elevations the shrub grows smaller and sparser. It is likely that the shrubs are covered by snow throughout the winter season.

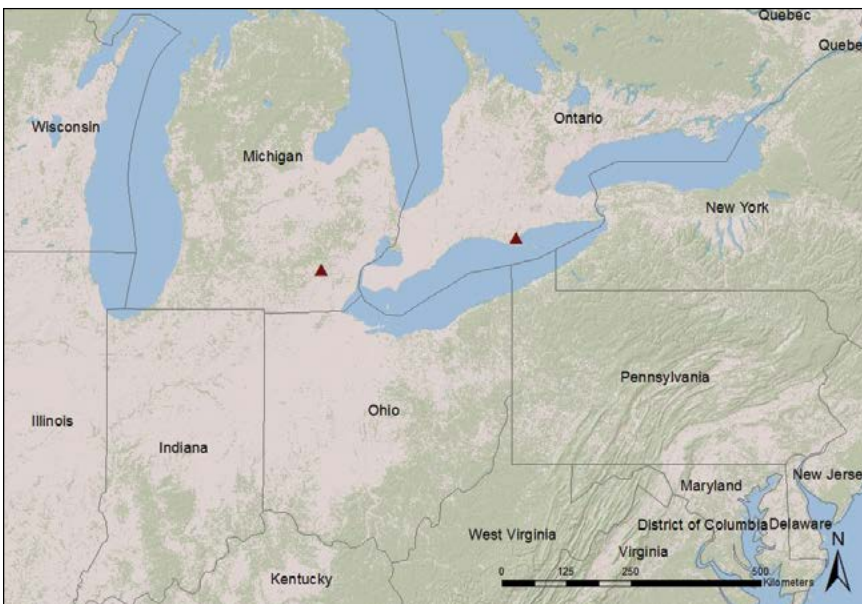
This species was listed as Indeterminate in the 1997 IUCN Red List of Threatened Plants. This species was evaluated as Vulnerable under criteria B1ab(iii,v)+2b(iii,v) in the Red List of the Endemic Plants of the Caucasus, based on a provisional assessment undertaken during a Global Tree Specialist Group workshop in Tbilisi in 2005. The higher threat category suggested here is based on data gathered from more recent surveys, indicating that the actual extent of occurrence and area of occupancy of this species is more restricted than previous estimates suggested.

Refs: 5, 7, 9, 11, 74, 110, 126, 133, 208, 222, 236, 255



*Betula megrelica* growing on Mt Migaria, Georgia. Endangered (Bartlett, P., Stone Lane Gardens)

***Betula murrayana*** B.V.Barnes & Dancik



CR D

*Taxonomic note:* Some debate exists over whether this species should be considered an independent taxonomic lineage

Canada (Ontario), United States (Michigan)

Described as a new species in 1985, this species is an unusual natural hybrid of an already naturally hybridised species, *Betula x purpusii*, crossed with another native species, *Betula alleghaniensis*.

*B. murrayana* has a severely fragmented population, containing two subpopulations separated by a distance of approximately 320 km.

The site from which this species was first collected was from a low swampy area adjacent to a lake in Washtenaw County, Michigan. Two individuals were found here in the early 1980s, but one individual has since died. A high likelihood that the second individual may die before new seedlings become established is inferred, which would lead to a loss of one of the two subpopulations.

In 1987, a second occurrence was discovered in Norfolk County, Ontario. This likely represents an independent origin of the species. Although no hard population data exists for the Ontario subpopulation, it has been inferred that there are less than 25 individuals

and more than likely, based on the Michigan subpopulation data, less than 10 individuals. This species therefore qualifies as Critically Endangered under criterion D.

At both sites *B. murrayana* faces threats from stochastic events and small population size.

The species nearly qualifies as Critically Endangered under criterion B, as the two subpopulations have an extent of occurrence and area of occupancy of less than 1.0 km<sup>2</sup>, but it has been suggested that it is highly likely that this species will be found elsewhere in the Great Lakes/St Lawrence Valley areas as it is a hybrid, but it is not thought

additional subpopulations would be large enough to reduce the proposed category.

*Ex situ* collections of *B. murrayana* are held in the Holden Arboretum, the University of Michigan Matthaei Botanical Gardens (US) and the Ness Botanic Garden, University of Liverpool (UK). The specimen in the Holden Arboretum has recently been diagnosed with Bronze Birch Borer (see Case Study 3). However, the single tree in cultivation at the Ness Botanic Garden produces viable seed which comes true. These seedlings are now being distributed to other botanic gardens to increase the security of *ex situ* collections.

This naturally occurring hybrid takes different characteristics from its related taxa. The bark is shiny, smooth, dark red with pale horizontal lenticels and peels in a similar way to *B. allegheniensis*. The leaves are ovate with serrated margins similar to *Betula x purpusii* but are larger. This is a medium sized tree to 15 m tall, usually with several trunks. It flowers in late spring and fruits in late autumn.

This species is ranked G1Q (Critically imperilled with questionable taxonomy) on NatureServe. This species was listed as Endangered in the 1997 IUCN Red List of Threatened Plants.

Refs: 5, 6, 44, 133, 143, 221, 222, 224, 236

Assessor: Stritch, L.



*Betula murrayana* (Reznicek, A.A., michiganflora.net)



*Betula murrayana* (Reznicek, A.A., michiganflora.net)



*Betula tianschanica* Rupr.



reported as a threat (to its synonym *B. jarmolenkoana*). Part of the range of this species is within a protected area; the Xinjiang Tian Shan mountain system in China, a World Heritage Site. It is therefore better conserved within this part of its range, but no other reported conservation actions are in place in other parts of its range.

This species was assessed as Endangered A2ac; B2ab(ii,iii) on the IUCN Red List (in 2007) and in the Red List of Trees of Central Asia (in 2009). These assessments did not take occurrence in Mongolia into account and presence in Tajikistan was uncertain. These occurrences increase the area of occupancy of this species, likely above threatened thresholds. Population information in these new areas is not available and therefore it cannot be assessed under criterion A over its entire range.

This species is assessed as Near Threatened under criterion A, assuming the known decline in population in parts of its range equates to a total population reduction of nearly 30%.

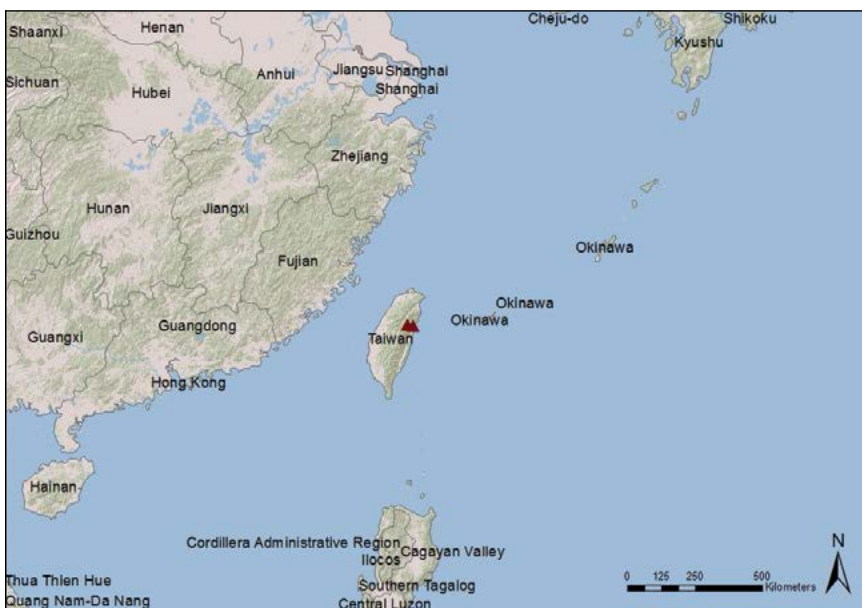
Refs: 5, 39, 42, 74, 77, 99, 100, 133, 208, 220, 222, 246

NT  
China (Xinjiang: Tian Shan), Kazakhstan, Kyrgyzstan, Mongolia, Tajikistan, Uzbekistan

This species occurs in the river basins and valleys of western Tian Shan (Ugan, Pskem and Chatkal). It is found from 1,300 to 2,500 m ASL in Xinjiang (China). Despite a fairly wide range, this species has a restricted area of

occupancy. Populations are fragmented. Populations in Central Asia (Uzbekistan, Kazakhstan and Kyrgyzstan) have declined at a rapid rate (exceeding 50% over the past 3 generations). This species is threatened by livestock grazing, wood collection, avalanches and tourism in Central Asia, but these threats are likely present across the range of this species. Fire has also been

*Carpinus hebestroma* Yamam.



CR B1ab(iii,v)  
Province of China (East Taiwan: Hualien Xian)

Endemic to Taiwan, this species is known only from the type specimen locality in Batakan, Hualien Xian (Hualien County). Within this locality, the species has small and fragmented subpopulations, distributed 20 km along the Li-Wu riverbank.

It is assessed here as Critically Endangered due to its limited extent of occurrence, being only known from only a single location and a projected decline in number of mature individuals and quality of habitat as a result of natural threats.

This species is threatened by disturbances including landslides after typhoons, which are common in Taiwan. The habitat of this species is located in the Taroko National Park which is a protected area, but this does not provide protection against natural occurrences.

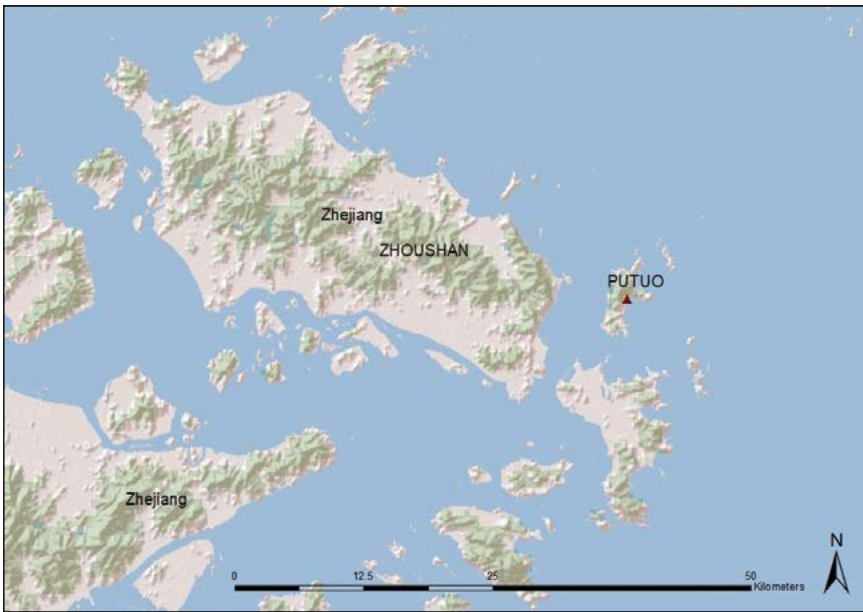
This species is very rare in cultivation and is not currently known to be involved in any propagation or reintroduction programmes. This species would benefit from *ex situ* conservation to provide additional protection against natural threats.

*Carpinus hebestroma* is a small deciduous tree to 8 m, with greyish black

bark and lanceolate shaped leaves with serrated margins. The tree is monoecious and flowers between May–July. It prefers to grow on limestone areas in montane forests, and is found at an altitude of 1,000–1,500 m ASL.

*Refs:* 11, 42, 74, 91, 94, 99, 120, 133, 208

*Carpinus putoensis* W.C.Cheng



sexually in the wild, but strong winds during flowering and seed-setting stages mean natural regeneration is almost absent. Low soil fertility also hinders natural succession and many once forested areas are now covered by tussock rangelands and grasses.

*Carpinus putoensis* is cultivated in the Hangzhou Botanical Garden where various propagation experiments are being conducted. This species is also part of a conservation programme led by the Zhoushan Institute of Forestry. This has involved cultivation and planting of approximately 79 individuals in a 1 hectare *near situ* reintroduction site, close to the remaining single mature individual. These 79 individuals were planted 30 years ago, but have not yet reached maturity.

CR D  
China (Zhejiang: Zhoushan Dao)

*Carpinus putoensis* is endemic to Putuo Island of the Zhoushan Archipelago, Zhejiang Province, China. Originally growing in evergreen broad-leaved forests, this species now exists as a single mature individual (approximately 200 years old), preserved on the top of Foding Mountain. This species might have disappeared many years ago if it was not for its location beside Huiji temple, an indirectly protected environment. This single tree was discovered in the early 1930s and since then no more wild individuals have been found.

The islands of the Zhoushan Archipelago have unique geographical environments and climatic conditions and their forests have been subjected

to intense human use for many years. It is for these reasons that there are many rare and endangered tree species endemic to these islands. A new marine economy zone in the Zhoushan Archipelago is increasing human activity in this area, further threatening these rare species.

Putuo Island has been proclaimed a nation's key nature reserve and this species is under first-grade state protection. A fence has been erected around the remaining *C. putoensis* tree to protect it with an interpretation panel containing information about the tree.

With a well-developed root system, this species is thought to be able to withstand both drought and storms. The species is monoecious, thereby in principle is still able to reproduce

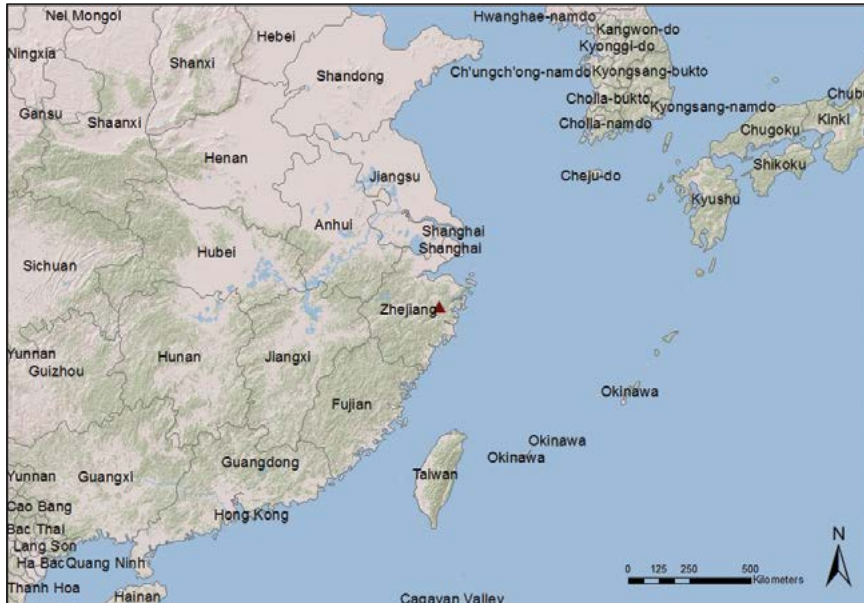
A joint BGCI and Zhoushan Institute of Forestry initiative is also propagating a supply of plants to be planted on Huaniao Island, next to Putuo Island, establishing an additional *near situ* reintroduction site providing further protection for the species, and enabling reintroduction to Putuo Island in future. Full floristic survey of Huaniao Island is also underway. If *C. putoensis* is found on Huaniao Island *in situ* conservation measures will be put in place.

Conservation measures being undertaken for this species will help improve the chance of survival. *C. putoensis* is a deciduous tree, up to 13 m tall. It has brown grey bark and elliptic leaves with double serrated margins.

*Refs:* 11, 42, 74, 99, 105, 121, 123, 133, 171, 190, 208, 241, 253



*Carpinus tientaiensis* W.C.Cheng



CR B1ab(iii)+2ab(iii); C2a(i); D  
China (Zhejiang: Tianmu Shan)

Endemic to China, this species is only found in the forests of Tiantai Mountain in the North West Province of Zhejiang. It has a reported area of occupancy of 0.03 km<sup>2</sup>. This species is rare and it is reported that only 21 mature individuals exist in the wild, at a single location.

Decline in area, extent and quality of habitat is observed and predicted to continue. Observed population decline is due to deforestation and conversion of land into monoculture plantations of bamboo and tea. A very small population makes this species susceptible to stochastic events as well as continued habitat loss. Competition from other

species is also a threat, especially bamboo which is a fast growing species reaching full size within 3–4 months. Conservation of this species should be a priority.

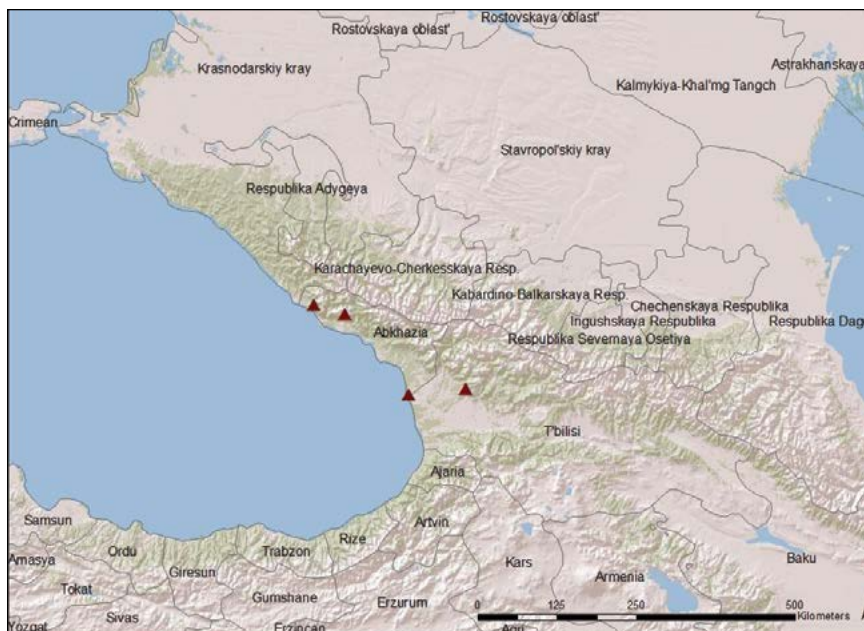
This species is not known to cultivation. No propagation or reintroduction programmes are known to exist for this species.

*Carpinus tientaiensis* is a medium sized tree, reaching heights of 16–20 m. It is found growing in forests on mountain slopes.

*Carpinus tientaiensis* is assessed as Critically Endangered, occurring in a single location with a very small area of occupancy and extent of occurrence, with a low population number. Decline in area, extent and quality of habitat is also observed and predicted to continue. This species is also assessed as Critically Endangered on the Chinese Red List.

Refs: 11, 42, 74, 99, 105, 133, 171, 208

*Corylus colchica* Albov



VU B1ab(iii)+B2ab(iii)  
Georgia

This species is endemic to Georgia, found in Abkhazeti (Bzipi range, Mt. Arabika massif, Kodori range) and Samegrelo (Egrisi range).

The extent of occurrence of this species is estimated to be 5,000–20,000 km<sup>2</sup> and the area of occupancy is estimated to be 500–2,000 km<sup>2</sup>.

The population of this species is severely fragmented and composed of 15–20 small subpopulations, occurring in rocky limestone areas from the middle montane through to subalpine zones. This species is threatened by forest clear cutting and grazing. Forest clearance is ongoing across Georgia and there is

currently little financial or administrative support available to reverse this trend. A continuing decline in the area, extent and quality of habitat is inferred from the overall continuing decline in forested areas in Georgia.

To ensure survival of this species, population monitoring is required, along with the identification and establishment of new protected areas.

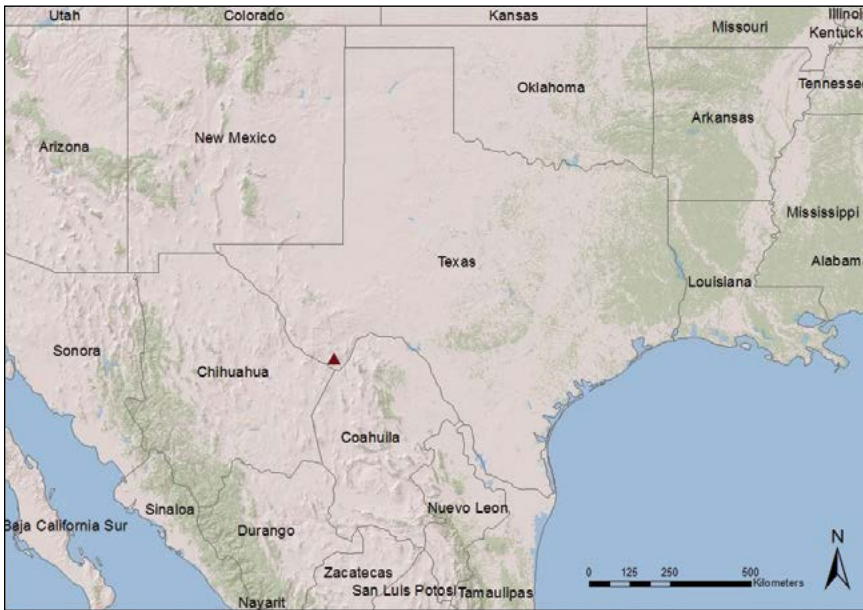
This species is listed as Vulnerable in the Red List of Georgia (2006) and by the IUCN/SSC Caucasus Plant Red

List Authority in 2007. No additional information contradicting this assessment has been found. The assessment therefore remains unchanged.

Refs: 74, 133, 208

Assessor: IUCN/SSC Caucasus Plant Red List Authority

***Ostrya chisosensis*** Correll



of oak (*Quercus*) pine (*Pinus*) woodlands along streams and on adjacent moist slopes. As such, these two taxa are to be considered glacial relicts restricted to these canyons as well as reproductively isolated.

*O. chisosensis* is protected by United States Federal Law and is protected within Big Bend National Park, but threats still exist, including insect and disease damage and climate change. The oak-pine woodlands in which this species occurs are heavily-timbered and also subject to wildfires, the intensity and size of fires has been increasing in the distributional region of this species due to recent droughts. Drought also threatens to dry out streams and moist slopes which this species relies upon to survive.

CR B1ab(i,ii,iii,iv,v)+B2ab(i,ii,iii,iv,v)  
United States (Texas)

Endemic to the United States, *Ostrya chisosensis* is known from eight occurrences in Big Bend National Park in Texas, with an extent of occurrence of approximately 20.5 km<sup>2</sup>. The eight subpopulations occur in geographically separated canyons and are therefore reproductively isolated. The area of occupancy is 4.0 km<sup>2</sup>. The population size is 639 mature individuals with around 150 mature individuals in the largest subpopulation.

Based on inaccessibility, populations are thought to be stable, however catastrophic wildfire has been identified as being able to cause loss of any and/or all eight subpopulations. The overstorey vegetation in the canyons is oak-pine and is subject to very intense wildfires. The climate in the southwestern United

States is becoming drier and warmer. It can be inferred under these conditions that the chance of intense or catastrophic wildfires is greatly increased, especially in the next 150 years. Besides wildfire there is a high probability that the current plant communities in these canyons will change with the potential loss of the oak pine overstorey and the concurrent loss of moist slopes and streamside habitats leading to the loss of *O. chisosensis* to taxa adapted to drier and warmer climate.

During the Pliocene/Pleistocene era, the Arcto-tertiary geoflora extended southward in to the mountains of the American southwest and adjacent Mexico. As the Pleistocene Era came to a close the climate became warmer and drier. Tree taxa such as *O. knowltonii* and *O. chisosensis* became restricted to canyons, occurring in the understorey

This species is a tree to 12 m, occurring in canyons along stream sides and on moist slopes.

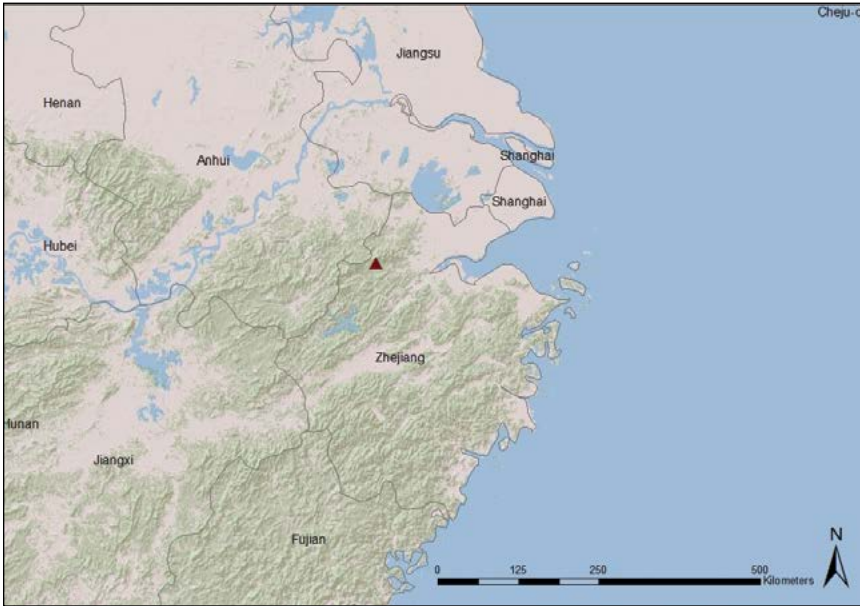
This species is ranked as G5T2 on NatureServe, using a place holder name *Ostrya virginiana* var. 1 (var. 1 in place of *Ostrya virginiana* var. *chisosensis*, a widely accepted synonym for this taxon, but it has not been published). Personal communication with staff at Big Bend National Park reports there are 8 occurrences, but several of these locations were last visited in 1993. Field surveys are recommended to ensure these subpopulations are still present.

NatureServe also reports 2 occurrences in Mexico, but there is no published documentation of these occurrences.

Refs: 11, 14, 44, 74, 133, 143, 161, 196, 208, 222, 224, 226, 227, 230, 231

Assessor: Stritch, L.



*Ostrya rehderiana* Chun

CR B1ab(i,ii,v)+2ab(i,ii,v); C2a(i); D  
China (Zhejiang: Tianmu Shan)

Endemic to China, this species occurs only in the western part of Tianmu Mountain (Mount Xitianmu) in the Zhejiang Province. It has an estimated extent of occurrence (EEO) and area of occupancy (AOO) of 0.04 km<sup>2</sup>.

The only species of the genus *Ostrya* occurring in eastern China, *Ostrya rehderiana* was once a fairly common species in the woods of Tianmushan (Tianmu Mountains) when it was discovered there in 1927. However, it is now considered extremely rare. This reduction in population size has been rapid, with the wild population now reported as consisting of only five individual trees confined to the western part of the mountain. All five individuals have experienced damage to either the trunk or branches, one of them

(1 m DBH) has had the top of its trunk broken and the other four have had their lower lateral branches cut off.

The rapid reduction in population of this species is mainly due to deforestation and the planting of bamboo. The major threats to this species in the wild are human disturbance and competition with bamboo and other tree species. Continued human disturbance can weaken regenerative ability and reduce the number of seedlings beneath the remaining mature individuals. As *O. rehderiana* is shade intolerant competition from nearby trees is of particular concern, especially bamboo which is a fast growing species reaching full size within 3–4 months.

There is low genetic variation in the remaining 5 individuals. Offspring from the remaining individuals have been found to have experienced inbreeding

and have reduced genetic variation, which can threaten the overall survival of the species by reducing the ability to adapt to a changing environment. It is advisory to reproduce each remaining individual via asexual reproduction, to reduce the risk of the permanent loss of genetic variation if one individual were to die, and then set up propagation and reintroduction programmes.

West Tianmu Mountain has been declared a nature reserve and stone fences have been erected around the remaining individuals of this species. However, despite these efforts, the wild populations do not appear to be regenerating naturally.

This species is rare in cultivation, but is reported to occur in a few arboreta and botanic gardens outside of its natural range. The Arnold Arboretum of Harvard University, U.S., has cultivated a collection of 11 living specimens of this species collected from Mount Xitianmu.

This deciduous tree occurs in broad-leaved forests and can grow to 21 m in height. The male inflorescences bud in July and blossom in April; the female inflorescences appear while buds are developing and leaves completely unfold in April. The fruits ripen in September and leaves fall in November.

This species was listed as Critically Endangered (D1) in the 1998 World List of Threatened Trees. The same conservation category (Critically Endangered) is given here. New updated information on its population size and range, more criteria (B, C and D) have now been able to be used to assess this species.

*Refs:* 11, 42, 74, 99, 121, 123, 133, 155, 171, 208, 248

## BETULACEAE TAXA EVALUATED AS DATA DEFICIENT

Additional research is needed to gather information on the status of taxa assessed as Data Deficient. Many taxa assessed as Data Deficient have very small reported distributions. As an insurance policy, all Data Deficient taxa should be considered under threat until sufficient information is available to fully assess their conservation status, or taxonomic uncertainty is resolved.

The following taxa are assessed as threatened on the Chinese Red List. However very little information is available on these taxa and they are therefore assessed as Data Deficient. Further research and conservation action is required for these taxa which have small reported distributions and are likely to be threatened.	Category on Chinese Red List
<p><b><i>Carpinus purpurinervis</i></b> Hu China (Guangxi: Du'an Taozu Zizhixian, Guizhou: Dushan Xian, Xingyi Xi) A small tree to 5 m, found growing in sparse forests or thickets on limestone. Distribution is restricted to two provinces in China. Potentially threatened but needs further field research to establish its conservation status. Refs: 42, 74, 99, 133, 208</p>	VU
<p><b><i>Corylus wangii</i></b> Hu China (Sichuan?, Yunnan: Weixi Xian) Known only from NW Yunnan, with a possible specimen type collected from E Sichuan in 1988. A tall tree up to 7 m, found growing in temperate broad-leaved forests. Potentially threatened but requires further field research. Refs: 42, 74, 99, 133, 208, 222, 242</p>	VU
<p><b><i>Ostrya yunnanensis</i></b> W.K.Hu China (Yunnan: Luquan Xian) Known only from the Luquan Xian region of Yunnan, it grows up to 20 m, in moist forests at 2,600 m ASL. Further field research is needed to establish its conservation status. Refs: 42, 56, 74, 75, 99, 107, 133, 208, 222</p>	CR
<p><b><i>Ostryopsis nobilis</i></b> Balf.f. &amp; W.W.Sm. <i>Taxonomic note: Populations found in north west Yunnan previously ascribed to Ostryopsis nobilis are now recognised as a new species O. intermedia</i> China (SW Sichuan, NW Yunnan) A small shrub to 5 m, forming thickets on sunny mountain slopes. Distribution is restricted to SW Sichuan and NW Yunnan with populations described as sparse. Potentially threatened with habitat loss, but requires further field research to establish its conservation status. Refs: 42, 74, 99, 133, 168, 208, 222, 253</p>	VU
<p><b><i>Betula schmidtii</i></b> Regel China (E Jilin: Linjiang, NE Liaoning), Democratic People's Republic of Korea, Japan (N and C Honshu), Republic of Korea, Russian Federation (Central Asian Russia: Primoryi) In the wild this species is able to grow up to 35 m tall and 9 m in girth, making it the tallest growing Birch. In the mountains of Korea it forms gnarled, multi-stemmed trees and is much smaller. It is found growing in rocky places in the mountains, in mixed forest. Although widespread, it is reported as rare in Russia and to be threatened in China. It is also rare in cultivation. This species is considered potentially threatened, but requires further field research to establish its conservation status. Refs: 5, 42, 74, 99, 113, 114, 133, 154, 159, 208, 222</p>	NT

The following species are assessed as Data Deficient as not enough information is available to carry out a full conservation assessment. Intraspecific taxa (even if given a Data Deficient rating) are presented below the species-level assessment (see Globally Threatened Betulaceae taxa, pages 15 - 31 and Least Concern Betulaceae taxa, pages 37 - 53).

### ***Alnus djavanshameshirii*** H.Zare

N Islamic Republic of Iran  
A large tree reaching 20–30 m in height, this species has a limited geographical distribution, known only from Dodangeh forest. It is reported to be very rare, but

there is limited population information available for this species. There is insufficient information available to carry out a full conservation assessment.  
Refs: 74, 250

### ***Alnus dolichocarpa*** H.Zare, Amini & Assadi

N Islamic Republic of Iran  
A small to large tree found only near the Caspian Sea, this species is considered relatively rare. However, there is insufficient information available to carry out a full conservation assessment of this species.  
Refs: 74, 250

### ***Alnus fauriei*** H.Lév. & Vaniot

Japan (N and C Honshu)  
A large shrub capable of achieving tree-stature, *A. fauriei* grows on soils with permanent moisture. This species is reported to be a recent introduction to cultivation, but is not commonly grown. Further research is needed to determine the conservation status of this species.  
Refs: 74, 77, 133, 154, 208

### ***Alnus firma*** Siebold & Zucc.

Japan (Kyushu)  
This species has a small natural distribution but has been used extensively to control erosion and improve soil

conditions in Korea, outside of its natural range. It has spread from planting sites and become naturalized, implying that natural regeneration is not a problem for this species. However, limited information is available on the status of wild populations of this species within its natural range. This species is therefore assessed as Data Deficient.

Refs: 74, 133, 154, 159, 208, 222

***Alnus glutipes*** (Jarm. ex Czerpek) Vorosch.

Russian Federation (Central Asian Russia: Yakutiya)

Occurring as a shrub or tree, this species is found in mountain-taiga forests. However, there is insufficient information available to carry out a full conservation assessment. Further field research is required.

Refs: 74, 133, 208

***Alnus hakkodensis*** Hayashi

Japan (Honshu)

Occurring as a shrub or tree, this species

is found in the mountains of Honshu.

This species was assessed as Rare in the 1997 IUCN Red List of Threatened Plants, but is assessed as Data Deficient in the Red List of Threatened Plants of Japan. Further field research is required for a full conservation assessment to be undertaken.

Refs: 74, 132, 133, 208, 211, 236

***Alnus lanata*** Duthie ex Bean

China (W Sichuan: Kangdang Xian, Luding Xian)

A tree to 20 m tall it is found on stream sides in montane forests. However, there is insufficient information available to carry out a full conservation assessment. Further field research is required.

Refs: 42, 74, 77, 133, 208, 222

***Alnus mairei*** H. Lév.

China (Yunnan)

This species has a small reported distribution occurring only in one region of China. It is not assessed on the Chinese Red List. There is insufficient

information available to carry out a full conservation assessment. Further field research is required.

Refs: 74, 99, 133, 208

***Alnus maximowiczii*** Callier



*Alnus maximowiczii* growing at Stone Lane Gardens. Data Deficient (Bartlett, P., Stone Lane Gardens)



*Alnus maximowiczii*

Democratic People's Republic of Korea, Japan (Hokkaido, Honshu), Republic of Korea, Russian Federation (Central Asian Russia: Kurile Islands?, Primoryi, Sakhalin; European Russia: Khabarovsk) Despite a fairly wide range, this species is reported to be scarce and seldom seen. There is insufficient information available to carry out a full conservation assessment. Further field research is required.

Refs: 74, 133, 154, 159, 208, 222

***Alnus orientalis*** Decne.

*Taxonomic note:* *Alnus orientalis* var. *pubescens* was listed as *Rare and endemic to Turkey, but this variety has since been included in the species A. orientalis.*

Cyprus, Islamic Republic of Iran, Israel, Jordan, Lebanon, Syrian Arab Republic, Turkey in Asia

Insufficient information is available on the distribution or population status of *A. orientalis* across its range, although threats are reported to be impacting upon part of the range of this species. This species is therefore assessed as Data Deficient. Further field research is required to verify the current distribution, population and threat status of this species.

Refs: 46, 54, 74, 133, 136, 208, 222, 250

***Alnus paniculata*** Nakai

Democratic People's Republic of Korea, Republic of Korea

This species has a small reported distribution. There is insufficient information available to carry out a full conservation assessment. Further field research is required.

Refs: 74, 133, 208

***Alnus serrulata*** Callier

Japan (S Honshu, Shikoku)

A small tree to 5 m. This species has a small reported distribution. There is insufficient information available to carry out a full conservation assessment. Further field research is required.

Refs: 74, 133, 154, 208

***Alnus sieboldiana*** Matsum.



*Alnus sieboldiana*

Japan (Honshu, Shikoku?, Nansei-shoto: Suwanose-jima?)

This tree is found in lowlands and foothills, especially in coastal areas. The distribution of this species is uncertain and no



population or threat information is available. Further field research is required.  
Refs: 74, 77, 133, 154, 208, 222

---

***Alnus vermicularis*** Nakai

Democratic People's Republic of Korea, Republic of Korea

This species has a small reported distribution. There is insufficient information available to carry out a full conservation assessment. Further field research is required.

Refs: 74, 133, 208

---

***Betula baschkirica*** Tzvelev

East European Russia

This taxon is not listed by Ashburner and McAllister but are recognised by the World Checklist of Selected Plant Families. Due to the taxonomic uncertainty and very little information available on distribution and population status, it is assessed as Data Deficient and in need of further study.

Refs: 5, 74

---

***Betula celtiberica*** Rothm. & Vasc.

*Taxonomic note:* There is taxonomic uncertainty over whether this taxon should be recognised as a distinct species. Its geographical isolation and the fact that it can be distinguished morphologically suggests that it is worth recognising.

NW Spain (Cordillera Cantabrica)

Other populations of birch in isolated ranges in central Spain may belong to this species, but are thought more likely to be relict populations of *B. pendula* or *B. pubescens*. Further field research is needed to verify the distribution and population status of this species to enable a full conservation assessment to be carried out.

Refs: 5, 74, 133, 163

---

***Betula coriaceifolia*** V.N. Vassil.

Uzbekistan

This taxon is not listed by Ashburner and McAllister but are recognised by the World Checklist of Selected Plant Families. Due to the taxonomic uncertainty and very little information available on distribution and population status, it is assessed as Data Deficient and in need of further study.

Refs: 5, 74

---

***Betula corylifolia*** Regel & Maxim.

Japan (Honshu)

Despite a small distribution, this species is reported to be fairly widespread in the mountains of central Honshu. This species is considered the most distinct birch, probably not closely related to any other living species. This species needs further field research to determine distribution and threats.

Refs: 5, 74, 133, 154, 208, 222

---

***Betula delavayi*** Franch.

*Taxonomic notes:* (1) *B. delavayi*, *B. bomiensis*, *B. calcicola* and *B. potaninii* taxa are sometimes confused. However they are separable by their visible morphological characters, ploidy and geographical distribution (2) Confusion with other species, and simple misidentifications of such a poorly understood species, makes its complete distribution difficult to determine (3) *B. delavayi* var. *polyneura* closely resembles both *B. delavayi* and *B. calcicola*, but has more numerous veins, it may represent a distinct taxon (4) *B. delavayi* var. *microstachya* deserves further study  
China (Gansu?, W Hubei?, Qinghai?, Sichuan, E Xizang?, NW Yunnan)

This species is assessed as Least Concern on the Chinese Red List, but this species has uncertain distribution and Ashburner and McAllister report that its conservation status is uncertain. Further research is required to enable a full conservation assessment to be carried out.

Refs: 5, 42, 74, 75, 77, 99, 123, 133, 208

---

***Betula falcata*** V.N. Vassil.

Tajikistan

This taxon is not listed by Ashburner and McAllister but are recognised by the World Checklist of Selected Plant Families. Due to the taxonomic uncertainty and very little information available on distribution and population status, it is assessed as Data Deficient and in need of further study.

Refs: 5, 74

---

***Betula fargesii*** Franch.

China (Chongqing, Hubei)

This species is reported as Least Concern on the Chinese Red List. However, Ashburner and McAllister report that this species is known only from [a] restricted area on both sides of the Sichuan/Hubei border and that its conservation status is uncertain, so it seems likely this species is rare in the wild. Part of its distribution is within Shennongjia Forest Reserve in West Hubei. This species is very rare in cultivation. Further field research is required to determine the conservation status of this species.

Refs: 5, 42, 74, 99, 133

---

***Betula honanensis*** S.Y.Wang & C.L.Chang

China (Henan)

This taxon is not listed by Ashburner and McAllister but are recognised by the World Checklist of Selected Plant Families. Due to the taxonomic uncertainty and very little information available on distribution and population status, it is assessed as Data Deficient and in need of further study.

Refs: 5, 74

---

***Betula karagandensis*** V.N.Vassil.

Kazakhstan

This taxon is not listed by Ashburner and McAllister but are recognised by the World Checklist of Selected Plant Families. Due to the taxonomic uncertainty and very little information available on distribution and population status, it is assessed as Data Deficient and in need of further study.

Refs: 5, 74

---

***Betula klokovii*** Zaver.

Ukraine

This taxon is not listed by Ashburner and McAllister but are recognised by the World Checklist of Selected Plant Families. Due to the taxonomic uncertainty and very little information available on distribution and population status, it is assessed as Data Deficient and in need of further study.

Refs: 5, 74



***Betula kotulae*** Zaver.

Ukraine

This taxon is not listed by Ashburner and McAllister but are recognised by the World Checklist of Selected Plant Families. Due to the taxonomic uncertainty and very little information available on distribution and population status, it is assessed as Data Deficient and in need of further study.

Refs: 5, 74

***Betula potamophila*** V.N.Vassil.

Tajikistan

This taxon is not listed by Ashburner and McAllister but are recognised by the World Checklist of Selected Plant Families. Due to the taxonomic uncertainty and very little information available on distribution and population status, it is assessed as Data Deficient and in need of further study.

Refs: 5, 74

***Betula psammophila*** V.N.Vassil.

Kazakhstan

This taxon is not listed by Ashburner and McAllister but are recognised by the World Checklist of Selected Plant Families. Due to the taxonomic uncertainty and very little information available on distribution and population status, it is assessed as Data Deficient and in need of further study.

Refs: 5, 74

***Betula saksarensis*** Polozhij &

A.T.Malzeva

Central Asian Russia: Krasnoyarsk

This taxon is not listed by Ashburner and McAllister but are recognised by the World Checklist of Selected Plant Families. Due to the taxonomic uncertainty and very little information available on distribution and population status, it is assessed as Data Deficient and in need of further study.

Refs: 5, 74

***Betula saviczii*** V.N.Vassil.

Kazakhstan

This taxon is not listed by Ashburner and McAllister but are recognised by the World Checklist of Selected Plant Families. Due to the taxonomic uncertainty and very little information available on distribution and population status, it is assessed as Data Deficient and in need of further study.

Refs: 5, 74

***Betula skvortsovii*** McAll. & Ashburner

*Taxonomic note:* Described for the first time by Ashburner and McAllister, 2013  
China (Sichuan)

Shrub with several stems growing to 2.5 m, this species grows on dry slopes and thickets. There is insufficient information available to carry out a full conservation assessment. Further field research is required.

Refs: 5, 25, 133

***Betula sunanensis*** Y.J.Zhang

China (Gansu)

This taxon is not listed by Ashburner and McAllister but are recognised by the World Checklist of Selected Plant Families. Due to the taxonomic uncertainty and very little information available on distribution and population status, it is assessed as Data Deficient and in need of further study.

Refs: 5, 74

***Betula wuyiensis*** J.B.Xiao

China (Fujian)

This taxon is not listed by Ashburner and McAllister but are recognised by the World Checklist of Selected Plant Families. Due to the taxonomic uncertainty and very little information available on distribution and population status, it is assessed as Data Deficient and in need of further study.

Refs: 5, 74

***Betula zinserlingii*** V.N.Vassil

Kyrgyzstan

This taxon is not listed by Ashburner and McAllister but are recognised by the World Checklist of Selected Plant Families. Due to the taxonomic uncertainty and very little information available on distribution and population status, it is assessed as Data Deficient and in need of further study.

Refs: 5, 74

***Carpinus dayongiana*** K.W.Liu &

Q.Z.Lin

China (Hunan: Dayong Xian)

A small tree to 4 m found in subtropical broad-leaved forests. There is no quantitative data available from which to ascertain if the population trend is increasing, stable or decreasing across its geographic range.

Refs: 42, 74, 99, 133, 208

***Carpinus eximia*** Nakai

Democratic People's Republic of Korea, Republic of Korea

Very little information is available for this species. Field research is required to determine its conservation status.

Refs: 74, 133, 208

***Carpinus faginea*** Lindl.

India (Himanchal Pradesh, Jammu-Kashmir, Uttaranchal), Nepal

Found in cool broad-leaved forests in temperate Himalaya. There is insufficient information available to carry out a full conservation assessment. Further field research is required.

Refs: 21, 41, 74, 76, 133, 208, 222

***Carpinus japonica*** Blume

Japan (Honshu, Kyushu, Shikoku)

This species can grow as a shrub or a tree. It is shade intolerant, therefore disturbance events are important for the seedling growth of this species. It grows at high elevations on the upper slope of valleys. It is reported to be rare, however insufficient data is available to carry out a full conservation assessment. Further field research is required.

Refs: 74, 133, 154, 193, 208, 222

***Carpinus laxiflora*** (Siebold & Zucc.)  
Blume



*Carpinus laxiflora*

Democratic People's Republic of Korea, Japan (Hokkaido, Honshu, Kyushu, Shikoku), Republic of Korea  
A tree to 15 m this species occurs in woodland in mountainous areas. There is insufficient information available to carry out a full conservation assessment. Further field research is required.  
Refs: 74, 113, 133, 154, 208, 222

***Carpinus lipoensis*** Y.K.Li

China (Guizhou)  
This species has a small distribution, restricted to one province of China. This species is not assessed on the Chinese Red List. There is insufficient information available to carry out a full conservation assessment. Further field research is required.  
Refs: 74, 133, 208

***Carpinus luochengensis*** J.Y.Liang

China (Guangxi)  
A shrub to a height of 2–3 m found growing in montane dwarf forest at mid to high altitudes. This species has a small distribution, restricted to one province of China. This species is not assessed on the Chinese Red List.

There is insufficient information available to carry out a full conservation assessment. Further field research is required.  
Refs: 74, 79, 106, 133, 208

***Carpinus mengshanensis*** S.B.Liang & F.Z.Zhao

China (Shandong)  
This species has a small distribution, restricted to one province of China. This species is assessed as Data Deficient on the Chinese Red List. There is insufficient information available to carry out a full conservation assessment. Further field research is required.  
Refs: 74, 99, 133, 208

***Carpinus microphylla*** Z.C.Chen ex Y.S.Wang & J.P.Huang

China (W Guangxi: Tianyang Xian)  
A shrub to 3 m high this species grows in thickets. This species has a small distribution, restricted to one province of China. This species is assessed as Data Deficient on the Chinese Red List. There is insufficient information available to carry out a full conservation assessment. Further field research is required.  
Refs: 42, 74, 99, 133, 208

***Carpinus omeiensis*** Hu & W.P.Fang

China (Guizhou: Dejiang Xian, Sichuan: Emei Shan Junlian Xian)  
A tree to 7 m found in broad leaved forests. This species has a small distribution, restricted to two provinces of China. This species is not assessed on the Chinese Red List. There is insufficient information available to carry out a full conservation assessment. Further field research is required.  
Refs: 42, 74, 77, 133, 208

***Carpinus paohsingensis*** W.Y.Hsia

C and E China (exact locations unknown)  
Found in evergreen forests at 1,500 m ASL. The distribution of this species is unknown. This species is not assessed on the Chinese Red List. There is insufficient information available to carry out a full conservation assessment. Further field research is required.  
Refs: 74, 133, 208

***Carpinus shimenensis*** C.J.Qi

China (Hunan)  
This species has a small distribution, restricted to one province of China. This species is not assessed on the Chinese Red List. There is insufficient information available to carry out a full conservation assessment. Further field research is required.  
Refs: 74, 133, 208

***Corylus jacquemontii*** Decne.

Afghanistan?, India (Himachal Pradesh, Jammu-Kashmir, Uttaranchal), Nepal  
A tall tree to 25 m, found growing in moist Oak forests of the upper montane zones. It is reported as rare in the Himalayan region. The wood can be used for agricultural implements and household articles, its nuts are edible and parts of the tree can be used as a medicinal tonic. Potentially threatened but requires further field research.  
Refs: 1, 21, 28, 68, 74, 133, 195, 208, 222

***Corylus potaninii*** Bobrov

China (Chongqing, Guizhou, Hubei, Sichuan, Yunnan)  
This species is not assessed on the Chinese Red List. There is insufficient information available to carry out a full conservation assessment. Further field research is required.  
Refs: 74, 133, 208

***Ostryopsis intermedia*** B.Tian & J.Q.Liu

China (NW Yunnan)  
A recently discovered species it grows as a small shrub to 5 m, forming thickets on sunny slopes. Only known from NW Yunnan, its population is sparse and likely threatened by habitat loss, plantations and over collection for building materials and fuelwood. Therefore this species is likely to be threatened but there is insufficient information available to carry out a full conservation assessment. Further field research is required.  
Refs: 42, 74, 133, 208, 209

## BETULACEAE TAXA EVALUATED AS LEAST CONCERN

Most taxa have been assessed as Least Concern on the basis of their wide distribution and the lack of any direct threats to the species. For taxa that are less widespread additional information is provided to justify their assessment as Least Concern. (Data deficient infraspecific taxa are also listed here under the assessment of the species).

***Alnus acuminata*** Kunth N Argentina (Catamarca, Jujuy, Salta, Tucumán), Bolivarian Republic of Venezuela, Colombia, Costa Rica, Ecuador, El Salvador, Guatemala, Honduras, Mexico (Chiapas, Chihuahua, Durango, Guanajuato, Guerrero, Hidalgo, Jalisco, México Distrito Federal, México State, Michoacán, Morelos, Nayarit, Oaxaca, Puebla, Querétaro, San Luis Potosí, Sinaloa, Sonora, Tlaxcala, Veracruz), Panama, Peru, Plurinational States of Bolivia  
*Refs:* 24, 26, 29, 32, 58, 59, 60, 64, 74, 77, 84, 87, 112, 117, 133, 140, 157, 160, 178, 179, 208, 222, 235, 254

***Alnus acuminata*** subsp. ***acuminata***  
*Taxonomic note:* *There is some debate over the acceptance of this subspecies.* N Argentina (Jujuy, Salta, Tucumán), Bolivarian Republic of Venezuela, Colombia, Ecuador, Peru, Plurinational States of Bolivia  
*Refs:* 24, 26, 32, 64, 74, 77, 84, 112, 133, 157, 222

***Alnus acuminata*** subsp. ***arguta*** (Schltdl.) Furlow  
*Taxonomic note:* *There is some debate over the acceptance of this subspecies.* Costa Rica, El Salvador, Guatemala, Honduras?, Mexico (Chiapas, Chihuahua?, Durango, Guanajuato, Guerrero, Hidalgo, Jalisco, México Distrito Federal, México State, Michoacán, Morelos, Nayarit, Oaxaca, Puebla, Querétaro, San Luis Potosí, Sinaloa, Sonora, Veracruz), Panama  
*Refs:* 24, 29, 59, 64, 74, 77, 87, 133, 140, 144, 178, 179, 208, 222, 235

***Alnus acuminata*** subsp. ***glabrata*** (Fernald) Furlow  
*Taxonomic note:* *There is some debate over the acceptance of this subspecies.* Mexico (Chiapas?, Durango, Guanajuato,

Guerrero, Hidalgo, México Distrito Federal, México State, Michoacán, Morelos, Oaxaca, Puebla, Querétaro?, Sinaloa, Tlaxcala, Veracruz?)  
*Refs:* 24, 29, 59, 64, 74, 77, 133, 208  
*Assessor:* Stritch, L.



*Alnus cordata*

***Alnus cordata*** (Loisel.) Duby  
 NW Albania, France: Corsica, Southern Italy (inc. Sicily)

This species has a limited natural range, but most of the range of this species occurs in protected areas. It also spreads readily and rapidly, and has become naturalised in much of Europe. It is therefore not considered to be threatened, however some threats have been identified, including; a reduction in clear cutting practices in protected areas which could have a negative impact on population growth, competition from other species, climate change at lower altitudes, and root rot caused by the pathogen *Phytophthora alni*. Active conservation management within protected areas and population studies are advised for this species, to ensure it does not become threatened in future.  
*Refs:* 11, 74, 102, 133, 136, 157, 170, 208, 222, 238

***Alnus cremastogyne*** Burkill  
 China (SE Gansu, N Guizhou, S Shaanxi, Sichuan, Zhejiang)  
 This species is endemic to south western China with a fairly small natural distribution. Although there are some reported threats impacting the survival of this species in parts of its range, it grows rapidly and has a rapid regeneration rate. It is also being planted at restoration sites within its natural range. This species is therefore not considered to be threatened, but monitoring of reported threats would be beneficial, to

ensure this species does not become threatened in future. This species is assessed as Least Concern on the Chinese Red List.  
*Refs:* 42, 74, 92, 99, 133, 205, 206, 208, 245

***Alnus ferdinandi-coburgii*** C.K.Schneid.  
 China (Guizhou, SW Sichuan, Yunnan)  
 This species is assessed as Least Concern on the Chinese Red List.  
*Refs:* 42, 74, 77, 99, 107, 133, 208

***Alnus formosana*** (Burkill) Makino  
 Province of China (Taiwan: Tanshui)  
 Although this species has a fairly small distribution, found only in Taiwan, it is not currently subject to any major threats and the population is not predicted to decline in the near future. This species is assessed as Least Concern on the Chinese Red List.  
*Refs:* 42, 74, 77, 82, 91, 94, 99, 133, 208, 222

***Alnus glutinosa*** (L.) Gaertn.  
***Alnus glutinosa*** subsp. ***glutinosa***  
 Albania, Algeria, Armenia?, Austria, Azerbaijan?, Belarus, Belgium, Bosnia and Herzegovina, Bulgaria, Croatia, Czech Republic, Denmark, Estonia, Finland, France (inc. Corsica), Georgia, Germany, Greece, Hungary, Islamic Republic of Iran, Italy (inc. Sardegna, Sicilia), Kazakhstan, Latvia, Libya?, Liechtenstein, Lithuania, Luxembourg, Montenegro, Morocco, Netherlands, Norway, Poland, Portugal, Romania, Russian Federation (Eastern Asian Russia: West Siberia; European Russia: Central European Russia, Chechnya, Dagestan, East European Russia, Ingushetiya, Kabardino-Balkariya, Karachaevo-Cherkessiya, Krasnodar, North European Russia, Northwest European Russia, Severo-Osetiya, South European Russia, Stavropol), Serbia, Slovakia, Slovenia, Spain, Sweden, Switzerland, The Former Yugoslav Republic of Macedonia, Tunisia, Turkey in Asia, Turkey in Europe, Ukraine (inc. Krym), United Kingdom (Great Britain, Northern Ireland) (The species and type subspecies share the same distribution).  
*Refs:* 4, 12, 16, 19, 20, 23, 40, 43, 44, 71, 74, 102, 116, 131, 133, 138, 146, 149, 170, 189, 208, 222, 223, 224, 233, 238, 243, 249



*Alnus glutinosa* subsp. *antitaurica*  
Yalt.

**DD**

N Islamic Republic of Iran, SC Turkey  
(Turkey in Asia)

This little known subspecies occurs as a shrub or tree found in deciduous scrub or forest areas by streams. This subspecies has been previously listed as rare in national and regional red list publications, but at the time was thought to be endemic to Turkey. It has since been reported as present in Iran, but there is insufficient data available to carry out a full conservation assessment. Further research is required and it is assessed here as Data Deficient.

Refs: 46, 47, 54, 74, 133, 250

*Alnus glutinosa* subsp. *barbata*  
(C.A.Mey.) Yalt.

**DD**

Armenia?, Azerbaijan?, Georgia, Islamic Republic of Iran, Russian Federation (European Russia: Chechnya, Dagestan, Ingushetiya, Kabardino-Balkariya, Karacheyevo-Cherkessiya, Krasnodar, Severo-Osetiya, Stavropol), Turkey in Asia

This species occurs as a shrub or tree found in damp woods and along river banks. There is insufficient information available to carry out a full conservation assessment. Further field research is required. It is assessed here as Data Deficient.

Refs: 15, 30, 74, 133, 208

*Alnus glutinosa* subsp. *betuloides*  
Ansin

**DD**

SE Turkey (Turkey in Asia)

A little known subspecies which occurs as a shrub or tree, this taxon is restricted to the mountains of East Anatolia in Erzurum, Bingöl and Bitlis Provinces. It is found by streams and swamps. This species was assessed as Rare in the 1997 IUCN Red List of Threatened Plants (ref 236). However, there is insufficient information available to carry out a full conservation assessment. Further field research is required.

Refs: 47, 74, 80, 133, 236

*Alnus hirsuta* (Spach) Rupr.



*Alnus hirsuta*

China (Heilongjiang, Jilin, Liaoning, Nei Mongol, Shandong), Democratic People's Republic of Korea, Japan (Hokkaido, Honshu, Kyushu, Shikoku), Republic of Korea, Russian Federation (Central Asian Russia: Amur, Buryatiya, Chita, Kamchatka, Magadan, Primoryi, Sakhalin, Yakutiya; European Russia: Khabarovsk)

Refs: 42, 74, 99, 133, 136, 154, 159, 180, 208, 222

*Alnus incana* (L.) Moench

Albania, Armenia, Austria, Azerbaijan, Belarus, Bosnia and Herzegovina, Bulgaria, Canada (Alberta, British Columbia, Labrador, Manitoba, New Brunswick, Newfoundland, Northwest Territories, Nova Scotia, Nunavut, Ontario, Prince Edward Island, Quebec, Saskatchewan, Yukon), Croatia, Czech Republic, Estonia, Finland, France, Georgia, Germany, Greece?, Hungary, Italy, Latvia, Liechtenstein, Lithuania, Moldova, Montenegro, Netherlands, Norway, Poland, Romania, Russian Federation (Eastern Asian Russia: West Siberia; Central European Russia, Chechnya, Dagestan, East European Russia, Ingushetiya, Kabardino-Balkariya, Karacheyevo-Cherkessiya, Krasnodar, North European Russia, Northwest European Russia?, Severo-Osetiya, South European Russia, Stavropol), Saint Pierre and Miquelon, Serbia, Slovakia, Slovenia, Sweden, Switzerland, The Former Yugoslav Republic of Macedonia, Turkey in Asia, Ukraine, United States (Alaska, Arizona, California, Colorado, Connecticut, Idaho, Illinois, Indiana, Iowa, Maine, Maryland, Massachusetts, Michigan, Minnesota, Montana, Nevada, New Hampshire, New Jersey, New Mexico,

New York, North Dakota, Ohio, Oregon, Pennsylvania, Rhode Island, Utah, Vermont, Virginia, Washington, West Virginia, Wisconsin, Wyoming).

*Alnus incana* is ranked G5 (Globally secure) on NatureServe.

Refs: 4, 40, 44, 48, 64, 71, 74, 81, 89, 97, 110, 115, 116, 131, 133, 136, 138, 143, 149, 172, 186, 189, 208, 212, 217, 221, 222, 223, 224, 225, 233, 237, 238, 249

*Alnus incana* subsp. *incana*

Albania, Armenia, Austria, Azerbaijan, Belarus, Bosnia and Herzegovina, Bulgaria, Croatia, Czech Republic, Estonia, Finland, France, Georgia, Germany, Greece?, Hungary, Italy, Latvia, Lithuania, Moldova, Montenegro, Netherlands, Norway, Poland, Romania, Russian Federation (Eastern Asian Russia: West Siberia; Central European Russia, Chechnya, Dagestan, East European Russia, Ingushetiya, Kabardino-Balkariya, Karacheyevo-Cherkessiya, Krasnodar, North European Russia, Severo-Osetiya, South European Russia, Stavropol), Serbia, Slovakia, Slovenia, Sweden, Switzerland, The Former Yugoslav Republic of Macedonia, Turkey in Asia, Ukraine.

*Alnus incana* subsp. *incana* is ranked as G5T5 (Globally secure) on NatureServe.

Refs: 64, 74, 133, 222, 224

*Alnus incana* subsp. *rugosa* (Du Roi)  
R.T.Clausen

Canada (Labrador, Manitoba, New Brunswick, Newfoundland, Nova Scotia, Nunavut, Ontario, Prince Edward Island, Québec, Saskatchewan), Saint Pierre and Miquelon, United States (Connecticut, Illinois, Indiana, Iowa, Maine, Maryland, Massachusetts, Michigan, Minnesota, New Hampshire, New Jersey, New York, North Dakota, Ohio, Pennsylvania, Rhode Island, Vermont, Virginia, West Virginia, Wisconsin)  
Refs: 44, 64, 74, 81, 133, 143, 172, 186, 208, 217, 221, 222, 223, 224, 225, 233, 237

*Alnus incana* subsp. *tenuifolia* (Nutt.)

Breitung

Canada (Alberta, British Columbia, Northwest Territories, Saskatchewan, Yukon), United States (Alaska, Arizona,

California, Colorado, Idaho, Montana, Nevada, New Mexico, Oregon, Utah, Washington, Wyoming).

*Alnus incana* subsp. *tenuifolia* is ranked as G5T5 (globally secure) on NatureServe.

Refs: 44, 64, 74, 133, 143, 186, 208, 217, 221, 222, 224, 225, 233

*Alnus incana* subsp. *kolaensis* (Orlova) Á.Löve and D.Löve

**DD**

*Taxonomic note: the taxonomic status of this species is uncertain.*

Finland, Norway, Russian Federation (European Russia: Northwest European Russia)?, Sweden

A tree found growing in river valleys, frequently found bordering boreal or alpine areas and can also be found in shrub tundra in the bordering Arctic.

This is a little known subspecies. It is assessed here as Data Deficient.

Refs: 48, 74, 97, 133, 143, 208, 212  
Assessor: Stritch, L.

*Alnus japonica* (Thunb.) Steud.

China (Anhui, Hebei, Henan, Jiangsu, Jilin, Liaoning, Shandong), Democratic People's Republic of Korea, Japan (Hokkaido, Honshu, Kyushu, Ryukyu Islands, Shikoku), Province of China (Taiwan), Republic of Korea, Russian Federation (Central Asian Russia: Kurile Islands?, Primoryi, Sakhalin)  
Refs: 42, 74, 99, 120, 133, 157, 159, 208, 222

*Alnus jorullensis* Kunth Guatemala?, Honduras, Mexico (Chiapas, Colima, Durango, Guanajuato, Guerrero, Hidalgo, Jalisco, México Distrito Federal, México State, Michoacán, Morelos, Oaxaca, Puebla, Queretaro, Sinaloa, Veracruz, Zacatecas)

Refs: 29, 33, 59, 64, 74, 133, 140, 145, 147, 160, 208, 222, 235

*Alnus jorullensis* subsp. *jorullensis*

**DD**

Guatemala?, Honduras, Mexico (Chiapas, Colima, Durango, Guerrero, Hidalgo, Jalisco, México Distrito Federal, México State, Michoacán, Morelos, Oaxaca, Puebla, Veracruz)

This is a little known taxon, with a fairly wide range within Mexico, but its distribution is restricted to high altitudes

(2,300 m to 3,800 m ASL). Climate change may therefore present a threat to this taxon. It is assessed here as Data Deficient.

Refs: 64, 59, 74, 133, 145

*Alnus jorullensis* subsp. *lutea* Furlow  
**DD**

Mexico (Colima, Durango, Guanajuato, Guerrero, Hidalgo, Jalisco, México Distrito Federal, México State, Michoacán, Morelos, Oaxaca, Puebla, Queretaro, Sinaloa, Veracruz, Zacatecas)

This is a Little known taxon, with a fairly wide range within Mexico, but its distribution is limited to along streams in areas between 1,000 m and 2,500 m ASL. It is assessed here as Data Deficient.

Refs: 59, 74, 133, 208

Assessor: Stritch, L.

*Alnus mandshurica* (Callier) Hand.-Mazz.

China (Heilongjiang, Jilin, Liaoning, Nei Mongol), Democratic People's Republic of Korea, Republic of Korea, Russian Federation (Central Asian Russia: Primoryi; European Russia: Khabarovsk)  
Refs: 42, 74, 77, 99, 133, 159, 208, 222

*Alnus matsumurae* Callier

Japan (N and C Honshu)

This tree species has a small distribution, but it is reported to be common across its range. Due to its relatively small range, monitoring is recommended to ensure populations remain stable.  
Refs: 74, 77, 133, 208, 222

*Alnus nepalensis* D.Don

Bangladesh, Bhutan, China (Guangxi, Guizhou, SW Sichuan, Xizang, Yunnan), India (Arunachal Pradesh, Assam, Darjiling, Himanchal Pradesh, Manipur, Meghalaya, Mizoram, Nagaland, Sikkim, Tripura, Uttaranchal), Myanmar, Nepal, N Thailand, N Vietnam

Refs: 3, 28, 37, 41, 43, 60, 68, 74, 83, 99, 125, 133, 152, 157, 181, 191, 195, 208, 222, 224, 234

*Alnus nitida* (Spach) Endl.

NE Afghanistan, India (Himanchal Pradesh, Jammu-Kashmir, Uttaranchal), W and C Nepal, N Pakistan  
Refs: 15, 37, 41, 45, 74, 125, 133, 208, 222

*Alnus oblongifolia* Torr.

Mexico (Chihuahua, Sonora), United States (Arizona, New Mexico)

This species is ranked G3G4 (Vulnerable/Apparently Secure) on NatureServe (ref 143).

Refs: 44, 64, 74, 133, 143, 161, 208, 221, 222, 224, 225

Assessor: Stritch, L.

*Alnus pendula* Matsum.



*Alnus pendula*

Democratic People's Republic of Korea, Japan (Hokkaido, Honshu), Republic of Korea

Refs: 74, 77, 133, 154, 159, 208, 222, 224

*Alnus rhombifolia* Nutt.

United States (California, Idaho, Montana, Nevada, Oregon, Washington)  
This species is ranked G5 (Secure) on NatureServe (ref 143).

Refs: 44, 74, 90, 133, 143, 208, 217, 221, 222, 224, 225, 233

Assessor: Stritch, L.

*Alnus rubra* Bong.

Canada (British Columbia, Yukon), United States (Alaska, California, Idaho, Montana, Oregon, Washington)

This species is ranked G5 (Secure) on NatureServe (ref 143).

Refs: 16, 44, 64, 74, 90, 133, 143, 157, 165, 208, 217, 221, 222, 223, 224, 225, 233, 224, 225, 233

Assessor: Stritch, L.

*Alnus serrulata* (Aiton) Willd.

*Taxonomic note: this species has been erroneously called Alnus rugosa in a number of earlier floristic works.*

Canada (New Brunswick?, Nova Scotia, Québec), United States (Alabama, Arkansas, Connecticut, Delaware, District of Columbia, Florida, Georgia, Illinois, Indiana, Kansas?, Kentucky, Louisiana, Maine, Maryland, Massachusetts, Mississippi, Missouri, New Hampshire,

New Jersey, New York, North Carolina, Ohio, Oklahoma, Pennsylvania, Rhode Island, South Carolina, Tennessee, Texas, Vermont, Virginia, West Virginia). This species is ranked G5 (Secure) on NatureServe (ref 143).

Refs: 43, 44, 64, 72, 74, 81, 133, 143, 172, 186, 208, 221, 223, 224, 225, 233, 237

Assessor: Stritch, L.

***Alnus trabeculosa*** Hand.-Mazz.

China (Anhui, Fujian, N Guangdong, Guizhou, S Henan, Hubei, E Hunan, Jiangsu, Jiangxi, Zhejiang), Japan (Honshu).

This species is reported as rare in Japan, but it also occurs in China where it is not considered to be threatened.

This species is therefore assessed as Least Concern, but population monitoring should be implemented in Japan and conservation action if necessary, to maintain genetic diversity across the full range of this species.

Refs: 42, 74, 77, 96, 99, 132, 133, 141, 154, 208, 222, 224

***Alnus viridis*** (Chaix) DC.

*Taxonomic note:* There is still some debate over the acceptance of the naming of this taxon. Many references report *Alnus alnobetula* as the accepted name. As this complex occurs in North America, the taxonomy used here reflects the taxonomy widely used in that region. This differs to the taxonomy of the World Checklist of Selected Plant Families and recognises only three subspecies; *subsp. crispa*, *subsp. fruticosa* and *subsp. sinuata*. The *Alnus alnobetula* complex recognises additional infraspecific taxa.

Austria, Belarus, Bosnia and Herzegovina, Bulgaria, Canada (Alberta, British Columbia, Labrador, Manitoba, New Brunswick, Newfoundland, Northwest Territories, Nova Scotia, Ontario, Prince Edward Island, Quebec, Saskatchewan, Yukon), China?, Croatia, Czech Republic, France (inc Corsica), Germany, Greenland, Hungary, Italy, Japan (Hokkaido, Honshu), Mongolia, Montenegro, Poland, Romania, Russian Federation (Central Asian Russia: Amur, Buryatiya, Chita, Kamchatka, Krasnoyarsk, Kurile Islands, Magadan, Primoryi, Sakhalin, Yakutiya; Eastern Asian Russia: Altay,

West Siberia; European Russia: Central European Russia, Irkutsk, Khabarovsk, North European Russia), Serbia, Slovenia, Switzerland, The Former Yugoslav Republic of Macedonia, United States (Alaska, Aleutian Islands, California, Colorado, Idaho, Maine, Massachusetts, Michigan, Minnesota, Montana, New Hampshire, New York, North Carolina, Oregon, Pennsylvania, Tennessee, Vermont, Washington, Wyoming), Ukraine.

This species is ranked G5 (secure) on NatureServe.

Refs: 18, 44, 57, 62, 64, 71, 74, 81, 86, 98, 111, 133, 139, 143, 167, 172, 182, 186, 199, 208, 215, 217, 221, 222, 223, 224, 233, 238

***Alnus viridis*** subsp. *viridis* (Chaix) DC.

Austria, Bosnia and Herzegovina, Bulgaria, Czech Republic, France, Germany, Hungary, Italy, Macedonia, Poland, Romania, Serbia, Slovenia, Switzerland, Ukraine.

Refs: 215, 222

***Alnus viridis*** subsp. *crispa* (Aiton) Turrill

Canada (Alberta, British Columbia, Manitoba, New Brunswick, Newfoundland, Northwest Territories, Nova Scotia, Nunavut, Ontario, Prince Edward Island, Quebec, Saskatchewan), Greenland, France (St. Pierre and Miquelon), United States (Alaska, Maine, Massachusetts, Michigan, Minnesota, New Hampshire, New York, North Carolina, Pennsylvania, Tennessee, Vermont, Wisconsin).

This taxon is not ranked (G5TNR) on NatureServe.

Refs: 44, 64, 74, 81, 143, 172, 186, 208, 222, 224, 233

***Alnus viridis*** subsp. *fruticosa* (Rupr.)

Nyman

*Taxonomic note:* There is still some debate over the acceptance of the naming of this taxon. *Alnus alnobetula* subsp. *fruticosa* is sometimes considered the accepted name for this taxon.

Canada (Alberta, British Columbia, Northwest Territories, Saskatchewan, Yukon), China (Nei Mongol), Mongolia, Russian Federation (Altay, Amur, Arkhangelsk, Buryatiya, Chita, Gomo-Altay, Irkutsk, Kemerovo, Khabarovsk, Kirov, Komi, Krasnoyarsk, Magadan, Nenets, Novosibirsk, Omsk, Perm, Tomsk, Tuva, Tyumen,

Yakutia-Sakha), United States (Alaska, California, Oregon, Washington)

This taxon is not ranked (G5TNR) on NatureServe (ref 143).

Refs: 44, 64, 74, 143, 186, 208, 215, 222, 224, 233

***Alnus viridis*** subsp. *sinuata* (Regel)

Á.Löve & D.Löve

*Taxonomic note:* There is still some debate over the acceptance of the naming of this taxon. *Alnus alnobetula* subsp. *sinuata* is sometimes considered the accepted name for this taxon.

Canada (Alberta, British Columbia, Northwest Territories, Yukon), Russian Federation (Siberia), United States (Alaska, California, Idaho, Montana, Oregon, Washington, Wyoming)

This taxon is ranked G5T5 (Secure) on NatureServe.

Refs: 44, 64, 74, 143, 182, 186, 208, 217, 222, 223, 224, 233

Assessor: Stritch, L.

***Betula alleghaniensis*** Britton



*Betula alleghaniensis*

Canada (Labrador, New Brunswick, Newfoundland, Nova Scotia, Ontario, Prince Edward Island, Québec), Saint Pierre and Miquelon, United States (Connecticut, Georgia, Illinois, Indiana, Iowa, Kentucky, Maine, Maryland, Massachusetts, Michigan, Minnesota, New Hampshire, New Jersey, New York, North Carolina, Ohio, Pennsylvania, Rhode Island, South Carolina, Tennessee, Vermont, Virginia, West Virginia, Wisconsin)



This species is ranked G5 (Secure) on NatureServe.

Refs: 5, 16, 44, 51, 74, 90, 133, 143, 172, 202, 208, 222, 224, 233

Assessor: Stritch, L.

**Betula alnoides** Buch.-Ham. ex D. Don  
Bhutan, Bangladesh, China (Fujian, Guangxi, Hainan, Hubei, Sichuan, S Yunnan), India (Arunachal Pradesh, Assam, Darjiling, Himanchal Pradesh, Manipur, Meghalaya, Mizoram, Nagaland, Sikkim, Tripura, Uttaranchal), Laos, Myanmar, Nepal, Thailand, Vietnam

Refs: 5, 37, 41, 42, 56, 68, 64, 83, 99, 125, 133, 152, 208, 222, 234

**Betula ashburneri** McAll. & Rushforth



*Betula ashburneri* growing in the Himalayas at 3,400 m

Bhutan, China (SW Sichuan, NW Yunnan, SE Xizang)

This species is known only from a few localities within its range. However, it is reported by Ashburner and McAllister (ref 5) to be 'probably locally common'.  
Refs: 5, 9, 74, 127, 208

**Betula chinensis** Maxim.

*Taxonomic note:* This species has a morphologically distinct 6x cytotype known only from two high mountains in South Korea whose conservation status is uncertain. The species otherwise is 8x which is common. Until more collections of both types have been checked and compared, and a geographical difference has emerged, the two types do not merit different names.

China (E Gansu, Hebei, Henan, Liaoning, Nei Mongol, Shaanxi, Shandong, Shanxi), Democratic Republic of Korea, Republic of Korea

Ashburner and McAllister note that the conservation status of the 6x cytotype in South Korea is uncertain. The

conservation status of the full species complex is considered more secure.

Refs: 5, 42, 74, 99, 113, 133, 159, 208, 222

**Betula cordifolia** Regel

*Taxonomic note:* until recently this species has been regarded as a variety of *B. papyrifera*. Studies confirm the diploid status of *B. cordifolia*, defined its morphological distinctness and suggest that it is likely to be one of the constituent genomes of hexaploid *B. papyrifera*.

Canada (Labrador, New Brunswick, Newfoundland, Nova Scotia, Ontario, Prince Edward Island, Quebec), Saint Pierre and Miquelon, United States (Connecticut?, Maine, Massachusetts, Michigan, Minnesota, New Hampshire, New York, North Carolina, Pennsylvania, Vermont, Virginia, Wisconsin, West Virginia)

Refs: 5, 44, 74, 77, 133, 222, 233

**Betula costata** Trautv.

China (Hebei, Heilongjiang, Jilin, Liaoning, Nei Mongol), Democratic People's Republic of Korea, Republic of Korea, Russian Federation (Central Asia Russia: Amur, Primoryi; European Russia: Khabarovsk)

Refs: 5, 42, 74, 99, 113, 133, 159, 208, 222

**Betula cylindrostachya** Lindl. ex Wall.

*Taxonomic notes:* (1) This tetraploid species is often confused with the closely related diploid *B. alnoides* and *B. luminifera*. It can be distinguished from *B. alnoides* by its spring rather than autumn-winter flowering period, its wider fruiting catkins and more cordate leaf bases. *B. luminifera* is morphologically very similar, but has (usually) solitary female catkins (catkins are in groups of two to six in the other two species) (2) The recently described *B. fujianensis* would seem to be synonymous with *B. cylindrostachya*, the only significant difference being the glandular shoots and the absence of hair tufts in the secondary vein axils on the abaxial leaf surface (3) *B. rhombibracteata* is doubtfully distinct from *B. cylindrostachya*

Bhutan, China (SW Sichuan, NW Yunnan, Fujian), India (Arunachal

Pradesh, Assam, Darjiling, Himanchal Pradesh, Manipur, Meghalaya, Mizoram, Nagaland, Sikkim, Tripura, Uttaranchal), N Myanmar, Nepal, Pakistan

Refs: 5, 9, 42, 67, 74, 77, 83, 99, 133, 208, 222

**Betula dahurica** Pall.



*Betula dahurica*

*Taxonomic note:* This species occurs as two cytotypes: the octoploid cytotype is common and widespread in continental north-eastern Asia including Korea, but the hexaploid is rare and found in Japan and the Kurile Island of Iturup. It has been proposed by Ashburner and McAllister (2013) that the continental octoploid cytotype is recognised as var. *dahurica*, the Kurile Island and Hokkaido populations as var. *okuboi*, and the more distinct Honshu populations as var. *parvifolia*

China (Hebei, Heilongjiang, E Jilin, N Liaoning, Nei Mongol, Shaanxi, Shanxi), Democratic People's Republic of Korea, Japan (Hokkaido, Honshu), Republic of Korea, Mongolia, Russian Federation (Central Asian Russia: Amur, Buryatiya?, Chita, Kurile Islands, Primoryi; European Russia: Khabarovsk)

(*B. dahurica* var. *dahurica* does not occur in Japan, otherwise its distribution matches the species)

*B. dahurica* is assessed as Vulnerable in Japan, but due to its wide distribution outside of Japan it is considered to be locally threatened in Japan, but not globally threatened.

Refs: 5, 42, 74, 99, 128, 132, 133, 154, 159, 208

**Betula dahurica** var. **dahurica**

China (Hebei, Heilongjiang, E Jilin, N Liaoning, Nei Mongol, Shaanxi, Shanxi), Democratic People's Republic of Korea  
This taxon is reported to be common and widespread (see taxonomic note for *B. dahurica*).

Refs: 5, 74

**Betula dahurica** var. **okuboi** Miyabe & Tatew.

**DD**

Japan (Hokkaido), Russian Federation (Central Asian Russia: Kurile Islands)  
This little known variety is reported to be rare in the wild (see taxonomic note for *B. dahurica*). It is assessed as Near Threatened in Japan, but insufficient information is available to carry out a full range wide conservation assessment. It is assessed here as Data Deficient and in need of further field research.

Refs: 5, 74, 128, 133

**Betula dahurica** var. **parvifolia**

Ashburner & McAll.

**DD**

*Taxonomic note: this is described as a new variety by Ashburner and McAllister (2013)*

Japan (Honshu)

This taxon is known only from a small population near Nobeyama in Nagano Prefecture in the central part of the main island of Honshu, Japan. Cultivated living collections and all known herbarium specimens seem to be from the same locality. This taxon is reported as 'not rare' in the single locality that it is known from, however, only one seed bearing tree was found. The very restricted distribution of this taxon makes it vulnerable to natural disaster, including pest or disease outbreak, or human induced land clearance. Natural regeneration is also assumed limited as only one seed bearing tree has been reported from the remaining population. Additional fieldwork is recommended to ensure no other populations exist. As this taxon is only recently described there is very little published information about this taxon. Currently available information indicates this may be threatened. Further field research is required to determine its conservation status.

Refs: 5

**Betula ermanii** Cham.



*Betula ermanii* 'Polar Bear'



*Betula ermanii*



*Betula ermanii*

*Taxonomic note: B. ermanii* var. *saitoana* was previously described as threatened is no longer an accepted variety of *B. ermanii*

**Betula ermanii** var. **ermanii**

China (Heilongjiang, Jilin, Liaoning, Nei Mongol), Democratic People's Republic of Korea, Japan (Hokkaido, Honshu, Shikoku), Republic of Korea, Russian Federation (Central Asian Russia: Amur, Buryatiya, Chita, Kamchatka, Kurile Islands?, Magadan, Primoryi, Sakhalin, Yakutiya; European Russia: Irkutsk, Khabarovsk)

Refs: 5, 42, 74, 99, 113, 133, 154, 159, 208, 212, 222

**Betula ermanii** var. **lanata** Regel

China (Heilongjiang, Jilin, Liaoning), Russian Federation (Central Asian Russia: Amur, Buryatiya, Chita, Magadan, Primoryi, Sakhalin, Yakutiya; European Russia: Irkutsk, Khabarovsk)

Refs: 5, 74, 133

**Betula fruticosa** Pall.

*Taxonomic notes: (1) B. tatewakiana is generally considered a minor variant of B. fruticosa (2) B. baicalensis is a possible hybrid between B. fruticosa and B. pendula (3) B. middendorffii and B. divaricata probably belong here, but are very similar to B. glandulosa from Goose Bay in Labrador*

China (N Heilongjiang, Jilin?, Nei Mongol), Democratic People's Republic of Korea, Mongolia, Japan (Hokkaido)?, Republic of Korea, Russian Federation (Central Asian Russia: Amur, Buryatiya, Chita, Kamchatka, Magadan, Primoryi, Sakhalin, Yakutiya; European Russia: Irkutsk, Khabarovsk)

This species is assessed as Vulnerable in Japan under the synonym *Betula ovalifolia*. This species is therefore considered locally threatened in Japan, but due to its wider distribution outside of Japan it is not considered to be globally threatened.

Refs: 5, 42, 74, 99, 132, 133, 154, 159, 208, 212, 222

**Betula glandulosa** Michx.

*Taxonomic note: B. nana* subsp. *exilis* is here treated as a dwarf, mainly more northern, variant of *B. glandulosa*. Canada (Alberta, British Columbia, Labrador, Manitoba, New Brunswick, Newfoundland, Northwest Territories,



Nova Scotia, Ontario, Prince Edward Island, Québec, Saskatchewan, Yukon), Greenland, Russian Federation (Central Asian Russia: Amur, Buryatiya, Kamchatka, Krasnoyarsk, Kuril Islands?, Magadan, Sakhalin, Yukutiya; Eastern Asian Russia: Altay, West Siberia; European Russia: Irkutsk, Khabarovsk), Saint Pierre and Miquelon, United States (Alaska, California, Colorado, Idaho, Maine, Montana, New Hampshire, New York, Oregon, South Dakota, Utah, Washington, Wyoming)

Refs: 5, 44, 49, 55, 74, 81, 95, 133, 143, 182, 194, 208, 217, 221, 222, 223, 224, 225, 233

Assessor: Stritch, L.

***Betula gmelinii*** Bunge

*Taxonomic note:* *B. apoiensis*, a species previously listed as *Vulnerable* in the 1997 IUCN Red List of Threatened Plants (ref 236), is a probable local variant of *B. gmelinii*

China (N Heilongjiang, N Liaoning, Nei Mongol), Democratic People's Republic of Korea, Japan (Hokkaido: Mt Apoi), N Mongolia, Republic of Korea, Russian Federation (Central Asian Russia: Buryatiya, Chita, Krasnoyarsk, Yakutiya; Eastern Asian Russia: West Siberia; European Russia: Irkutsk)

Refs: 5, 42, 74, 99, 133, 222, 236

***Betula grossa*** Sieb. & Zucc.

Japan (Honshu, Kyushu, Shikoku)  
This species has a fairly small range, but it colonises easily following disturbance. It is therefore assessed as Least Concern, but would benefit from further field research to verify distribution and population status within its range.

Refs: 5, 74, 133, 154, 208, 222

***Betula humilis*** Schrank



*Betula humilis*

Austria, Belarus, China (Xinjiang: Altay Shan), Czech Republic, Democratic

People's Republic of Korea, Estonia, Germany, Kazakhstan, Latvia, Lithuania, Poland, Republic of Korea, Romania, Switzerland, Russian Federation (Central Asian Russia: Buryatiya, Krasnoyarsk; Eastern Asian Russia: West Siberia; European Russia: Central European Russia, East European Russia, Irkutsk, Kaliningrad, Khabarovsk, South European Russia, Northwest European Russia), Mongolia, Ukraine

This species has a wide but patchy distribution and has a reducing population across its range, which is likely to continue to decline if additional conservation measures are not put in place. It is now rare in Western Europe, has only a few locations reported in Germany, is scarce in Poland where it appears to be absent from formerly recorded sites, and is thought to be extinct in the Czech Republic where it has not been seen for at least 50 years. Populations are reported to be rare in Austria, *Vulnerable* in Romania and *Critically Endangered* in Switzerland. This species has declined over past centuries, primarily due to the advance of cultivation and the drainage of bogs. The threats facing this species are not likely to cease, therefore depending on current area of occupancy, this species could qualify as *Vulnerable* under criterion A due to its reduced population. However, due to a lack of data on population reductions, it is currently not possible to specify a threat category or *Near Threatened* category. Further study is needed to better quantify the population size reduction.

Refs: 5, 11, 22, 40, 42, 71, 74, 78, 99, 109, 116, 124, 131, 133, 138, 149, 208, 216, 222, 244, 251

***Betula insignis*** Franch.

***Betula insignis*** subsp. *insignis*

China (Chongqing, Fujian?, Guangdong?, Guangxi?, Guizhou, Hunnan, W Hubei, Jiangxi?, Sichuan, Yunnan)

This species and subspecies are common and widespread in central China. They have no known threats. The species is assessed as *Least Concern* on the Chinese Red List. (The species and type subspecies share the same distribution).

Refs: 5, 42, 74, 75, 77, 99, 133, 208, 222

***Betula insignis*** subsp. *fansipanensis*  
Ashburner & McAll.

**DD**

*Taxonomic note:* Described for the first time by Ashburner and McAllister, 2013

China (Yunnan), Vietnam  
This little known subspecies occurs on mountain ridges on limestone, in southwest Yunnan and Fan-Si-Pan in Vietnam. As this taxon is recently described, further field research is required to enable a full conservation assessment to be undertaken. It is assessed here as *Data Deficient*.

Refs: 5

***Betula lenta*** L.



*Betula lenta* f. *uber*

*Taxonomic note:* *B. uber*, previously reported as *threatened*, is thought to be a form of *B. lenta* because leaf shape is the only consistent differential character. Assessments for *B. lenta* f. *lenta* and *B. lenta* f. *uber* are included here. Their range information is incorporated into the species-level assessment. See case study 1 for more information on *B. lenta* forma *uber*.



Canada (Ontario), United States (Alabama, Connecticut, Georgia, Kentucky, Maine, Maryland, Massachusetts, Mississippi, New Hampshire, New Jersey, New York, North Carolina, Ohio, Pennsylvania, Rhode Island, South Carolina, Tennessee, Vermont, Virginia, West Virginia).

This species is ranked G5 (Secure) on NatureServe (ref 143).

Refs: 5, 16, 44, 74, 77, 90, 119, 133, 143, 172, 208, 224, 228, 233

Assessor: Stritch, L.

**Betula luminifera** H.J.P.Winkl.

China (Anhui, Fujian, Gansu, N Guangdong, Guangxi, Guizhou, Henan, Hubei, Hunan, Jiangsu, Jiangxi, Shaanxi, Sichuan, Yunnan, Zhejiang)

This species is common and widespread across its range, with no known threats. This species is assessed as Least Concern on the Chinese Red List.

Refs: 5, 42, 74, 75, 99, 133, 208, 222

**Betula maximowicziana** Regel



*Betula maximowicziana*

Japan (Honshu, Hokkaido), Russian Federation (Central Asian Russia: Kurile Islands)

Refs: 5, 74, 133, 136, 154, 177, 208, 222

**Betula michauxii** Spach

Canada (Labrador, New Brunswick, Newfoundland, Nova Scotia, Québec), Saint Pierre and Miquelon

Refs: 5, 44, 74, 133, 208, 222, 224, 233

Assessor: Stritch, L.

**Betula microphylla** Bunge

*Taxonomic note:* *Betula halophila* is a probable synonym of *B. microphylla*. The status of *B. halophila* is uncertain—this species previously listed as Extinct in the 1997 IUCN Red List of Threatened Plants. Although its unique habitat for a birch suggests that it may be genetically distinct from any other birch, it is not easily distinguishable morphologically.

China (Xinjiang: Altay Shan, Hami Xian), Kazakhstan, Kyrgyzstan?, Mongolia, Russian Federation (Altay, Buryatiya, Tuva), Uzbekistan

Refs: 5, 42, 74, 99, 133, 208, 236

**Betula nana** L.

Austria, Belarus, Canada (Nunavut?), Czech Republic, Estonia, Finland, France, Germany, Greenland, Iceland, Italy, Latvia, Lithuania, Norway, Poland, Romania, Russian Federation (Central Asian Russia: Krasnoyarsk; Eastern Asian Russia: West Siberia; European Russia: Central European Russia, East European Russia, Irkutsk, North European Russia), Slovakia, Svalbard and Jan Mayen, Sweden, Switzerland, United Kingdom (Great Britain)

This species is ranked G5 (Secure) on NatureServe.

Refs: 4, 5, 19, 31, 40, 44, 53, 74, 78, 109, 116, 131, 133, 138, 142, 143, 149, 156, 208, 215, 222, 224, 233, 244

Assessor: Stritch, L.

**Betula nigra** L.



*Betula nigra*

United States (Alabama, Arkansas, Connecticut, Delaware, District of Columbia, Florida, Georgia, Illinois, Indiana, Iowa, Kansas, Kentucky, Louisiana, Maryland, Massachusetts, Minnesota,

Mississippi, Missouri, New Hampshire?, New Jersey, New York, North Carolina, Ohio, Oklahoma, Pennsylvania, South Carolina, Tennessee, Texas, Vermont, Virginia, West Virginia, Wisconsin)

This species is ranked G5 (Secure) on NatureServe.

Refs: 5, 16, 27, 38, 43, 44, 55, 74, 90, 119, 133, 143, 172, 202, 208, 222, 223, 224, 232

Assessor: Stritch, L.

**Betula occidentalis** Hook.

Canada (Alberta, British Columbia, Manitoba, Northwest Territories, Nunavut?, Ontario, Saskatchewan, Yukon), United States (Alaska, Arizona, California, Colorado, Idaho, Montana, Nebraska, Nevada, New Mexico, North Dakota, Oregon, South Dakota, Utah, Washington, Wyoming)

This species is ranked G5 (Secure) on NatureServe.

Refs: 5, 34, 35, 44, 74, 90, 118, 133, 143, 182, 208, 217, 218, 221, 222, 223, 224, 225, 233, 239

Assessor: Stritch, L.

**Betula papyrifera** Marshall

*Taxonomic note:* *B. kenaica* is said to differ from *B. papyrifera* primarily in its smaller stature and in its smaller, blunter-tipped, more coarsely and regularly serrate leaves. It is best considered a westward extension of *B. papyrifera* into southern Alaska, perhaps affected by introgression from *B. pendula* subsp. *mandshurica*.

Canada (Alberta, British Columbia, Labrador, Manitoba, New Brunswick, Newfoundland, Northwest Territories, Nova Scotia, Ontario, Prince Edward Island, Quebec, Saskatchewan, Yukon), Saint Pierre and Miquelon, United States (Alaska, Colorado, Connecticut, Idaho, Illinois, Indiana, Iowa, Maine, Massachusetts, Michigan, Minnesota, Montana, Nebraska, New Hampshire, New Jersey, New York, North Dakota, Ohio?, Oregon, Pennsylvania, Rhode Island, South Dakota, Vermont, Washington, West Virginia?, Wisconsin, Wyoming)

This species is ranked G5 (Secure) on NatureServe.

Refs: 5, 16, 44, 50, 74, 90, 95, 119, 133, 143, 172, 202, 208, 221, 222, 223, 224, 225, 233

Assessor: Stritch, L.

**Betula pendula** Roth

*Taxonomic notes:* (1) Trees from the extremes of the distribution in Europe (*B. pendula*), north-east Asia and Japan and western North America (*B. platyphylla*, *B. mandshurica*) and SW China and Tibet (*B. szechuanica*) do look different and can be distinguished from one another. However, when the whole continuous geographical range of diploid silver birches is considered, all those named as species intergrade in geographically intervening areas. It is thought to be best divided into three subspecies, *subsp. pendula* in Europe and eastwards to central Asia, *subsp. mandshurica* in eastern Asia and western North America and *subsp. szechuanica* in western China from Qinghai and Gansu to Yunnan and southeast Xizang (2) *B. platyphylla* has been described as a separate species, representing birches from Mongolia east of the Altai and into western and north-eastern China but it is thought the two are synonymous (3) *B. oycoviensis* previously listed as threatened is a form of *B. pendula* (4) *B. pendula subsp. font-queri* and *B. pendula subsp. parvibracteata*, previously listed as threatened are thought to be only minor variants of *B. pendula* (5) *B. szaferi*, described previously as extinct in the wild, is now considered a weak growing and heavily fruiting form of *B. pendula*, due to the presence of a mutant gene Albania, Armenia, Austria, Azerbaijan?, Belarus, Belgium, Bosnia and Herzegovina, Bulgaria, Canada (Alberta, British Columbia, Manitoba, Northwest Territories, Nunavut, Ontario, Saskatchewan, Yukon), China (Gansu, Heilongjiang, Jilin, Liaoning, Qinghai, Sichuan, Xinjiang, SE Xizang, N Yunnan), Croatia, Czech Republic, Denmark, Estonia, Finland, France (inc. Corsica), Georgia, Germany, Greece, Hungary, Iraq, Islamic Republic of Iran, Italy (inc. Sicily), Japan, Kazakhstan, Kyrgyzstan?, Latvia, Liechtenstein, Lithuania, Luxembourg, Mongolia, Montenegro, Morocco, Netherlands, Norway, Poland, Romania, Russian Federation (Central Asian Russia: Amur, Chita, Buryatiya, Krasnoyarsk, Magadan, Tuva, Yakutiya; Eastern Asian Russia: Altay, West Siberia; European Russia: Central European Russia, Chechnya, Dagestan, East

European Russia, Ingushetiya, Irkutsk, Kabardino-Balkariya, Karachaevo-Cherkessiya, Krasnodar, North European Russia, Northwest European Russia, Severo-Osetiya, South European Russia, Stavropol), Serbia (inc. Kosovo), Slovakia, Slovenia, Spain, Sweden, Switzerland, The Former Yugoslav Republic of Macedonia, Turkey in Asia, Ukraine (inc. Krym), United Kingdom (Great Britain, Northern Ireland), United States (Alaska), Uzbekistan  
Refs: 4, 5, 12, 15, 19, 23, 30, 40, 61, 71, 74, 99, 102, 110, 116, 131, 133, 138, 146, 149, 175, 177, 189, 203, 204, 208, 213, 215, 222, 229, 249

**Betula pendula** subsp. **pendula**

Albania, Armenia, Austria, Azerbaijan?, Belarus, Belgium, Bosnia and Herzegovina, Bulgaria, Croatia, Czech Republic, Denmark, Estonia, Finland, France (inc. Corsica), Georgia, Germany, Greece, Hungary, Iraq, Islamic Republic of Iran, Italy (inc. Sicily), Kazakhstan, Kyrgyzstan?, Latvia, Lithuania, Luxembourg, Mongolia, Montenegro, Morocco, Netherlands, Norway, Poland, Romania, Russian Federation (Central Asian Russia: Chita, Buryatiya, Krasnoyarsk, Tuva; Eastern Asian Russia: Altay, West Siberia; European Russia: Central European Russia, Chechnya, Dagestan, East European Russia, Ingushetiya, Irkutsk, Kabardino-Balkariya, Karachaevo-Cherkessiya, Krasnodar, North European Russia, Northwest European Russia, Severo-Osetiya, South European Russia, Stavropol), Serbia (inc. Kosovo), Slovakia, Slovenia, Spain, Sweden, Switzerland, The Former Yugoslav Republic of Macedonia, Turkey in Asia, Ukraine (inc. Krym), United Kingdom (Great Britain, Northern Ireland), Uzbekistan  
Refs: 4, 5, 12, 15, 19, 23, 30, 40, 61, 71, 74, 99, 102, 110, 116, 131, 133, 138, 146, 149, 175, 177, 189, 203, 204, 208, 213, 215, 222, 229, 249

**Betula pendula** subsp. **mandshurica**

(Regel) Ashburner & McAll.

*Taxonomic note:* a newly described combination by Ashburner & McAllister, 2013

Canada (Alberta, British Columbia, Manitoba, Northwest Territories, Nunavut, Ontario, Saskatchewan, Yukon), China (Heilongjiang, Liaoning, Jilin), Japan,

Russian Federation (Russian Federation (Central Asian Russia: Buryatiya, Chita, Krasnoyarsk, Yakutiya; Eastern Asian Russia: West Siberia; European Russia: Irkutsk), United States (Alaska)  
Refs: 5, 44, 177, 221, 223, 224, 225  
Assessor: Stritch, L.

**Betula pendula** subsp. **szechuanica**

(C.K.Scheid.) Ashburner & McAll.

**DD**

*Taxonomic note:* a newly described combination by Ashburner & McAllister, 2013  
China (Gansu, Qinghai, Sichuan, SE Xizang, N Yunnan)

This little known subspecies occurs as a tree to 10 m with a spreading habit, occurring in woodland and on open hill-sides. This taxon is cultivated for ornamental purposes. This taxon is reported to have a fairly wide distribution, occurring across five states of China. However, it is recently described and no population information or detailed distribution information is available for this species. Additional field research is needed to determine distribution and population status to enable a full conservation assessment to be undertaken. It is assessed here as Data Deficient.

Refs: 5, 177

**Betula populifolia** Marshall

Canada (New Brunswick, Nova Scotia, Ontario, Prince Edward Island, Quebec), United States (Connecticut, Delaware, Illinois, Indiana, Maine, Maryland, Massachusetts, New Hampshire, New Jersey, New York, North Carolina, Ohio, Pennsylvania, Rhode Island, Vermont, Virginia, West Virginia)

This species is ranked G5 (Secure) on NatureServe (ref 143).

Refs: 5, 44, 55, 74, 81, 90, 133, 135, 143, 169, 172, 208, 217, 221, 222, 223, 224, 233

Assessor: Stritch, L.

**Betula potaninii** Batalin

*Taxonomic notes:* (1) *B. delavayi*, *B. bomiensis*, *B. calcicola* and *B. potaninii* taxa are very confused. However they are separable by their visible morphological characters, ploidy and geographical distribution. (2) *B. trichogemma* seems to be no more than a minor variant of *B. potaninii*. (3) *B. jilungensis* may be a tree form of *B. potaninii* or perhaps a distinct species





*Betula potaninii*

China (SE Gansu, Shaanxi, N and W Sichuan)

This species has no known threats and is assessed as Least Concern on the Chinese Red List

Refs: 5, 42, 74, 75, 99, 133, 208, 222

***Betula pubescens* Ehrh.**

*Taxonomic note:* (1) Although there is great variation in habit and stature in trees of this species associated with different habitats there are no clear boundaries between the different forms. The most useful taxonomic treatment is to give names to the most distinct, but only at the varietal level. Therefore var. *pubescens* for the tall central European and southern British and Scandinavian populations, var. *pumila* for northern populations, which are probably derived from var. *pubescens* through adaptive selection and introgression from *B. nana*, var. *fragrans* for aromatic, small leaved trees from northwest Britain, and var. *litwinowii* for Anatolian and Caucasian populations which are probably largely the result of introgression from *B.*

*pendula*

Armenia, Austria, Azerbaijan, Belarus, Belgium, Bosnia and Herzegovina, Canada (Newfoundland), Croatia, Czech Republic, Denmark, Estonia, Finland, France, Georgia, Germany, Greenland, Hungary, Iceland, Italy, Latvia, Liechtenstein, Lithuania, Luxembourg, Montenegro, Netherlands, Norway, Poland, Romania, Russian Federation (Central Asian Russia: Buryatiya, Krasnoyarsk, Yakutiya; Eastern Asian Russia: Altay, West Siberia; European Russia: Central European Russia, Chechnya, Dagestan, East European Russia, Ingushetiya, Irkutsk, Kabardino-Balkariya, Karachaevo-Cherkessiya, Khabarovsk, Krasnodar,

North European Russia, Northwest European Russia, Severo-Osetiya, South European Russia, Stavropol), Serbia (inc. Kosovo), Slovenia, Spain, Sweden, Switzerland, The Former Yugoslav Republic of Macedonia, Turkey in Asia, Turkey in Europe, Ukraine, United Kingdom (Great Britain, Northern Ireland)

Refs: 4, 5, 8, 12, 19, 23, 40, 44, 69, 71, 74, 111, 116, 131, 133, 138, 146, 148, 149, 153, 189, 192, 199, 204, 208, 212, 213, 215, 222, 224, 233, 249

***Betula pubescens* var. *pubescens***

Armenia, Austria, Azerbaijan, Belarus, Belgium, Bosnia and Herzegovina, Croatia, Czech Republic, Denmark, Estonia, France, Georgia, Germany, Hungary, Italy, Latvia, Liechtenstein, Lithuania, Luxembourg, Montenegro, Netherlands, Poland, Romania, Russian Federation (Central Asian Russia: Buryatiya, Krasnoyarsk, Yakutiya; Eastern Asian Russia: Altay, West Siberia; European Russia: Central European Russia, Chechnya, Dagestan, East European Russia, Ingushetiya, Irkutsk, Kabardino-Balkariya, Karachaevo-Cherkessiya, Khabarovsk, Krasnodar, North European Russia, Northwest European Russia, Severo-Osetiya, South European Russia, Stavropol), Serbia (inc. Kosovo), Slovenia, Spain, Switzerland, The Former Yugoslav Republic of Macedonia, Turkey in Asia, Turkey in Europe, Ukraine, United Kingdom (Great Britain, Northern Ireland)

Refs: 4, 5, 8, 12, 19, 23, 40, 44, 69, 71, 74, 111, 116, 131, 133, 138, 146, 148, 149, 153, 189, 199, 204, 213, 215, 222, 224, 233, 249

***Betula pubescens* var. *fragrans***

Ashburner & McAll.

**DD**

*Taxonomic note:* this is described as a new variety by Ashburner & McAllister, 2013

United Kingdom (Great Britain: Northumberland, Lake Bala)

Small trees to about 5 m with twisted trunks. This taxon can be found on steep hillsides and rocky streambanks in the mountains and throughout the Scottish Highlands at all altitudes. This is a new variety described by Ashburner and McAllister (2013). Little information is available about this taxon.

Refs: 5

***Betula pubescens* var. *golitsinii***

(V.N.Vassil.) Tzvelev

**DD**

South European Russia

This taxon is not listed by Ashburner and McAllister but are recognised by the World Checklist of Selected Plant Families. Due to the taxonomic uncertainty and very little information available on distribution and population status, it is assessed as Data Deficient and in need of further study.

Refs: 5, 74

***Betula pubescens* var. *litwinowii***

(Doluch.) Ashburner & McAll.

**DD**

*Taxonomic notes:* (1) A newly described combination by Ashburner and McAllister, 2013 (2) *B. litwinowii* is hardly distinguishable from *B. pubescens* var. *litwinowii* of the Swiss Jura or the Pyrenees (3) *B. recurvata* differs mainly in its larger leaves and absence of resin glands and is probably a local variant (4) The recently described *B. browicziana*, which was listed as Rare in the 1997 IUCN Red List of Threatened Plants (ref 236) and Endangered at a GTSG regional tree Red Listing workshop in Georgia in 2005, is thought to be a local variant Armenia, Azerbaijan, Georgia, Russian Federation (European Russia: Chechnya, Dagestan, Ingushetiya, Kabardino-Balkariya, Karachaevo-Cherkessiya, Krasnodar, Severo-Osetiya, Stavropol), Turkey in Asia

At high elevations it has a multi-stemmed, crooked shape and is shorter in height. It is often found clinging to cliff sides.

The status of this taxon remains uncertain.

Refs: 5, 8, 192, 236, 256

***Betula pubescens* var. *pumila* (L.)**

Govaerts

**DD**

Canada (Newfoundland), Finland, Greenland, Iceland, Norway, Russian Federation (Eastern Asian Russia: Altay, West Siberia; North European Russia), Sweden

A dwarf shrub found in sheltered rocky valleys in the arctic, and on mountains further south. These populations are extensive and dominate the vegetation over large areas. The conservation status of this taxon remains uncertain.

Refs: 5, 74, 133, 208, 212



***Betula pumila*** L.

Canada (Alberta, British Columbia, Labrador, Manitoba, New Brunswick, Newfoundland, Northwest Territories, Nova Scotia, Ontario, Prince Edward Island, Québec, Saskatchewan, Yukon), Saint Pierre and Miquelon, United States (California, Colorado, Connecticut, Idaho, Illinois, Indiana, Iowa, Kansas, Maine, Massachusetts, Michigan, Minnesota, Montana, Nebraska, New Hampshire, New Jersey, New York, North Dakota, Ohio, Oregon, South Dakota, Vermont, Washington, Wisconsin, Wyoming)

This species is ranked G5 (Secure) on NatureServe (ref 143).

Refs: 5, 44, 74, 133, 143, 208, 221, 222, 224, 225, 233

Assessor: Stritch, L.

***Betula raddeana*** Trautv.

Armenia? Azerbaijan, Georgia, Russian Federation (Dagestan, Karachyevo-Cherkessiya)

This species was assessed as Near Threatened in the World List of Threatened Trees. However a more recent assessment led by the IUCN, Missouri Botanical Garden and botanists from five countries situated in the Caucasus region, has reassessed this species as Least Concern due to its wide distribution on the eastern Greater Caucasus, presumed large population and because it is unlikely to be declining fast enough to qualify for listing in a threatened category. However, population monitoring is needed, taking into account forest clear-cutting and negative effects of traditional land use (incl. grazing and cattle camping in subalpine forests). The effects of global climate change on this species should be studied, but it is predicted to ascend to higher altitudes.

Refs: 5, 8, 9, 74, 110, 133, 192, 208, 222

Assessor: IUCN/SSC Caucasus Plant Red List Authority

***Betula utilis*** D.Don

*Taxonomic notes:* (1) *B. utilis*, *B. jacquemontii* and *B. albosinensis*, are clearly closely related, and have been recognised in the past as separate species, subspecies or varieties. All are tetraploid and, although the extremes are very different, it is often difficult to distinguish

between them. They are here treated as subspecies of *B. utilis*: *B. utilis* subsp. *utilis*, *B. utilis* subsp. *jacquemontii*, *B. utilis* subsp. *albosinensis* (2) *B. jinpingensis* is doubtfully distinct from *B. utilis* Afghanistan, Bhutan, China (Gansu, Hebei, Henan, Hubei, Ningxia, Qinghai, Shaanxi, Shanxi, W Sichuan, E and S Xizang, NW Yunnan), India (Arunachal Pradesh, Darjiling, Himachal Pradesh, Jammu-Kashmir, Sikkim, Uttaranchal), Kazakhstan, Kyrgyzstan, Nepal, Pakistan, Tajikistan, Uzbekistan

Refs: 2, 5, 9, 41, 42, 45, 68, 74, 99, 107, 122, 125, 133, 177, 208, 219, 222

***Betula utilis*** subsp. *utilis*

*Betula utilis* subsp. *utilis*

Bhutan, China (Sichuan, Xizang, Yunnan), India (Arunachal Pradesh, Darjiling, Sikkim), Nepal

Refs: 2, 5, 9, 41, 42, 45, 68, 74, 99, 107, 122, 125, 133, 177, 208, 219, 222

***Betula utilis*** subsp. *occidentalis* Kitam

*Betula utilis* subsp. *occidentalis*

Afghanistan, India (Jammu-Kashmir), Kazakhstan, Kyrgyzstan, Pakistan, Tajikistan, Uzbekistan

Refs: 5, 74, 133, 208

***Betula utilis*** subsp. *albosinensis*

(Burkill) Ashburner & McAll.

**DD**

China (Gansu, Hebei, Henan, Hubei, Ningxia, Shaanxi, Shanxi, Sichuan)

A tree to 35 m it forms a component of cool temperate mixed or mainly conifer forest. It is cultivated for ornamental use. The wood is hard, dense and rather brittle, being used for many purposes. There is little information available about this taxon. Further research is required. It is assessed here as Data Deficient.

Refs: 5, 177

***Betula utilis*** subsp. *jacquemontii*

*Betula utilis* subsp. *jacquemontii*

(Spach) Ashburner & McAll.

**DD**

India (Himanchal Pradesh, Jammu-Kashmir, Uttaranchal), Nepal

A small tree to 15 m, this taxon is found in forests, stony river beds, screes and rocky places in the mountains. Older trees develop thick plates of bark and form gnarled trees on the mountains. It is cultivated as an ornamental, this taxon has long been a favourite in gardens and arboreta. The timber is used for firewood, and the bark stripped for roofing. Further population information is required to ensure exploitation is not causing a population decline. It is assessed here as Data Deficient.

Refs: 5, 74, 133, 208

**Carpinus betulus** L.



*Carpinus betulus*

Albania, Armenia, Austria, Azerbaijan, Belarus, Belgium, Bosnia and Herzegovina, Bulgaria, Croatia, Czech Republic, Denmark, Estonia, France, Georgia, Germany, Greece, Hungary, Islamic Republic of Iran, Italy, Latvia, Liechtenstein, Lithuania, Luxembourg, Moldova, Montenegro, Netherlands, Poland, Romania, Russian Federation (European Russia: Central European Russia, Chechnya, Dagestan, Ingushetiya, Kabardino-Balkariya, Kaliningrad, Karacheyevo-Cherkessiya, Krasnodar, Severo-Osetiya, South European Russia, Stavropol), Serbia, Slovakia, Slovenia, Spain, Sweden, Switzerland, The Former Yugoslav Republic of Macedonia, Turkey in Asia, Turkey in Europe, Ukraine, United Kingdom (Great Britain)

Refs: 15, 19, 22, 23, 30, 71, 74, 116, 131, 133, 137, 138, 146, 149, 176, 189, 204, 208, 222, 224, 247, 249

**Carpinus caroliniana** Walter

*Taxonomic note: there is some confusion in the naming of this species. This species has been recorded as Near Threatened in the Mexican cloud forests but it is now recognised that C. tropicalis is the accepted name of this tree species as it occurs in Mexico and Central America. The range of C. caroliniana is now delimited to North America. The ranges of the two subspecies overlap and hybrids with intermediate features are common.*

Canada (Ontario, Quebec), United States (Alabama, Arkansas, Connecticut, Delaware, District of Columbia, Florida, Georgia, Illinois, Indiana, Iowa, Kentucky, Louisiana, Maine, Maryland, Massachusetts, Michigan, Minnesota, Mississippi, Missouri, New Hampshire, New Jersey, New York, North Carolina, Ohio, Oklahoma, Pennsylvania, Rhode Island, South Carolina, Tennessee, Texas, Vermont, Virginia, West Virginia, Wisconsin)

This species is ranked G5 (Secure) on NatureServe.

Refs: 16, 29, 43, 44, 59, 66, 73, 74, 77, 81, 90, 133, 135, 136, 143, 172, 200, 202, 208, 217, 221, 222, 223, 224, 225, 233

**Carpinus caroliniana** subsp. **caroliniana**

United States (Alabama, Arkansas, Delaware, Florida, Georgia, Illinois, Iowa?, Kentucky, Louisiana, Maryland, Mississippi, Missouri, New Jersey?, North Carolina, Oklahoma, South Carolina, Tennessee, Texas, Virginia)

This species is ranked G5T4T5 (Apparently Secure/Secure) on NatureServe (ref 143).

Refs: 16, 29, 44, 66, 73, 74, 77, 133, 135, 143, 200, 217, 221, 224, 225

**Carpinus caroliniana** subsp. **virginiana** (Marshall) Furlow

Canada (Ontario, Quebec), United States (Alabama, Arkansas, Connecticut, Delaware, District of Columbia, Georgia, Illinois, Indiana, Iowa, Kentucky, Maine, Maryland, Massachusetts, Michigan, Minnesota, Mississippi, Missouri, New Hampshire, New Jersey, New York, North Carolina, Ohio, Oklahoma, Pennsylvania, Rhode Island, South Carolina, Tennessee, Vermont, Virginia, West Virginia, Wisconsin)

This species is ranked G5T5 (Secure) on NatureServe (ref 143).

Refs: 16, 29, 44, 74, 77, 81, 133, 135, 143, 172, 202, 208, 217, 221, 224, 225, 233

Assessor: Stritch, L.

**Carpinus chuniana** Hu

China (N Guangdong: Lechang Xian, Guizhou: Fanjing Shan, SE Hubei)

Assessed as Least Concern on the Chinese Red List.

Refs: 42, 74, 99, 133, 208

**Carpinus cordata** Blume

China (Anhui, Gansu, Guizhou, Hebei, Hubei, Hunan, Jiangsu, Jiangxi, Liaoning, S Ningxia, Shaanxi, Shandong, Shanxi, Sichuan, Zhejiang), Democratic People's of Korea, Japan (Hokkaido, Honshu, Kyushu, Shikoku), Republic of Korea, Russian Federation (Central Asian Russia: Primoryi)

Refs: 42, 74, 77, 99, 113, 133, 154, 159, 208, 222



*Carpinus cordata*

**Carpinus cordata** var. **cordata**

China (SE Gansu, Hebei, Heilongjiang, Jilin, Liaoning, Shaanxi, Shandong: Kunyu Shan, Shanxi), Democratic People's Republic of Korea, Japan (Hokkaido, Honshu, Kyushu, Shikoku), Republic of Korea, Russian Federation (Central Asian Russia: Primoryi)

Refs: 42, 74, 99, 133, 208

**Carpinus cordata** var. **chinensis**

Franch.



*Carpinus cordata* var. *chinensis*

China (Anhui, SE Gansu, Guizhou, Hubei, Hunan, Jiangsu, Jiangxi, SW Shaanxi: Tabai Shan, Sichuan, Zhejiang), Japan (Honshu, Kyushu, Shikoku)?

Refs: 42, 74, 77, 99, 133, 208

**Carpinus cordata** var. **mollis** (Rehder)

W.C.Cheng ex C.Chen  
China (Gansu, S Ningxia, Shaanxi: Hua Shan, Sichuan)

Refs: 42, 74, 99, 133, 208

**Carpinus fangiana** Hu

China (N Guangxi, Guizhou, Sichuan, E Yunnan)

Assessed as Least Concern on the Chinese Red List.

Refs: 42, 74, 75, 77, 99, 133, 208



*Carpinus fargesiana* H.J.P.Winkl.  
*Carpinus fargesiana* var. *fargesiana*  
 China (S Gansu, W Henan, W Hubei, S Shaanxi, Sichuan)  
 Assessed as Least Concern on the Chinese Red List.  
 Refs: 42, 74, 77, 99, 133, 208, 222

*Carpinus fargesiana* var. *hwai* (Hu & W.C.Cheng) P.C.Li  
 China (W Hubei: Lichuan Xian, E Sichuan: Wan Xian)  
 Assessed as Least Concern on the Chinese Red List.  
 Refs: 42, 74, 99, 133, 208

*Carpinus firmifolia* (H.J.P.Winkl.) Hu  
 China (Guizhou: Guiyang Shi)  
 Assessed as Least Concern on the Chinese Red List.  
 Refs: 42, 74, 99, 133

*Carpinus henryana* (H.J.P.Winkl.) H.J.P.Winkl.  
 China (E Gansu, W Guizhou, Henan, W Hubei, S Shaanxi, E Sichuan, Yunnan)  
 Assessed as Least Concern on the Chinese Red List.  
 Refs: 42, 74, 75, 77, 99, 133, 208, 222

*Carpinus henryana* var. *henryana*  
**DD**  
 China (Sichuan)  
 This taxon has a small reported distribution. There is limited information available about this taxon and further research is required. It is assessed here as Data Deficient.  
 Refs: 74, 133, 208

*Carpinus henryana* var. *oblongifolia* (Hu) Rushforth  
**DD**  
 China (Hubei)  
 A tree to 18 m tall, found in subtropical forests. This taxon has a small reported distribution. There is limited information available about this taxon and further research is required. It is assessed here as Data Deficient.  
 Refs: 74, 133, 208

*Carpinus henryana* var. *simplicidentata* (Hu) Rushforth  
**DD**  
 China (Hubei)  
 This taxon has a small reported distribution. There is limited information available about this taxon and further research is required. It is assessed here as Data Deficient.  
 Refs: 74, 77, 133, 208

*Carpinus kawakamii* Hayata  
 China (Fujian: Liancheng Xian)?, Province of China (Taiwan: Alishan)  
 Reported to be a common species with a large population and no known threats. Assessed as Least Concern on the Chinese Red List.  
 Refs: 42, 74, 77, 91, 94, 99, 120, 133, 208, 222

*Carpinus kawakamii* var. *kawakamii*  
**DD**  
 Province of China (Taiwan)  
 This taxon has a small reported distribution. There is limited information available about this taxon and further research is required. It is assessed here as Data Deficient.  
 Refs: 42, 74, 77, 91, 94, 99, 133, 222

*Carpinus kawakamii* var. *minutiserrata* (Hayata) S.S.Ying  
**DD**  
 Province of China (Taiwan)  
 Found in forests on mountain slopes at medium altitudes. This taxon has a small reported distribution. There is limited information available about this taxon and further research is required. It is assessed here as Data Deficient.  
 Refs: 74, 120, 133, 208

*Carpinus kweichowensis* Hu  
 China (SW Guizhou: Zhenfeng Xian, SE Yunnan)  
 Assessed as Least Concern on the Chinese Red List.  
 Refs: 42, 74, 93, 99, 133, 208

*Carpinus londoniana* H.J.P.Winkl.  
*Carpinus londoniana* var. *londoniana*  
 China (S Anhui, Fujian, N Guangdong, Guangxi, SE Guizhou, Hainan, Hunan, Jiangxi, SC Sichuan, S Yunnan, Zhejiang), Lao People's Democratic Republic, SE Myanmar, N Thailand, Vietnam  
 Refs: 42, 74, 77, 99, 106, 133, 208, 210

*Carpinus londoniana* var. *latifolius* P.C.Li  
 China (Zhejiang: Ningbo Xian)  
 Assessed as Least Concern on the Chinese Red List.  
 Refs: 42, 74, 99, 133

*Carpinus londoniana* var. *lanceolata* (Hand.-Mazz.) P.C.Li  
**DD**

China (Hainan)  
 Only found growing in subtropical forests on Hainan Island, population numbers are unknown. There is limited information available about this taxon and further research is required. It is assessed here as Data Deficient.  
 Refs: 42, 74, 106, 133, 208, 210

*Carpinus londoniana* var. *xiphobracteata* P.C.Li  
**DD**  
 China (Zhejiang: Yin Xian)  
 Found growing in forests on moist mountain slopes at around 700 m ASL. There is limited information available about this taxon and further research is required. It is assessed here as Data Deficient.  
 Refs: 42, 74, 99, 133

*Carpinus mollicoma* Hu  
 China (Sichuan: Emi Shan, E Xizang: Bomi Zian, SE Yunnan: Malipo Xian)  
 Assessed as Least Concern on the Chinese Red List.  
 Refs: 42, 74, 99, 133, 208

*Carpinus monbeigiana* Hand.-Mazz.  
 China (Xizang, C and NW Yunnan)  
 Assessed as Least Concern on the Chinese Red List.  
 Refs: 42, 74, 75, 77, 99, 133, 208

*Carpinus orientalis* Mill.  
*Carpinus orientalis* subsp. *orientalis*  
 Albania, Armenia, Azerbaijan, Bosnia and Herzegovina, Bulgaria, Croatia, Georgia, Greece, Hungary, Islamic Republic of Iran, Italy (inc. Sicilia), Lebanon?, Moldova, Montenegro, Romania, Russian Federation (European Russia: Chechnya, Dagestan, Ingushetiya, Kabardino-Balkariya, Karachaevo-Cherkessiya, Krasnodar, Severo-Osetiya, Stavropol), Serbia, Slovenia, Syrian Arab Republic?, The Former Yugoslav Republic of Macedonia, Turkey in Asia, Turkey in Europe, Ukraine (Krym) (The species and type subspecies share the same distribution).  
 Refs: 15, 30, 74, 110, 133, 136, 170, 192, 203, 204, 208, 222, 249

*Carpinus orientalis* subsp. *macrocarpa* (Willk.) Browicz  
**DD**  
 Islamic Republic of Iran  
 Often found in transition forests including deciduous temperate mixed forest and scrub at high altitudes. Further field



research is required to obtain enough information for an assessment to be performed.

Refs: 15, 74, 101, 133, 208

***Carpinus polyneura*** Franch.

China (Fujian, N Guangdong, Guizhou, Hubei, Hunan, Jiangxi, Shaanxi, NE Sichuan: Chengkou Xian, Zhejiang)

Refs: 42, 74, 77, 99, 133, 208, 222

***Carpinus polyneura*** var. ***polyneura***

**DD**

China (Hunan, Sichuan)

This taxon has a small reported distribution. There is limited information available about this taxon and further research is required. It is assessed here as Data Deficient.

Refs: 42, 74, 77, 99, 133, 208, 222

***Carpinus polyneura*** var. ***sunpanensis***

(K.C.Hsia) P.C.Li

**DD**

China (Sichuan)

Restricted to North Sichuan, this tree grows up to 10 m in height and is found in temperate broad-leaved forests.

There is limited information available about this taxon and further research is required. It is assessed here as Data Deficient.

Refs: 74, 133, 208

***Carpinus polyneura*** var. ***tsunyiensis***

(Hu) P.C.Li

**DD**

China (Guizhou)

Found only in Guizhou. A tree to 7 m in height, it is found growing in mountainous mixed forest. There is limited information available about this taxon and further research is required. It is assessed here as Data Deficient.

Refs: 74, 133, 208

***Carpinus pubescens*** Burkill

China (Guizhou, Hubei?, Shaanxi, Sichuan, Yunnan: Mile Xian), N Vietnam  
Assessed as Least Concern on the Chinese Red List.

Refs: 42, 74, 75, 77, 99, 133, 208

***Carpinus rankanensis*** Hayata

*Taxonomic note: The two varieties (C. rankanensis var. rankanensis and C. rankanensis var. matsudae) are not recognised in the most recent taxonomic treatment.*

Province of China (Taiwan)

Reported to be common across its range, with a large population and no known threats. The two varieties are assessed as Least Concern on the Chinese Red List.

Refs: 42, 74, 77, 91, 94, 96, 99, 120, 133, 208

***Carpinus rupestris*** A.Camus

China (W Guangxi, SW Guizhou: Xingyi Xian, SE Yunnan)

Assessed as Least Concern on the Chinese Red List.

Refs: 42, 74, 99, 133, 208

***Carpinus shensiensis*** Hu

China (S Gansu, S Shaanxi: Nanwutai)

Assessed as Least Concern on the Chinese Red List.

Refs: 42, 74, 77, 99, 133, 208

***Carpinus tropicalis*** (Donn.Sm.) Lundell

*Taxonomic note: There is some confusion over the naming of this species. It is sometimes referred to as C. caroliniana.*

El Salvador, Guatemala, Honduras, Mexico (Chiapas, Guerrero, Hidalgo, Jalisco, México State, Michoacán, Morelos, Nayarit, Nuevo León, Oaxaca, Puebla, San Luis Potosí, Sinaloa, Tamaulipas, Veracruz), Nicaragua

Refs: 10, 17, 29, 44, 65, 73, 74, 130, 133, 145, 164, 187, 188, 208

Assessor: Stritch, L.

***Carpinus tropicalis*** subsp. ***tropicalis***

El Salvador, Guatemala, Honduras, Mexico (Chiapas, Guerrero, Hidalgo, Jalisco, Oaxaca, San Luis Potosí, Sinaloa, Veracruz), Nicaragua

Refs: 17, 66, 74, 133, 164

The parent species is reported to be Near Threatened within Mexico, however it is assessed globally as Least Concern as it is not considered threatened in other parts of its range. *C. tropicalis* subsp. *tropicalis* has a smaller distribution in Mexico and its distribution outside of Mexico aligns with the parent species. Neither are considered to meet thresholds to be considered threatened at present, but deforestation of cloud forest habitat poses a threat and therefore a reassessment is recommended in 10 years for both the parent species and *C. tropicalis* subsp. *tropicalis*.

***Carpinus tropicalis*** subsp. ***mexicana***

Furlow

**DD**

Mexico (Hidalgo, Jalisco, México State, Michoacán, Morelos, Nayarit, Nuevo León, Puebla, San Luis Potosí, Tamaulipas, Veracruz)

This subspecies is endemic to Mexico and occurs in the mountains and the trans-Mexican volcanic belt. It is found on moist slopes and canyons in cloud forest. The wood is collected for firewood and coal. This taxon is potentially threatened but further field research is needed to determine its conservation status. It is therefore assessed here as Data Deficient.

Refs: 17, 74, 133, 164

***Carpinus tsaiiana*** Hu

China (SW Guizhou, SE Yunnan: Pingbian Miaozi Sishixian)

Assessed as Least Concern on the Chinese Red List.

Refs: 42, 74, 99, 133, 208

***Carpinus tschonoskii*** Maxim.

China (Anhui, Guangxi, Guizhou, W Henan, Hubei, Hunan, Jiangsu, Jiangxi, Sichuan, Yunnan, Zhejiang), Democratic People's Republic of Korea, Japan (Honshu, Shikoku), Republic of Korea

Assessed as Least Concern on the Chinese Red List.  
Refs: 42, 74, 99, 133, 136, 154, 159, 174, 208, 222

***Carpinus turczaninowii*** Hance

China (Beijing: Jinshan, S Gansu, Henan, Jiangsu, S Liaoning, Shaanxi, Shandong), Democratic People's Republic of Korea, Japan (Honshu, Kyushu, Shikoku), Republic of Korea

Assessed as Least Concern on the Chinese Red List.  
Refs: 42, 74, 77, 99, 133, 136, 154, 159, 208, 222

***Carpinus viminea*** Wall. ex Lindl.

Bangladesh, Bhutan, China (Anhui, Fujian, N Guangdong, Guangxi, Guizhou, Hubei, Hunan, Jiangsu, Jiangxi, Sichuan, Xizang, Yunnan, Zhejiang), India (Arunachal Pradesh, Assam, Darjiling, Himachal Pradesh, Jammu-Kashmir, Manipur, Meghalaya, Mizoram, Nagaland, Sikkim, Tripura, Uttaranchal), Myanmar, Nepal, Thailand, Vietnam

Refs: 41, 42, 68, 74, 75, 77, 99, 133, 208, 222, 234

***Corylus americana*** Walter

Canada (Manitoba, Ontario, Quebec, Saskatchewan), United States (Alabama, Arkansas, Connecticut, Delaware, District of Columbia, Georgia, Illinois, Indiana, Iowa, Kansas, Kentucky, Louisiana, Maine, Maryland, Massachusetts, Michigan, Minnesota, Mississippi, Missouri, Nebraska, New Hampshire, New Jersey, New York, North Carolina, Ohio, Oklahoma, Pennsylvania, Rhode Island, South Carolina, South Dakota, Tennessee, Vermont, Virginia, West Virginia, Wisconsin)

This species is ranked G5 (Secure) on NatureServe (ref 143).

Refs: 43, 44, 74, 81, 133, 135, 143, 172, 202, 208, 217, 222, 223, 224, 233, 237

Assessor: Stritch, L.

***Corylus avellana*** L.***Corylus avellana*** var. *avellana*

Albania, Armenia, Austria, Azerbaijan, Belarus, Belgium, Bosnia and Herzegovina, Bulgaria, Croatia, Czech Republic, Denmark, Estonia, Faroe Islands?, Finland, France (inc. Corsica), Georgia, Germany, Greece (inc. East Aegean Islands?, Kriti?), Hungary, Islamic Republic of Iran, Iraq?, Italy (inc. Sardegna, Sicilia), Latvia, Liechtenstein, Lithuania, Luxembourg, Moldova, Montenegro, Netherlands, Norway, Poland, Portugal, Romania, Russian Federation (European Russia: Central European Russia, Chechnya, Dagestan, East European Russia, Ingushetiya, Kabardino-Balkariya, Karachaevo-Cherkessiya, Krasnodar, North European Russia, Northwest European Russia, Severo-Osetiya, South European Russia, Stavropol), Serbia, Slovakia, Slovenia, Spain, Sweden, Switzerland, The Former Yugoslav Republic of Macedonia, Turkey in Asia, Ukraine (inc. Krym), United Kingdom (Great Britain, Northern Ireland) (The species and type subspecies share the same distribution).

Refs: 1, 4, 15, 19, 20, 23, 30, 36, 71, 74, 85, 102, 110, 116, 131, 133, 136, 138, 146, 149, 158, 170, 177, 189, 203, 204, 208, 222, 249

***Corylus avellana*** var. *pontica* (K.Koch) H.J.P.Winkl.**DD**

Greece (East Aegean Islands?), Russian Federation (European Russia: Chechnya, Dagestan, Ingushetiya, Kabardino-Balkariya, Karachaevo-Cherkessiya, Krasnodar, Severo-Osetiya, Stavropol), Turkey in Asia.

This lesser known variety is found growing in deciduous scrub and forest. It produces edible nuts which are often harvested from the wild and sold at local markets. There is little information available about this species. Over exploitation could present a threat to this species. It is assessed here as Data Deficient.

Refs: 74, 85, 133, 158, 203, 208

***Corylus chinensis*** Franch.

*Corylus chinensis*

China (Gansu, Guizhou, Henan?, Hubei, Hunan?, Shaanxi, SW Sichuan, Xizang, NW Yunnan)

This species was assessed as Endangered (EN) in the 1998 World List of Threatened Trees, but has a fairly wide distribution and is assessed as Least Concern on the Chinese Red List. Declines have been witnessed due to deforestation, but the local assessment as Least Concern implies these threats are not large enough for this species to qualify in a threat category.

Refs: 42, 74, 99, 121, 133, 190, 208, 222

***Corylus colurna*** L.

Albania, Azerbaijan, Bosnia and Herzegovina, Bulgaria, Croatia?, Georgia, Greece, Islamic Republic of Iran, Montenegro, Romania, Russian Federation (European Russia: Chechnya, Dagestan, Ingushetiya, Kabardino-Balkariya, Karachaevo-Cherkessiya, Krasnodar, Severo-Osetiya,



*Corylus colurna* at the Royal Botanic Gardens, Kew, Millennium Seed Bank

Stavropol), Serbia, The Former Yugoslav Republic of Macedonia, Turkey in Asia, Turkey in Europe

Refs: 15, 30, 45, 71, 74, 114, 133, 136, 177, 197, 204, 208, 222, 249

***Corylus cornuta*** Marshall

Canada (Alberta, British Columbia, Labrador, Manitoba, New Brunswick, Newfoundland, Nova Scotia, Ontario, Prince Edward Island, Quebec, Saskatchewan), Saint Pierre and Miquelon, United States (Alabama, California, Colorado, Connecticut, Delaware?, Georgia, Idaho, Illinois, Iowa, Kentucky, Maine, Maryland, Massachusetts, Michigan, Minnesota, Montana, New Hampshire, New Jersey, New York, North Carolina, North Dakota, Ohio, Oregon, Pennsylvania, Rhode Island, South Carolina, South Dakota, Tennessee, Vermont, Virginia, Washington, West Virginia, Wisconsin, Wyoming)

This species is ranked G5 (Secure) on NatureServe.

Refs: 44, 74, 81, 133, 135, 143, 172, 182, 202, 208, 217, 222, 223, 224, 233, 237

***Corylus cornuta*** subsp. *cornuta*

Canada (Alberta, British Columbia, Labrador, Manitoba, New Brunswick, Newfoundland, Nova Scotia, Ontario, Prince Edward Island, Quebec, Saskatchewan), Saint Pierre and Miquelon, United States (Alabama, Colorado, Connecticut, Delaware?, Georgia, Idaho, Illinois, Iowa, Maine, Maryland, Massachusetts, Michigan, Minnesota, Montana, New Hampshire, New Jersey, New York, North Carolina, North Dakota, Ohio, Pennsylvania, Rhode Island,

South Carolina, South Dakota, Tennessee, Vermont, Virginia, West Virginia, Washington, Wisconsin, Wyoming)  
This species is ranked G5T5 (Secure) on NatureServe.

Refs: 44, 74, 81, 133, 135, 143, 172, 202, 224, 233, 237

***Corylus cornuta*** subsp. ***californica*** (A.DC.) A.E.Murray

*Taxonomic note:* This subspecies is most often treated as a variety of the northern *C. cornuta*. The two taxa may not be very closely related, differing conspicuously in appearance, habitat, phytogeography and various other features. A thorough taxonomic study of this group should be undertaken.

Canada (British Columbia), United States (California, Oregon, Washington)  
This species is ranked G5T5 (Secure, inexact numeric rank) on NatureServe.

Refs: 44, 74, 133, 143, 182, 208, 217, 223, 224, 233

Assessor: Stritch, L.

***Corylus fargesii*** (Franch.) C.K.Schneid.

China (S Gansu, Guizhou, Henan, Hubei, Hunan, Jiangxi, S Ningxia, Shaanxi, NE Sichuan: Chengkou Xian)  
Assessed as Least Concern on the Chinese Red List.

Refs: 42, 74, 77, 99, 133, 208, 222

***Corylus ferox*** Wall.

Bhutan, China (SE Gansu, Guizhou, W Hubei, Ningxia, Shaanxi, E and SW Sichuan, Xizang, Yunnan), India (Arunachal Pradesh, Assam, Darjiling, Manipur, Meghalaya, Mizoram, Nagaland, Sikkim, Tripura), Myanmar, Nepal  
Refs: 41, 42, 74, 75, 99, 125, 133, 151, 208, 222

***Corylus ferox*** var. ***ferox***

Bhutan, China (Guizhou: Fanjiang Shan, SW Sichuan, NW and W Yunnan), India (Arunachal Pradesh, Assam, Darjiling, Manipur, Meghalaya, Mizoram, Nagaland, Sikkim, Tripura), Myanmar, Nepal  
Refs: 42, 74, 99, 133, 208, 222

***Corylus ferox*** var. ***tibetica*** (Batalin)

Franch.  
China (SE Gansu, Guizhou, W Hubei, Ningxia, Shaanxi, E Sichuan, Xizang, Yunnan)  
Assessed as Least Concern on the Chinese Red List.  
Refs: 42, 74, 75, 99, 133, 208, 222

***Corylus heterophylla*** Fisch. ex Trautv.  
China (Anhui, E and S Gansu, Guizhou, Hebei, Heilongjiang, Henan, Hubei, Hunan, Jiangsu, Jiangxi, Jilin, Liaoning, E Nei Mongol, Ningxia, Shaanxi, Shandong, Shanxi, NE Sichuan, Zhejiang), Democratic People's Republic of Korea, Japan (Hokkaido, Honshu, Kyushu), Republic of Korea, Russian Federation (Central Asian Russia: Amur, Chita, Khabarovsk, Primoryi), E Mongolia?  
Refs: 42, 74, 75, 99, 113, 133, 154, 159, 208, 222

***Corylus heterophylla*** var. ***heterophylla***

China (E Gansu, Hebei, Heilongjiang: Dailling, Daxinganling, Henan, Jilin: Changbai Shan, Liaoning, E Nei Mongol, Ningxia: Liupan Shan, Shanxi), Democratic People's Republic of Korea, Japan (Hokkaido, Honshu, Kyushu), Republic of Korea, Russian Federation (Amur, Chita, Khabarovsk, Primoryi), E Mongolia?  
Refs: 42, 74, 99, 133, 222

***Corylus heterophylla*** var. ***sutchuenensis*** Franch.

China (Anhui, S Gansu, Guizhou, Henan, Hubei, Hunan, Jiangsu, Jiangxi, Shaanxi, Shandong, NE Sichuan: Chengkou Xian, Zhejiang)  
Refs: 42, 74, 75, 99, 133, 208, 222

***Corylus maxima*** Mill.

Croatia, Greece?, Serbia, Slovenia  
Refs: 30, 74, 133, 136, 177, 208, 249

***Corylus sieboldiana*** Blume

China (Gansu, Hebei, Heilongjiang, Henan, Jilin, Liaoning, Nei Mongol, Shaanxi, Sichuan), Democratic People's Republic of Korea, Japan (Hokkaido, Honshu), Republic of Korea, Russian Federation (Central Asian Russia: Amur, Chita, Primoryi; European Russia: Khabarovsk)  
Refs: 74, 113, 133, 154, 208, 222

***Corylus sieboldiana*** var. ***sieboldiana*** DD

Democratic People's Republic of Korea?, Japan (Hokkaido, Honshu, Kyushu, Shikoko)  
This taxon has a small reported distribution. There is limited information available about this taxon and further research is required. It is assessed here as Data Deficient.  
Refs: 74, 133, 159, 208, 222

***Corylus sieboldiana*** var. ***mandshurica*** (Maxim.) C.K.Schneid.



*Corylus sieboldiana* var. *mandshurica*



*Corylus sieboldiana* var. *mandshurica*

China (E Gansu, Hebei, Heilongjiang, Henan, Jilin, Liaoning, Nei Mongol, Shaanxi, E and N Sichuan), Democratic People's Republic of Korea, Japan (Hokkaido, Honshu), Republic of Korea, Russian Federation (Amur, Chita, Khabarovsk, Primoryi)

This taxon has a wide distribution, however it would benefit from further research to verify population status. Its nuts are edible and therefore over-exploitation could be a risk.

Refs: 74, 133, 154, 159, 208, 222

***Corylus wulingensis*** Q.X.Liu &

C.M.Zhang  
China (Hunan)  
Assessed as Least Concern on the Chinese Red List.  
Refs: 74, 99, 133, 208

***Corylus yunnanensis*** (Franch.)

A.Camus  
China (W Guizhou, Hubei, SE and W Sichuan, W Yunnan: Dali Xian)  
Assessed as Least Concern on the Chinese Red List.  
Refs: 42, 56, 74, 75, 99, 107, 133, 208, 222



***Ostrya carpinifolia*** Scop.



*Ostrya carpinifolia*

Albania, Austria, Azerbaijan, Bosnia and Herzegovina, Bulgaria, Croatia, France (inc. Corsica), Georgia, Greece, Hungary?, Italy (inc. Sardinia, Sicilia), Lebanon, Montenegro, Russian Federation (European Russia: Chechnya, Dagestan, Ingushetiya, Kabardino-Balkariya, Karachaevo-Cherkessiya, Krasnodar, Severo-Osetiya, Stavropol), Serbia, Slovenia, Switzerland, Syrian Arab Republic, The Former Yugoslav Republic of Macedonia, Turkey in Asia, Turkey in Europe  
*Refs:* 20, 30, 71, 74, 102, 110, 111, 133, 170, 208, 222, 249

***Ostrya japonica*** Sarg.



*Ostrya japonica*

China (S Gansu, Hebei, Henan, Hubei, Shaanxi, W Sichuan), Democratic People's Republic of Korea, Japan (Hokkaido, Honshu, Kyushu, Shikoku), Republic of Korea  
*Refs:* 42, 74, 99, 133, 154, 159, 208, 222, 224

***Ostrya knowltonii*** Sarg.

United States (Arizona, New Mexico, Texas, Utah)  
 This species is ranked G3G4 (Vulnerable/Apparently Secure) on NatureServe (ref 143).  
*Refs:* 13, 14, 44, 74, 133, 143, 150, 166, 208, 214, 217, 224, 240  
 Assessor: Stritch, L.

***Ostrya multinervis*** Rehder

China (Guizhou, S Hunan: Xinning Xian and Junyan Shan, Jiangsu, SE Sichuan, Zhejiang)  
*Refs:* 42, 74, 99, 133, 208

***Ostrya trichocarpa*** D.Fang &

Y.S.Wang  
 China (SW Guangxi)  
 Assessed as Least Concern on the Chinese Red List.  
*Refs:* 42, 74, 99, 133, 208

***Ostrya virginiana*** (Mill.) K.Koch



*Ostrya virginiana*

*Taxonomic note:* There continues to be some debate on the acceptance of subspecific taxa of this species. It has been reported that *Ostrya virginiana* is Near Threatened in *The Red List of Mexican Cloud Forest Trees*, however it is thought that this assessment refers to *O. virginiana* subsp. *guatemalensis* that occurs in cloud forests from southern Mexico into Guatemala, El Salvador and Honduras.

Canada (Manitoba, New Brunswick, Nova Scotia, S Ontario, S Quebec), El Salvador, Guatemala, Honduras, Mexico (Chiapas, Chihuahua?, Durango, Guerrero, Hidalgo, Jalisco, México State, Michoacán?, Nayarit, Neuvo León?, Oaxaca, Puebla, Queretaro?, San Luis Potosí?, Sinaloa, Sonora,

Tamaulipas, Veracruz), United States (Alabama, Arkansas, Connecticut, Delaware, District of Columbia, Florida, Georgia, Illinois, Indiana, Iowa, Kansas, Kentucky, Louisiana, Maine, Maryland, Massachusetts, Michigan, Minnesota, Mississippi, Missouri, Nebraska, New Hampshire, New Jersey, New York, North Carolina, North Dakota, Ohio, Oklahoma, Pennsylvania, Rhode Island, South Carolina, South Dakota, Tennessee, Texas, Vermont, Virginia, West Virginia, Wisconsin, Wyoming)  
 This species is ranked G5 (Secure) on NatureServe .

*Refs:* 10, 16, 29, 43, 44, 59, 73, 74, 90, 130, 133, 135, 143, 145, 172, 187, 188, 198, 202, 208, 217, 222, 223, 224, 233, 237

***Ostrya virginiana*** subsp. ***virginiana***

Canada (Manitoba, New Brunswick, Nova Scotia, Ontario, Prince Edward Island, Quebec), United States (Alabama, Arkansas, Connecticut, Delaware, District of Columbia, Florida, Georgia, Illinois, Indiana, Iowa, Kansas, Kentucky, Louisiana, Maine, Maryland, Massachusetts, Michigan, Minnesota, Mississippi, Missouri, Nebraska, New Hampshire, New Jersey, New York, North Carolina, North Dakota, Ohio, Oklahoma, Pennsylvania, Rhode Island, South Carolina, South Dakota, Tennessee, Texas, Vermont, Virginia, West Virginia, Wisconsin, Wyoming)  
 This taxon is ranked G5T5 (Secure) on NatureServe.

*Refs:* 16, 29, 73, 74, 133, 135, 143, 172, 202, 217, 233, 237

***Ostrya virginiana*** subsp. ***guatemalensis*** (H.J.P.Winkl.) A.E.Murray

El Salvador, Guatemala, Honduras, Mexico (Chiapas, Guerrero, Oaxaca, Veracruz)  
*Refs:* 10, 29, 44, 73, 74, 130, 133, 145, 187, 188, 198, 208  
 Assessor: Stritch, L.

***Ostryopsis davidiana*** Decne.

China (Gansu, Hebei, Liaoning, Nei Mongol, Ningxia, Shaanxi, W Sichuan)  
*Refs:* 42, 74, 99, 133, 168, 208, 222

## REFERENCES

1. **Adnan, S.M., Khan, A.A., Latif, A., & Shiwari, Z.K. (2006)** Threats to the sustainability of Ethno-Medicinal uses in Northern Pakistan (A Case Study of Miandam Valley, District Swat, NWFP Province, Pakistan). *Lyonia* **11**: 91–100
2. **Alam, M. (2011)** *Trees and Shrubs of Afghanistan: A Dendrological Guide*. Rossolis, Switzerland
3. **Ambrish, K. (2013)** *Floristic Diversity of Arunachal Pradesh*. Bishen Singh Mahendra Pal Singh, Dehra Dun
4. **Artsdatabanken (2010)** *Red List Database (Informasjon om rødlistede arter er nå i Artsportalen)*. Artsdatabanken, Trondheim
5. **Ashburner, K. & McAllister, H.A. (2013)** *The Genus Betula: A Taxonomic Revision of Birches*. Kew Publishing, Kew
6. **Barnes, B.V. & Dancik, B.P. (1985)** Characteristics and origin of a new birch species, *Betula murrayana* from southeastern Michigan. *Canadian Journal of Botany* **63**: 223–226
7. **Bartlett, P. & Khutsishvili, M. (2014)** *Identifying wild populations of rare Birch in Georgia*, Stone Lane Gardens
8. **Bartlett, P. (2012)** *Plant study expedition to Georgia Caucasus*. Accessed: November 2013, <http://stonelanegardens.com/wp-content/static/2012/08/Summary-of-2012-Plant-study-expedition-to-Georgia-website-version.pdf>
9. **Bartlett, P. (2013)** *Searching for birches*. Accessed: December 2013, <http://www.rhs.org.uk/Plants/RHS-Publications/Journals/The-Plantsman/2013-issues/June/Searching-for-birches>
10. **Berendsohn, W.G., Gruber, A.K. & Salomon, J.M. (2009)** Listado de árboles de El Salvador In. Nova silva cuscatlanica. Árboles navitos e introducidos de El Salvador. Parte 1: Angiospermae–Familias A–L. *Englera* **29**: 17–225
11. **BGCI (2014)** *PlantSearch online database*. Accessed: 2014, [www.bgci.org/plant\\_search.php](http://www.bgci.org/plant_search.php)
12. **Botanical Society of the British Isles and the Biological Records Centre (2012)** *Online Atlas of the British and Irish Flora*. Accessed: November 2013, <http://www.brc.ac.uk/plantatlas/>
13. **Brasher, J.W. (2001)** Vascular Plants of Arizona: Betulaceae. *Journal of the Arizona–Nevada Academy of Science* **33**: 1–8
14. **Brian, N.J. & Spamer, E.E. (2000)** Knowlton Hop-Hornbeam Revisited (*Ostrya knowltonii* Cov.). *Bartonia* **60**: 49–56
15. **Browicz, K. (1972)** *flora des Iranischen Hochlandes und der Umrahmenden Gebirge: Persien, Afghanistan, Teile von West-Pakistan, Nord-Iraq, Azerbaidjan, Turkmenistan. Lfg. no. 96, Betulaceae*. Akademische Druck- u. Verlagsanstalt, Graz
16. **Burns, R.M. & Honkala, B.H. (1990)** *Silvics of North America*. USDA, Forest Service, Washington
17. **Carranza, E.G & Madrigal, X.S. (1995)** *Flora del Bajío de Regiones Adyacentes: Betulaceae*. Accessed: December 2013, [http://www1.inecol.edu.mx/publicaciones/resumeness/FLOBA/Flora\\_39.pdf](http://www1.inecol.edu.mx/publicaciones/resumeness/FLOBA/Flora_39.pdf)
18. **Catalogue des Milieux Naturels (2013)** *Flore et végétation de la France*. Accessed: December 2013, <http://philippe.julve.pagesperso-orange.fr/catminat.htm>
19. **Cheffings, C.M. & Farrell, L. (eds.) (2005)** *The vascular plant Red Data List for Great Britain*. Joint Nature Conservation Committee, Peterborough
20. **Chiappini, M. (1985)** *Guida alla flora pratica della Sardegna*. C. Delfino, Italy
21. **Chowdhery, H.J. & Wadhwa, B.M. (1984)** *Flora of Himachal Pradesh*. Botanical Survey of India, New Delhi
22. **Cinovskis, R.E. (1983)** *Konspekt dendroflory Kaliningradskoī oblasti*. Akademiā nauk Latviškoī SSR. Botanicheskiī sad, Latvia
23. **Colling, G. (2005)** *Red List of the Vascular Plants of Luxembourg*. Ferrantia 42, Luxembourg
24. **CONABIO (Comision Nacional para el conocimiento y uso de la Biodiversidad) (2013)** *Alnus acuminata*. Accessed: 12th July 2013, [http://www.conabio.gob.mx/conocimiento/info\\_especies/arboles/doctos/9-betul1m.pdf](http://www.conabio.gob.mx/conocimiento/info_especies/arboles/doctos/9-betul1m.pdf)
25. **Conservation International (2013)** *Mountains of Southwest China*. Accessed: January 2014, [http://www.conservation.org/where/priority\\_areas/hotspots/asia-pacific/Mountains-of-Southwest-China/Pages/default.aspx](http://www.conservation.org/where/priority_areas/hotspots/asia-pacific/Mountains-of-Southwest-China/Pages/default.aspx)

26. **Cordero, J & Boshier, D.H. (2003)** *Árboles de Centroamérica: Alnus acuminata*. Accessed: October 2013, [http://herbaria.plants.ox.ac.uk/adc/downloads/capitulos\\_especies\\_y\\_anexos/alnus\\_acuminata.pdf](http://herbaria.plants.ox.ac.uk/adc/downloads/capitulos_especies_y_anexos/alnus_acuminata.pdf)
27. **Correll, D.S. & Johnston, M.C. (1979)** *Manual of the Vascular Plants of Texas*. University of Texas Printing Division, Texas
28. **Dar, G.H., & Khuroo, A.A. (2013)** Floristic diversity in the Kashmir Himalaya: progress, problems and prospects. *Sains Malaysiana* **42**: 1377–1386
29. **Davidse, G., Sousa, M.S., Knapp, S., & Chiang F.C. (Eds.) (2009+)** Flora Mesoamericana (Online). National Autonomous University of Mexico. Available: <http://www.tropicos.org/Reference/1031867?projectid=3&langid=66>
30. **Davis, P.H. (ed.) (1965–1988)** *Flora of Turkey and the East Aegean Islands (Vols I-X)*. Edinburgh University Press, Edinburgh
31. **De Groot, W.J., Thomas, P.A. & Wein, R.W. (1997)** *Betula nana* L. and *Betula glandulosa* Michx. *Journal of Ecology* **85**: 241–264
32. **De la Cruz, H., Vilcapoma, G. & Zevallos, P.A. (2007)** Ethnobotanical study of medicinal plants used by the Andean people of Canta, Lima, Peru. *Journal of Ethnopharmacology* **111**: 284–294
33. **Del Valle Arango, J.I. & Perez, H.G. (1988)** Rendimiento y crecimiento del cerezo (*Alnus jorullensis*) en la region Central Andina, Columbia. *Revista Facultad Nal de Agronomia* **16**: 61–91
34. **Department of Agriculture, Forest Service, Rocky Mountain Research Station (1985)** *Field Guide to Forest Plants of Northern Idaho*. Accessed: October 2013, [http://www.fs.fed.us/rm/pubs/int/int\\_gtr180.pdf](http://www.fs.fed.us/rm/pubs/int/int_gtr180.pdf)
35. **Department of Agriculture, Forest Service, Rocky Mountain Research Station (2001)** *Riparian and Wetland Plant Community Types of the Shoshone National Forest*. Accessed: October 2013, [http://www.fs.fed.us/rm/pubs/rmrs\\_gtr085.pdf](http://www.fs.fed.us/rm/pubs/rmrs_gtr085.pdf)
36. **Department of Plant Pathology and Plant-Microbe Biology Cornell University (2002)** *Eastern Filbert Blight*. Accessed: January 2013, <http://plantclinic.cornell.edu/factsheets/filbertblight.pdf>
37. **Dobremez, J.F., Shakya, P.R., Camaret, S., Vigny, F. & Eynard-Machet, R. (1967–2009)** *Flora Himalaya Database*. Accessed: March 2014, <http://www.leca.univ-savoie.fr/db/florhy/>
38. **Duncan, W.H. and Duncan, M.B. (2000)** *Trees of the Southeastern United States*. University of Georgia Press, Georgia
39. **Eastwood, A., Lazkov, G., & Newton, A. (2009)** *The Red List of Trees of Central Asia*. FFI, BGCI, GTC, IUCN/SSC, Cambridge
40. **eBiodiversity Estonia (2012)** *Estonian Red List of Threatened Species*. Accessed: December 2013, <http://elurikkus.ut.ee/index.php?lang=eng>
41. **efloras (2000)** *Annotated Checklist of the Flowering Plants of Nepal*. Accessed: October 2013, [http://www.efloras.org/flora\\_page.aspx?flora\\_id=110](http://www.efloras.org/flora_page.aspx?flora_id=110)
42. **efloras (2008)** *Flora of China*. Accessed: October 2013, [http://www.efloras.org/flora\\_page.aspx?flora\\_id=2](http://www.efloras.org/flora_page.aspx?flora_id=2)
43. **efloras (2008)** *Flora of Missouri*. Accessed: October 2013, [http://www.efloras.org/flora\\_page.aspx?flora\\_id=11](http://www.efloras.org/flora_page.aspx?flora_id=11)
44. **efloras (2008)** *Flora of North America*. Accessed: October 2013, [http://www.efloras.org/flora\\_page.aspx?flora\\_id=1](http://www.efloras.org/flora_page.aspx?flora_id=1)
45. **efloras (2010)** *Flora of Pakistan*. Accessed: October 2013, [http://www.efloras.org/flora\\_page.aspx?flora\\_id=5](http://www.efloras.org/flora_page.aspx?flora_id=5)
46. **Ekim, T. (1989)** *List of Rare, Threatened and Endemic Plants in Turkey*. Turkish Association for Conservation of Nature and Natural Resources, Turkey
47. **Ekim, T., Koyuncu, M., Vural, M., Duman, H., Aytaç, Z. & Adigüzel, N. (2000)** *Red Data Book of Turkish Plants (Pteridophyta and Spermatophyta)*. Turkish Association for the Conservation of Nature and Van Centennial University, Ankara
48. **Elven, R. (ed.) (2007)** *Checklist of the Panarctic Flora (PAF) Vascular Plants*. Accessed: December 2013, <http://www.nhm2.uio.no/paf/>
49. **Environment and Natural Resources, Government of Northwest Territories** *Dwarf Birch–Betula glandulosa*. Accessed: October 2013, [http://www.enr.gov.nt.ca/\\_live/documents/content/Dwarf\\_Birch.pdf](http://www.enr.gov.nt.ca/_live/documents/content/Dwarf_Birch.pdf)



50. **Environment and Natural Resources, Government of Northwest Territories** *Paper Birch—Betula papyrifera*. Accessed: July 2013, [http://www.enr.gov.nt.ca/\\_live/documents/content/Paper\\_Birch.pdf](http://www.enr.gov.nt.ca/_live/documents/content/Paper_Birch.pdf)
51. **Erdman, G.G. (1990)** *Betula in U.S. Department of Agriculture Handbook 654*. U.S. Department of Agriculture, Forest Service, Washington
52. **Eristavi, M., Shulkina, T., Sikhuralidze, S., Asieshvili, L.** *Rare, Endangered and Vulnerable Plants of the Republic of Georgia*. Accessed: January 2014, <http://www.mobot.org/MOBOT/research/georgia/welcome.shtml>
53. **Euro+Med (2006)** *Euro+Med PlantBase—the information resource for Euro-Mediterranean plant diversity*. Accessed: August 2013, <http://ww2.bgbm.org/EuroPlusMed/>
54. **European Commission for Europe (1991)** *European Red List of Globally Threatened Animals and Plants*. United Nations, New York
55. **Eyre, F.H. (1980)** *Forest cover types of the United States and Canada*. Society of American Foresters, Washington
56. **Feng, Z.Z., Yang, S.Z., & Wang, D.M. (1998)** *Rare trees in Yunnan Province*. Esperanto Press, Beijing
57. **Fernard, D. (2010)** Expansion of green alder (*Alnus alnobetula*) in the northern French Alps: A palaeoecological point of view. *Complete Rendus Biologies* **333**: 424–428
58. **Flora Argentina (2012)** *Plantas vasculares de la República Argentina*. Accessed: February 2014, <http://www.floraargentina.edu.ar/>
59. **Fonseca, M. & Velazquez, E. (1998)** *Flora de Guerrero No.7—Betulaceae*. Facultad de Ciencias, UNAM, Mexico
60. **Forest, Farm and Community Tree Network (FACT Net) (2003)** *FACT Sheets*. Accessed: December 2013, [http://factnet.winrock.org/fnrm/factnet/factpub/FACTSH/A\\_acuminata.html](http://factnet.winrock.org/fnrm/factnet/factpub/FACTSH/A_acuminata.html)
61. **Forestry Commission (2012)** *Silver birch—Betula pendula*. Accessed: December 2013, <http://www.forestry.gov.uk/forestry/inf-d-5nldxl>
62. **Forestry Commission (2014)** *Green Alder (Alnus viridis)*. Accessed: December 2013, <http://www.forestry.gov.uk/fr/INFD-8CVEAE>
63. **Frye, C. of Maryland Department of Natural Resources (2014)** Personal communication to authors
64. **Furlow, J.J. (1979)** The systematics of the American species of *Alnus* (Betulaceae). *Rhodora* **81**: 1–121
65. **Furlow, J.J. (1987)** The *Carpinus caroliniana* complex in North America. I. A multivariate analysis of geographical variation. *Systematic Botany* **12**: 21–40
66. **Furlow, J.J. (1997)** The *Carpinus caroliniana* complex in North America. II. Systematics. *Systematic Botany* **12**: 416–434
67. **Gamble, J.S. (1896)** *Trees, Shrubs and Large Climbers Found in the Darjeeling District, Bengal*. Presidency Jail Press, Calcutta
68. **Gaur, R.D (1999)** *Flora of the District Garhwal North West Himalaya*. TransMedia, New Delhi
69. **German Federal Agency for Nature Conservation (BfN) (2013)** *Medicinal and Aromatic Plants in Albania, Bosnia-Herzegovina, Bulgaria, Croatia and Romania*. Accessed: November 2013, <http://www.bfn.de/fileadmin/MDB/documents/skript91.pdf>
70. **Gibson, J.P., Rice, S.A., & Stucke, C.M. (2008)** Comparison of population genetic diversity between a rare, narrowly distributed species and a common, widespread species of *Alnus* (Betulaceae). *American Journal of Botany* **95**: 588–596
71. **Godet, J. (1988)** *Collins Photographic Key to the Trees of Britain and Northern Europe*. William Collins Sons & Co. Ltd, Frome
72. **Godfrey, R.K., & Wooten, J.W. (1981)** *Aquatic and Wetland Plants of Southeastern United States: Dicotyledons*. University of Georgia Press, Georgia
73. **González-Espinosa, M., Meave, J.A., Lorea-Hernandez, F.G., Ibarra-Manriquez, G. & Newton, A.C. (2011)** *The Red List of Mexican Cloud Forest Trees*. FFI & BGCI, UK
74. **Govaerts, R. (2013)** *The World Checklist of Selected Plant Families*. Accessed: 2013/2014, <http://www.kew.org/wcsp/>

75. **Grey-Wilson, C. & Cribb, P. (2011)** *Guide to the Flowers of Western China*. Kew Publishing, Kew
76. **Grierson, A.J.C. & Long, D.G. (1983)** *Flora of Bhutan: including a record of plants from Sikkim*. Royal Botanic Garden, Edinburgh
77. **Grimshaw, J. & Bayton, R. (2009)** *New Trees: Recent Introductions to Cultivation*. Kew Publishing, Kew
78. **Grulich, V. (2012)** Red List of vascular plants of the Czech Republic. *Preslia* **84**: 631–645
79. **Guangxi Institute of Botany, Chinese Academy of Sciences (2013)** *Carpinus luochengensis* JY Liang. Accessed: December 2013, [http://translate.google.co.uk/translate?hl=en&sl=zh-CN&u=http://flora.gxib.cn/node/13875&prev=/search%3Fq%3DCarpinus%2Bluochengensis%26start%3D20%26sa%3DN%26rlz%3D1C2AVSX\\_en-GBGB558GB558%26biw%3D1680%26bih%3D961](http://translate.google.co.uk/translate?hl=en&sl=zh-CN&u=http://flora.gxib.cn/node/13875&prev=/search%3Fq%3DCarpinus%2Bluochengensis%26start%3D20%26sa%3DN%26rlz%3D1C2AVSX_en-GBGB558GB558%26biw%3D1680%26bih%3D961)
80. **Güner, A., Özhatay, N., Ekim, T. & Başer, K.H.C. (2000)** *The Flora of Turkey and the East Aegean Islands. Supplement II*. Edinburgh University Press, Edinburgh
81. **Haines, A. (2011)** *Flora Novae Angliae: A Manual for the Identification of Native and Naturalized Higher Vascular Plants of New England*. Yale University Press, Connecticut
82. **Haivangang, B. (2011)** *The Battle between Formosan Alder and Leaf Beetle—Keeping Tabs on Formosan Alder in Tataka Area in Yushan National Park*. Accessed: February 2014, [http://np.cpami.gov.tw/english/index.php?option=com\\_mgzen&view=detail&catid=30&id=387&Itemid=67&limitstart=1](http://np.cpami.gov.tw/english/index.php?option=com_mgzen&view=detail&catid=30&id=387&Itemid=67&limitstart=1)
83. **Hajra, P.K., Verma, D.M. & Giri, G.S. (eds.) (1996)** *Materials for the Flora of Arunachal Pradesh*. Botanical Survey of India, Calcutta
84. **Hammond, G.B., Fernandez, I.D., Villegas, L.F. & Vaisberg, A.J. (1998)** A survey of traditional medicinal plants from the Callejob de Huaylas. *Journal of Ethnopharmacology* **61**: 17–30
85. **Hanelt, P., Büttner, P., Mansfeld, R. & Kilian, R. (2001)** *Mansfeld's Encyclopaedia of Agricultural and Horticultural Crops*. Springer, Germany
86. **Hansen, E.M. (2012)** *Phytophthora alni*. *Forest Phthyophthoras* **2**
87. **Hardy, C. & Sutherland, N. (2008)** *Catalogo de las Plantas Vasculares de Honduras*. Secretaría de Recursos Naturales y Ambiente (SERNA), Honduras
88. **Harrison, J.W. & Stango III, P. (2003)** Shrubland tidal wetland communities of Maryland's Eastern Shore: identification, assessment and monitoring. *Maryland Department of Natural Resources, Natural Heritage Program* (Unpublished report submitted to the Environmental Protection Agency)
89. **Hosie, R. (1979)** *Native Trees of Canada*. Fitzhenry & Whiteside Ltd., Ontario
90. **Hough, R.B., Leistikow, K.U. & Thus, H. (2007)** *The Woodbook: The Complete Plates*. Taschen Benedikt Verlag GmbH
91. **Hsu, R. Researcher at Taiwan Forestry Research Institute (2014)** Personal communication to authors
92. **Hu, H., Chen, H. & Hu, Ti. (2012)** Adaptability Comparison between the Seedlings of *Eucalyptus gradis* and *Alnus cremastogyne* under the Condition of Continuous Drought Stress. *Journal of Agricultural Science* **4**: 76–86
93. **Hua, Z. & Chun, Y.L. (2012)** *Native Seed Plants in Xishuangbanna of Yunnan (Chinese Edition)*. Science Press, China
94. **Huang, T.C. (1996)** *Flora of Taiwan*. Editorial Committee of the Flora of Taiwan, Taiwan
95. **Hulten, E. (1968)** *Flora of Alaska and Neighbouring Territories: A Manual of the Vascular Plants*. Stamford University Press, California
96. **Hunt, D. (1996)** *Temperate trees under threat..* Proceedings of an International Dendrological Society Symposium on the Conservation Status of Temperate Trees
97. **Ilinsky, W.V., Rebrikov, D.V. & Shipunov, A.B. (2007)** *Heterogeneity in northern Russian alders (Alnus Mill., Betulaceae): combined approach*. Accessed: December 2013, <http://ashipunov.info/shipunov/belomor/english/2007/alnus.htm>
98. **Institute de Botanique (2013)** *Tela Botanica*. Accessed: November 2013, <http://www.tela-botanica.org/bdtfx-nn-3307?langue=en>

99. **Institute of Botany, The Chinese Academy of Sciences (2014)** Chinese Red List of Biodiversity—the Volume of Higher Plants. Publication in preparation. List available online at: <http://www.zhb.gov.cn/gkml/hbb/bgg/201309/W020130917614244055331.pdf>
100. **IUCN (2013)** *Tianshan mountains in China become World Heritage Site*. Accessed: January 2014, <http://www.iucn.org/?uNewsID=13177>
101. **Jafari, S.M. & Akhani, H. (2008)** Plants of the Jahan Nama protected area, Golestan Province, N. Iran. *Pakistan Journal of Botany* **4**: 1533–1554
102. **Jeanmonod, D. (2013)** *Flora Corsica*, Société Botanique de Centre-Ouest. Nercillac, France
103. **Jones, J.M. (2013)** The strange range of seaside alder. *Arnoldia* **71** (2): 1–10
104. **Jones, J.M., & Gibson, J.P. (2011)** Population genetic diversity and structure within and among disjunct populations of *Alnus maritima* (seaside alder) using microsatellites. *Conservation Genetics* **12**: 1003–1013
105. **Jun, L., Jingmin, J., Yitai, C., Honggang, S. & Wenhao, S. (2011)** Germplasm and Conservation of Rare and Endangered Tree Species Endemic to East China. *International Union of Forest Research Organizations* **30**: 53–55
106. **Kadoorie Farm and Botanic Garden (2002)** *Report of Rapid Biodiversity Assessments at Wuzhishan Nature Reserve, Central Hainan, China, 1999 and 2001. South China Forest Biodiversity Survey Report Series (Online Simplified Version)*. Accessed: January 2014, [http://www.kfbg.org/content/36/13/1/E24\\_Wuzhishan\\_report\\_w.pdf](http://www.kfbg.org/content/36/13/1/E24_Wuzhishan_report_w.pdf)
107. **Kaiyun, G. (1998)** *Highland Flowers of Yunnan*. Yunnan Science & Technology Press, China
108. **Kamruzzahan, S. (2003)** Is *Alnus viridis* a Glacial Relict in the Black Forest? *Inaugural-Dissertation Zur Erlangung der Doktorwürde der Fakultät für Biologie der Albert-Ludwigs-Universität Freiburg im Breisgau, Universität Freiburg im Breisgau*
109. **Kazmierczakowa, R. & Zarzycki, K. (2001)** *Polska Czerwona Księga Roslin (Polish Red Data Book of Plants), ed. 2. Pteridophytes and Flowering Plants*. Botaniki im. W. Szafera, Polska Akademia Nauk, Krakow
110. **Kec'xoveli, N. & Dulukhanov, A.G. (1975)** *Flora Gruzii III*. Akademiya nauk gruzinskoi SSR, Institut Botaniki, Tbilisi, Georgia
111. **Király, G. (2007)** *Red List of the vascular flora of Hungary (Vörös Lista: A magyarországi edényes flóra veszélyeztetett fajai)*. Sajat kiadás, Sopron
112. **Knoke, T., Calvas, B., Aguirre, N., Román-Cuesta, R.M., Günter, S., Stimm, B., Weber, M. & Mosandl, R. (2009)** Can tropical farmers reconcile subsistence needs with forest conservation? *Frontiers in Ecology and the Environment* **7**: 548–554
113. **Kolbek, J., Kucera, M., Jarolimek, I. & Valachovic, M. (2001)** *Distribution and Phytocoenology of Selected Woody Species of North Korea (D.P.R.K.)*. Academy of Sciences of the Czech Republic, Czech Republic
114. **Krasnoborov, I.M. (1988)** *Volcznik (Volczejagodnik) altajskij [Red Data Book of Russian Federation Plants]*. Agropromizdat, Moscow
115. **Kullman, L. (1992)** The ecological status of grey alder (*Alnus incana* (L.) Moench) in the upper subalpine birch forest of the central Scandes. *New Phytology* **120**: 445–451
116. **Laasimer, L. (1993)** *Flora of the Baltic countries: compendium of vascular plants I*, Estonian Academy of Sciences. Institute of Zoology and Botany, Estonia
117. **Lægaard, S. (1999)** *Betulaceae*. In: P.M. Jorgensen & Leon-Yanez, S. (eds.), *Catalogue of the Vascular Plants of Ecuador*. Monographs in Systematic Botany from the Missouri Botanical Garden, Missouri
118. **Lanner, R.M. (1983)** *Trees of the Great Basin: A Natural History*. University of Nevada Press, Nevada
119. **Leopold, D.J., McComb, W.C. & Muller, R.M. (1998)** *Trees of the Central Hardwood Forests of North America: An Identification and Cultivation Guide*. Timber Press, Oregon
120. **Li, H.L. (1963)** *Woody Flora of Taiwan*. The Morris Arboretum and The Livingston Publishing Company, Pennsylvania
121. **Li-Kuo, F. & Jian-Ming, J. (1992)** *China Plant Red Data Book—Rare and Endangered Plants 1*. Science Press, Beijing



122. Liu, C. & Elvin, M. (eds.) (2013) *Man's impact on the himalayas*. In: *Sediments of time: environment and society in Chinese history*. Cambridge University Press, UK
123. López-Pujol, J. & Zhao, A.M. (2004) China: a rich flora needed of urgent conservation. *Orsis* **19**: 49–89
124. Lucas G.L. & Walters S.M. (1976) *List of rare, threatened and endemic plants for the countries of Europe*. IUCN, Royal Botanic Gardens, Kew
125. Manandhar, N.P. & Manandhar, S. (2002) *Plants and people of Nepal*. Timer Press Inc, Oregon
126. McAllister, H.A. & Ashburner, K. (2007) *Betula megrelica*, Betulaceae. *Curtis's Botanical Magazine* **24**: 174–179
127. McAllister, H.A. & Rushforth, K. (2011) *Betula ashburneri*, Betulaceae. *Curtis's Botanical Magazine* **28**: 111–118
128. McAllister, H.A. (2013) *Betula dahurica*: A Special Birch Tree. *Arnoldia: The Arnold Arboretum of Harvard University* **70**
129. McAvoy, W. of Delaware Department of Natural Resources and Environment (2014) Personal communication to authors
130. Ministerio de Medio Ambiente Y Recursos Naturales (2009) *Listado Oficial de Especies de Vida Silvestre Amenazadas o Peligro de Extinción*. Ministerio de Medio Ambiente Y Recursos Naturales, El Salvador
131. Ministry of Natural Resources and Environmental Protection of the Republic of Belarus (2003–2014) *Plants of Belarus*. Accessed: March 2014, <http://hbc.bas-net.by/plantae/eng/default.php>
132. Ministry of the Environment (2013) *Japan Integrated Biodiversity Information System*. Accessed: 4th December 2013, <http://www.biodic.go.jp/english/J-IBIS.html>
133. Missouri Botanical Garden (2013) *Tropicos*. Accessed: 2013/2014, [www.tropicos.org](http://www.tropicos.org)
134. Moffett, M. of Georgia Department of Natural Resources (2014) Personal communication to authors
135. Mohlenbrock, R. (2002) *Vascular flora of Illinois*. Southern Illinois University Press, Illinois
136. More, D. & White, J. (2013) *Illustrated Trees of Britain and Europe*. Cassell, London
137. Moreno, J.C. (2008) *Lista Roja 2008 de la Flora Vasculare Española. 2008 Red List of Spanish Vascular Flora*. Dirección General de Medio Natural y Política Forestal (Ministerio de Medio Ambiente, y Medio Rural y Marino, y Sociedad Española de Biología de la Conservación de Plantas), Madrid
138. Moser, D., Gygax, A., Bäumler, B., Wyler, N. & Palese, R. (2002) *Red List of the Threatened Ferns and Flowering Plants of Switzerland (Rote Liste der gefährdeten Farn- und Blütenpflanzen der Schweiz)*. Bundesamt für Umwelt, Wald und Landschaft, Bern; Zentrum des Datenverbundnetzes der Schweizer Flora, Chambésy; Conservatoire et Jardin botaniques de la Ville de Genève, Chambésy
139. Muséum national d'Histoire naturelle (2013) *Inventaire national du Patrimoine naturel*. Accessed: December 2013, [http://inpn.mnhn.fr/espece/cd\\_nom/131226](http://inpn.mnhn.fr/espece/cd_nom/131226)
140. Nahed, J., Sánchez, A., Grande, D. & Péres-Gil, F. (1998) Evaluation of promissory tree species for sheep feeding in The Highlands of Chiapas, Mexico. *Animal Feed Science and Technology* **73**: 59–69
141. National Museum of Nature and Science (2010) *Global Red List of Japanese threatened plants*. Accessed: December 2013, <http://www.kahaku.go.jp/english/research/db/botany/redlist/index.html>
142. National Research Council of Canada (2007) *Flora of the Canadian Arctic Archipelago: Descriptions, Illustrations, Identification, and Information Retrieval*. Accessed: August 2013, <http://nature.ca/aaflora/data>
143. NatureServe (2013) *NatureServe Explorer: An online encyclopaedia of life [web application]. Version 7.1*. Accessed: October 2013, <http://www.natureserve.org/explorer>
144. Nee, M. (1981) *Flora de Veracruz*. Instituto Nacional de Investigaciones sobre Recursos Bióticos, Veracruz
145. Nelson Sutherland, C.H. (2008) *Catálogo de las plantas vasculares de Honduras: espermatofitas*. Secretaría de Recursos Naturales y Ambiente, Honduras

146. **NERI (National Environmental Research Institute, Denmark) (2007)** *The Danish Red Data Book*. Danish Ministry of the Environment, Roskilde
147. **Nieto, V.M. & Rodriguez, J. (2002)** *Alnus jorrullensis* Kunth. in *Manual de Semillas de Arboles Tropicales*. Accessed: 14th August 2013, <http://www.rngr.net/publications/manual-de-semillas-de-arboles-tropicales/parte-ii>
148. **Nikolić, T. & Topić, J. (2005)** *Red Book of Vascular Flora of Croatia*. Ministry of Culture, State Institute for Nature Protection, Republic of Croatia
149. **Nimis, P.L., Leht, M., Martellos, S. & Moro, A. (2008)** *An interactive flora of Estonia*. Accessed: March 2014, [http://dbiodbs.univ.trieste.it/carso/chiavi\\_pub21?sc=368](http://dbiodbs.univ.trieste.it/carso/chiavi_pub21?sc=368)
150. **Notaro, M., Mauss, A. & Williams, J. (2012)** Projected vegetation changes for the American Southwest: combined dynamic modeling and bio-climatic envelope approach. *Ecological Applications* **22**: 1365–1388
151. **Ohashi, H. (1975)** *Flora of Eastern Himalaya*. University Museum, University of Tokyo, Tokyo
152. **Ohba, H. & Malla, S.B. (1991)** *The Himalayan Plants*. University of Tokyo Press, Tokyo
153. **Ohlemuller, R., Gritti, E., Sykes, M.T. & Thomas, C.D. (2006)** Quantifying components of risk for European woody species under climate change. *Global Change Biology* **12**: 1788–1799
154. **Ohwi, J. (ed.) (1965)** *Betulaceae*. In: *Flora of Japan*. Smithsonian Institution, US
155. **Oldfield, S., Lusty, C. & MacKinven, A. (1998)** *The World List of Threatened Trees*. World Conservation Press, Cambridge
156. **Olivier, L., Galland, J.P., Maurin, H. & Roux, J.P. (1995)** *Livre Rouge de la flore menacée de France. Tome I: espèces prioritaires*. Museum National d'Histoire Naturelle, Service Patrimoine Naturel, Conservatoire Botanique National de Porquerolles, Ministère de l'Environnement, Paris
157. **Orwa, C., Mutua, A., Kindt, R., Jamnadass, R. & Simons, A. (2009)** *Agroforestry Database: a tree reference and selection guide version 4.0*. Accessed: December 2013, <http://www.worldagroforestry.org/resources/databases/agroforestry>
158. **Ozdemir, M. (1998)** Factors Influencing Shelf Life of Hazelnut. *Okyanus Danismanlik* **3**: 66–71
159. **Park, C.W. (2007)** *Betulaceae*. In: *Flora of Korea* Editorial Committee. *The Genera of Vascular Plants of Korea*. Academy Publishing Co, Korea
160. **Parker, T. (2008)** *Trees of Guatemala*. The Tree Press, Austin
161. **Pase, C.P. & Layser, E.F. (1997)** *Classification of riparian habitat in the Southwest*. In *Johnson, R.R. and D.A. Jones Technical Coordinators: Importance, Preservation and Management of Riparian Habitat, a Symposium*. Accessed: October 2013, <http://www.gcmrc.gov/library/reports/other/Johnson1977.pdf>
162. **Pattavina, P. of USFWS (2013)** Personal communication to authors
163. **Peinado, M. & Moreno, G. (1989)** The genus *Betula* (Betulaceae) in the Sistema Central (Spain). *Wildenowia* **18**: 343–359
164. **Pijut, P.M. (2008)** *The woody plant seed manual*. United States Department of Agriculture and Forest Service, US
165. **Pojar, J. & MacKinnon, A. (2004)** *Plant of the Pacific Northwest Coast: Washington, Oregon, British Columbia & Alaska*. Lone Pine Publishing, British Columbia
166. **Powell, A.M. (1998)** *Trees and Shrubs of the Trans-Pecos and Adjacent Areas*. University of Texas Press, Texas
167. **Procházka, F. (2001)** *Black and Red List of Vascular Plants of the Czech Republic*. Agency for Nature Conservation and Landscape Protection, Příroda
168. **Qiu, Q., Tian, B., Wen, H.Y., Wu, G.L. & Wang, W.J. (2009)** Isolation and characterization of microsatellite loci in *Ostryopsis davidiana* (Betulaceae). *Conservation Genetics* **10**: 751–753
169. **Radford, A.E., Ahles, H.E. & Bell, C.R. (1969)** *Manual of the Vascular Flora of the Carolinas*. University of North Carolina Press, North Carolina
170. **Raimondo, F.M., Domina, G. & Spadaro, V. (2010)** Checklist of the vascular flora of Sicily. *Quaderni di Botanica ambientale e applicata* **21**: 189–252

171. **Research Institute of Subtropical Forestry, Chinese Academy of Forestry** *Wild germplasm resources and conservation of rare and endangered tree species endemic to east China*. Accessed: January 2014, <http://www.apafri.org/CD%20GuangZhou/Presentations/Liu%20Jun.pdf>
172. **Rhoads, A.F., & Block, T.A. (2000)** *The Plants of Pennsylvania, An Illustrated Manual*. University of Pennsylvania Press, Pennsylvania
173. **Rice, S.A., & Gibson, J.P. (2009)** Is seedling establishment very rare in the Oklahoma seaside Alder, *Alnus maritima* subsp. *oklahomensis*? *Oklahoma Native Plant Record* **9**: 59–63
174. **Rix, M. (2012)** 733. CARPINUS TSCHONOSKII Betulaceae. *Curtis's Botanical Magazine* **29**: 144–151
175. **Royal Botanic Gardens, Kew (2012)** *Betula pendula* (Silver Birch). Accessed: December 2013, <http://www.kew.org/plants-fungi/Betula-pendula.htm>
176. **Royal Botanic Gardens, Kew (2014)** *Common hornbeam Carpinus betulus*. Accessed: January 2014, [http://apps.kew.org/trees/?page\\_id=78](http://apps.kew.org/trees/?page_id=78)
177. **Rushforth, K. (1999)** *Trees of Britain and Europe*. HarperCollins, London
178. **Russo, R.O. (1990)** Evaluating *Alnus acuminata* as a component in agroforestry systems. *Agroforestry Systems* **10**: 241–252
179. **Russo, R.O. (1994)** *Alnus acuminata: valuable timber tree for tropical highlands*. Accessed: 13 July 2013, [http://factnet.winrock.org/fnrm/factnet/factpub/FACTSH/A\\_acuminata.html](http://factnet.winrock.org/fnrm/factnet/factpub/FACTSH/A_acuminata.html)
180. **Saburo, M. (1962)** *Bulletin of the Government Forest Experiment Station*. Government Forest Experiment Station, Tokoyo
181. **Sahni, K.C. (1998)** *The Book of Indian Trees*. Oxford University Press, Oxford
182. **Sawyer Jr., J.O (2012)** *Jepson Flora Project*. Accessed: July 2013, [http://ucjeps.berkeley.edu/cgi-bin/get\\_JJM.pl?tid=65](http://ucjeps.berkeley.edu/cgi-bin/get_JJM.pl?tid=65)
183. **Schrader, J.A., & Graves, W.R. (2002)** Intraspecific systematics of *Alnus maritima* (Betulaceae) from three widely disjunct provinces. *Castanea* **67**: 380–401
184. **Schrader, J.A., & Graves, W.R. (2004)** Systematics of *Alnus maritima* (seaside Alder) resolved by ISSR polymorphisms and morphological characters. *Journal of the American Society for Horticultural Science* **129**: 231–236
185. **Schrader, J.A., Graves, W.R., Rice, S.A. & Gibson, J.P. (2006)** Differences in shade tolerance help explain varying success of two sympatric *Alnus* species. *International Journal of Plant Sciences* **167**: 979–989
186. **Scoggan, H.J. (1978)** *The Flora of Canada. Vol 3: Dicotyledoneae*. National Museum of Canada, Ottawa
187. **Secretaría de Medio Ambiente y Recursos Naturales (2010)** *Oficial Mexicana NOM-059-SEMARNAT-2010, Protección ambiental-Especies nativas de México de flora y fauna silvestres-Categorías de riesgo y especificaciones para su inclusión, exclusión o cambio-Lista de especies en riesgo*. Accessed: 5th September 2013, <http://200.77.231.100/work/normas/noms/2010/059semarnat2010a.pdf>
188. **Secretaría de Recursos Naturales y Ambiente (2008)** *Especies de Preocupación Especial en Honduras*. Accessed: 11th September 2013, [http://www.undp.org/content/dam/honduras/docs/publicaciones/Especies\\_Preocupacion\\_Especial\\_Honduras.pdf](http://www.undp.org/content/dam/honduras/docs/publicaciones/Especies_Preocupacion_Especial_Honduras.pdf)
189. **Seitter, H. (1977)** *Die Flora des Fürstentums Liechtenstein*. Botanisch-Zoologische Ges, Sargans, Liechtenstein
190. **Shanan, H., Yin, G., Ning, S. & Pingping, L. (eds.) (1998)** *Rare and precious plants of China*. Shanghai Scientific & Technical Publishers, Shanghai
191. **Sharma, E., Sharma, R., & Pradhan, M. (1998)** Ecology of Himalayan Alder (*Alnus nepalensis* D. Don). *PINSA* **1**: 59–78
192. **Shetekauri, S. & Jacoby, M. (2009)** *Mountain Flowers and Trees of Caucasia*. Koeltz Scientific Books, Germany
193. **Shibata, M. & Nakashizuka, T. (1995)** Seed and Seedling Demography of Four Co-Occurring *Carpinus* Species in a Temperate Deciduous Forest. *Ecology* **4**: 1099–1108
194. **Shiflet, T.N. (1994)** *Rangeland cover types of the United States*. Society for Range Management, Colorado



195. **Singh, N.P., Singh, K.P. & Singh, D.K. (2002)** *Flora of Mizoram*. Botanical Survey of India, Calcutta
196. **Sirotnak, J. Botanist of Big Bend National Park (2013)** Personal communication to authors
197. **Srivastava, K.K., Zargar, K.A., & Singh, S.R. (2010)** Genetic divergence among *Corylus colurna* genotypes based on morphological characters of hazelnut. *Biodiversity Research and Conservation* **17**: 13–17
198. **Standley, P.C., Steyermark, J.A. & Williams, L.O. (1946)** *Flora of Guatemala. Fieldiana Botany* **24**
199. **Stevanović, V. (1999)** *The Red Data Book of Flora of Serbia I: Extinct and Critically Endangered Taxa*. Institute for Protection of Nature of the Republic of Serbia, Belgrade
200. **Stevens, W.D., Montiel, O.M. & Pool, A. (eds.) (2009)** *Flora de Nicaragua*. Accessed: July 2013, <http://www.tropicos.org/projectwebportal.aspx?pagename=Home&projectid=7>
201. **Stocker, T.F., Qin, D., Plattner, G.-K., Tignor, M., Allen, S.K., Boschung, J., Nauels, A., Xia, Y., Bex, V. & Midgley, P.M. (ed) (2013)** *Climate Change 2013: The Physical Science Bases. Contribution of Working Group 1 to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change (IPCC)*. Cambridge University Press, Cambridge and New York
202. **Strausbaugh, P.D. & E.L. Core (1978)** *Flora of West Virginia*. Seneca Books, inc., West Virginia
203. **Strid, A. & Tan, K. (1997)** *Flora Hellenica Volume 1*. Koeltz Scientific Books, Germany
204. **Tachtadžjan, A.L. (1962)** *Flora Armenii: Mimosaceae–Juglandaceae, Volume 4*. Natsionalnaia akademiia nauk. Respubliki Armeniia. Institut botaniki
205. **Tang, D., Ishii, K. & Ohba, K. (1996)** In vitro regeneration of *Alnus cremastogyne* Burk from epiotyl explants. *Plant Cell Reports* **15**: 658–661
206. **The Nature Conservancy (2013)** *Places We Protect: China*. Accessed: December 2013, <http://www.nature.org/ourinitiatives/regions/asiaandthepacific/china/placesweprotect/china-pudacuo-national-park.xml>
207. **The Nature Conservancy (2013)** *Places We Protect: Liangshan region, Sichuan Province*. Accessed: December 2013, <http://www.nature.org/ourinitiatives/regions/asiaandthepacific/china/placesweprotect/sichuan-province.xml>
208. **The Plant List (2013)** *Version 1.1*. Accessed: 2013/2014, <http://www.theplantlist.org/>
209. **Tian, B., Liu, T.I., & Liu, J.Q. (2010)** *Ostryopsis intermedia*, a new species of Betulaceae from Yunnan, China. *Botanical Studies* **51**: 257–262
210. **Tigerpaper (2000)** *Conserving Musk Deer Through Captive Farming*. Accessed: December 2013, <http://www.mekonginfo.org/assets/midocs/0002887-environment-tigerpaper-vol-xxvii-no-1-january-march-2000regional-quarterly-bulletin-on-wildlife-and-national-parks-management.pdf#page=6>
211. **TOHOKU Regional Forest Office (2012)** *List of trees*. Accessed: December 2013, <http://www.rinya.maff.go.jp/tohoku/sidou/jumoku/riben02.html>
212. **Tolmachev, A.L., Yurtsev, B.A., Packer, J.G. & Griffiths, G.C.D. (2000)** *Flora of the Russian Arctic*. Gebrüder Borntraeger Verlag
213. **TRAFFIC International (1998)** *Europe's Medicinal and Aromatic Plants: their use, trade and conservation*. Accessed: December 2013, [http://www.traffic.org/species-reports/traffic\\_species\\_plants3.pdf](http://www.traffic.org/species-reports/traffic_species_plants3.pdf)
214. **Treher (2013)** Personal communication to authors
215. **Tutin, T.G., Burges, N.A., Chater, A.O., Edmondson, J.R., Heywood, V.H., Morse, D.M., Valentine, D.H., Walters, S.M. & Webb, D.A. (2010)** *Flora Europaea*. Cambridge University Press, United Kingdom
216. **Tzvelev, N.N. (2000)** *Red Data Book of Nature of the Leningrad Region*. World & Family, St. Petersburg
217. **U.S. Department of Agriculture (1992)** *Fire Effects Information System*. Accessed: October 2013, <http://www.fs.fed.us/database/feis/>
218. **U.S. Department of Agriculture, Forest Service, Intermountain Region (1995)** *Riparian community type classification for Humboldt and Toiyabe National Forests*. Accessed: October 2013, <http://babel.hathitrust.org/cgi/pt?id=umn.31951d01372938l;view=1up;seq=1>
219. **Ullah, A. & Rashid, A. (2014)** Conservation status of threatened medicinal plants of Mankial Valley Hindukush Range, Pakistan. *International Journal of Biodiversity and Conservation* **6**: 59–70
220. **UNESCO (2013)** *Xinjiang Tianshan*. Accessed: 15 January 2014, <http://whc.unesco.org/en/list/1414>

221. **United States Army Corps of Engineers (2013)** *National Wetland Plant List*. Accessed: 15th July 2013, <http://rsgisias.crrel.usace.army.mil/NWPL/#>
222. **USDA ARS National Genetic Resources Program (2013)** *Germplasm Resources Information Network, GRIN (Online database)*. Accessed: 2013/2014, <http://www.ars-grin.gov/cgi-bin/npgs/html/family.pl?144>
223. **USDA NRCS (2013)** *Fact Sheets & Plant Guides*. Accessed: 2013/2014, <http://plants.usda.gov/java/factSheet>
224. **USDA NRCS (2013)** *The PLANTS Database*. Accessed: 2013/2014, <http://plants.usda.gov/java/>
225. **USDA NRCS (2013)** *The PLANTS Database. Wetland Indicator Status*. Accessed: 2013/2014, [http://www.plants.usda.gov/wetinfo.html#new\\_categories](http://www.plants.usda.gov/wetinfo.html#new_categories)
226. **USDI NPS (2005)** *Big Bend National Park, Texas, Fire Management Plan Environmental Assessment*. Accessed: 23rd July 2013, [http://www.nps.gov/bibe/parkmgmt/upload/BIBE\\_FMP\\_EA-2.pdf](http://www.nps.gov/bibe/parkmgmt/upload/BIBE_FMP_EA-2.pdf)
227. **USDI NPS (2005)** *Big Bend National Park, Texas, Management Plan*. Accessed: July 2013, [http://www.nps.gov/bibe/parkmgmt/upload/BIBE\\_2005\\_FMP.pdf](http://www.nps.gov/bibe/parkmgmt/upload/BIBE_2005_FMP.pdf)
228. **USFWS (1994)** Final rule: Endangered and Threatened Wildlife and Plants; Reclassification of the Virginia Round-Leaf Birch (*Betula uber*) From Endangered to Threatened. *Federal Register* 59 FR 59173
229. **Vakkari, P. (2009)** *EUFORGEN Technical Guidelines for genetic conservation and use of silver birch (Betula pendula)*. Accessed: December 2013, [http://www.euforgen.org/fileadmin/bioversity/publications/pdfs/1372\\_Silver%20birch%20%28Betula%20pendula%29.pdf](http://www.euforgen.org/fileadmin/bioversity/publications/pdfs/1372_Silver%20birch%20%28Betula%20pendula%29.pdf)
230. **Van Devender, T. R., Spaulding, W.G. & Phillips, A.M. (1975)** *Late Pleistocene plant communities in the Guadalupe Mountains, Culberson County, Texas*. In: Genoways, H.G. & Baker, R.J. (eds.), *Biological Investigations in the Guadalupe Mountains National Park, Texas*. Texas
231. **Van Devender, T.R. (1986)** *Pleistocene Climates and Endemism in the Chihuahuan Desert Flora*. In: Barlow, J.C., Powell, A.M. & Timmerman, B.N. (eds.), *Invited Papers from the Second Symposium on Resources of the Chihuahuan Desert Region United States and Mexico*. Chihuahuan Desert Research Institute, Texas
232. **Vankat, J.L. (1979)** *The Natural Vegetation of North America*. John Wiley and Sons, New York
233. **VASCAN (2013)** *The Database of Vascular Plants of Canada*. Accessed: October 2013, <http://data.canadensys.net/vascan/search>
234. **Vietnam Forest Inventory and Planning Institute (1996)** *Vietnam Forest Trees*. Agricultural Publishing House, Hanoi
235. **Villarreal, L.M.G. (2000)** *La familia Betulaceae en el estado de Jalisco, Mexico*. Universidad de Guadalajara, Mexico
236. **Walter, K.S. and Gillett, H.J. [eds] (1998)** *1997 IUCN Red List of Threatened Plants*. Compiled by the World Conservation Monitoring Centre, IUCN–The World Conservation Union, Gland, Switzerland and Cambridge, UK. 1xiv +862pp
237. **Wang, G. And Yu, M. (2014)** *Pers. Comm.*
238. **Weakley, A., Ludwig, J.C. & Townsend, J.F. (2012)** *Flora of Virginia*. Botanical Research Institute of Texas Press, Texas
239. **Webber, J., Gibbes, J. & Hendry, S. (2004)** *Phytophthora Disease of Alder*. Accessed: December 2013, [http://www.forestry.gov.uk/pdf/fcin6.pdf/\\$FILE/fcin6.pdf](http://www.forestry.gov.uk/pdf/fcin6.pdf/$FILE/fcin6.pdf)
240. **Weber, W.A. & Wittmann, R.C. (2012)** *Colorado Flora: Eastern Slope*. University Press of Colorado, Colorado
241. **Welsh, S.L., Atwood, N.D., Goodrich, S. & Higgins, L.C. (2004)** *A Utah flora*. Brigham Young University, Utah
242. **Whitcher, I. N. & Wen, J. (1998)** A new distribution of *Corylus wangii* Hu (Betulaceae) in Sichuan province, China. *Journal of Wuhan Botanical Research* 4: 315–316
243. **Williamson, E.M. (2003)** *Potter's Herbal Cyclopaedia*. C.W. Daniel Company Limited
244. **Witkowski, Z.J., Król, W. & Solarz, W. (2003)** *Carpathian List of Endangered Species*. WWF and Institute of Nature Conservation, Polish Academy of Sciences, Vienna-Krakow
245. **WWF (2013)** *China–the Yangtze*. Accessed: 16th January 2014, [http://www.wwf.org.uk/what\\_we\\_do/safeguarding\\_the\\_natural\\_world/rivers\\_and\\_lakes/where\\_we\\_work/yangtze\\_china.cfm](http://www.wwf.org.uk/what_we_do/safeguarding_the_natural_world/rivers_and_lakes/where_we_work/yangtze_china.cfm)

246. **WWF (2014)** *Tian Shan montane conifer forests*. Accessed: January 2014, <http://worldwildlife.org/ecoregions/pa0521>
247. **WWF (2014)** *Western Asia: Georgia, Russia, Azerbaijan, Turkey, Armenia*. Accessed: January 2014, <http://worldwildlife.org/ecoregions/pa0408>
248. **Yuan-Yuan, L., Shen-Min, G., Shu-Zhen, Y., Yuan, L., & Xiao-Yong, C. (2012)** Genetic decline and inbreeding depression in an extremely rare tree. *Conservation Genetics* **13**: 343–347
249. **Zagrebu, S. (1976)** *Analiticka flora Jugoslavije*. Institut za Botaniku, Hrvatske
250. **Zare, H. & Amini, T. (2012)** A review of the genus *Alnus* Gaertn. in Iran, new records and new species. *Iranian Journal of Botany* **18**: 10–21
251. **Zarzycky, K., Wojewoda, W. & Heinrich, Z. (1992)** *List of Threatened Plants in Poland*. Polish Academy of Sciences, W. Szafer Institute of Botany, Cracow
252. **Zhang, X., Wang, Z., Li, X., Yu, C. & Chen, Y. (2011)** RAPD analysis of genetic diversity of different progenies from endangered plant *Carpinus putoensis*. *Shandong Forestry Science and Technology* **192**
253. **Zhang, Y.X., Xia, B., Zhou, Y., Ding, L.S. & Peng, S.L. (2013)** Two new cyclic diarylheptanoids from the stems of *Ostryopsis nobilis*. *Chinese Chemical Letters* **24**: 512–514
254. **Zuloaga, F. & Morrone, O. (ed) (1996)** *Catálogo de las Plantas Vasculares de la República Argentina*. Missouri Botanical Garden Press, Missouri
255. **Soloman, J., Shulkina, T., and Schatz, G. (Eds.). (2014)**. Red List of the Endemic Plants of the Caucasus: Armenia, Azerbaijan, Georgia, Iran, Russia and Turkey. Monographs in Systemic Botany from the Missouri Botanical Garden (MSB) 125. Missouri Botanical Garden Press, Saint Louis
256. **Global Trees Specialist Group. (2005)**. Globally threatened trees of the Caucasus. A report on the Caucasus regional tree red listing workshop. Tbilisi, Georgia. 26–28 September 2005
257. **McAllister, H. (1993)** Cytology and the conservation of rare birches. In: Hunt, D. (ed.), *Betula*, pp. 61–66



## ANNEX I

### IUCN RED LIST CATEGORIES AND CRITERIA (VERSION 3.1)

#### 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), through-out 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 has not yet been evaluated against the criteria.

#### 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  $\geq 90\%$  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  $\geq 80\%$  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  $\geq 80\%$ , 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  $\geq 80\%$  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<sup>2</sup>, 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<sup>2</sup>, 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  $\geq 70\%$  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  $\geq 50\%$  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  $\geq 50\%$ , 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  $\geq 50\%$  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 5,000 km<sup>2</sup>, 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<sup>2</sup>, 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 2,500 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  $\geq 50\%$  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  $\geq 30\%$  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  $\geq 30\%$ , 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.
    - (iii) area, extent and/or quality of habitat
    - (iv) number of locations or subpopulations
    - (v) number of mature individuals.
  4. An observed, estimated, inferred, projected or suspected population size reduction of  $\geq 30\%$  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.
    - 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.
- 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<sup>2</sup>, 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 2,000 km<sup>2</sup>, 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
- 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 1,000 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 1,000 mature individuals.
  2. Population with a very restricted area of occupancy (typically less than 20 km<sup>2</sup>) 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.

Source: IUCN (2001)



# The Red List of Betulaceae

For further information please contact:

BGCI

Descanso House

199 Kew Road, Richmond

Surrey, TW9 3BW

United Kingdom

Tel: +44 (0)20 8332 5953

Fax: +44 (0)20 8332 5956

E-mail: [info@bgci.org](mailto:info@bgci.org)

Web: [www.bgci.org](http://www.bgci.org)