

Securing a Future for the World's Threatened Trees – A Global Challenge

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Botanic Gardens Conservation International
Fauna & Flora International



**BOTANIC
GARDENS**
CONSERVATION
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**GLOBAL TREES
CAMPAIGN**



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This report has been produced by BGCI and FFI who jointly coordinate the Global Trees Campaign.

About the Global Trees Campaign (GTC) (www.globaltrees.org)

For over 20 years, the GTC has taken a targeted approach to the in situ conservation of individual tree species, supporting action on the ground and collaborating with partners to scale up our impact.



About Fauna & Flora International (FFI) (www.fauna-flora.org)

FFI protects threatened species and ecosystems worldwide, choosing solutions that are sustainable, based on sound science and take account of human needs. Operating in more than 40 countries worldwide, FFI saves species from extinction and habitats from destruction, while improving the livelihoods of local people. Founded in 1903, FFI is the world's longest established international conservation body and a registered charity.



About Botanic Gardens Conservation International (BGCI)

(www.bgci.org) BGCI is the world's largest plant conservation network with over 60,000 plant scientists and horticulturalists, and more than 600 member institutions in over 100 countries. Founded in 1987, BGCI mobilises botanic gardens and partners to secure plant diversity for the well-being of people and the planet. BGCI jointly coordinates the Global Tree Assessment with the IUCN/SSC Global Tree Specialist Group.

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Cloud Forest in Quito, Ecuador. (Natalia Tejedor)

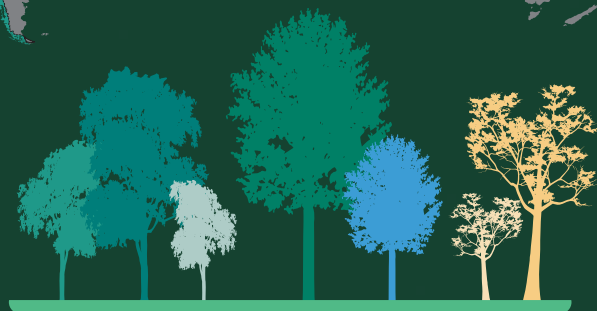
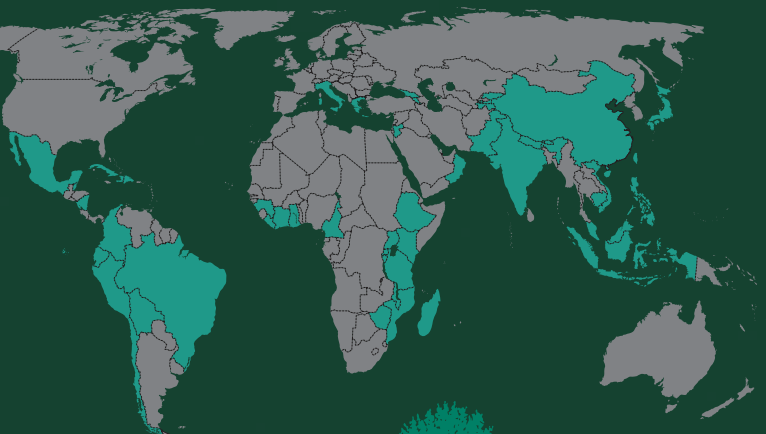
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GLOBAL TREES CAMPAIGN (GTC) SNAPSHOT



1 tree species thought to be extinct was rediscovered

60 threatened tree species with significantly higher known populations, as a result of survey work



200 threatened tree species with evidence of reduced or managed threats



10,000 people trained in tree conservation skills



>700,000 seedlings of **>300** threatened tree species planted



200 species where local stakeholders are now responsible for and implementing sustainable management of threatened trees



Acer



Dipterocarps



Magnolia



Nothofagus



Oak



Rhododendron

Global Conservation Consortia launched to coordinate action for highly threatened groups

The case for tree conservation

The loss of trees is a global problem. Deforestation and forest degradation result in declines in the area of land naturally covered by trees, but these headlines don't tell the full story. Tree diversity - the amazing range of nearly 60,000 different species that have evolved over the last 300 million years to make up this iconic group - is also under threat.

The *State of the World's Trees*, published in September 2021, shares the results of the Global Tree Assessment (GTA) - the first conservation assessment of all of the world's trees. The results tell us that 30% of all tree species - more than 17,500 species - are threatened with extinction. That's more than double the total number of globally threatened mammals, birds, reptiles and amphibians. The results also tell us that at least 142 tree species are already recorded as extinct.

Individual tree species play numerous economic, ecological and cultural roles. We depend on trees in our everyday lives - they provide us with food, timber and medicine. According to the *State of the World's Trees*, one in five tree species is recorded as having a specified human use and many have a variety of different uses. But it's not only people that depend on trees. As primary producers at the base of the food chain, plants, including trees, are the building blocks of ecosystems, essential to all life on this planet. A myriad of species of plants, animals and fungi are intrinsically linked to trees, often interacting within complex and fascinating mutually beneficial relationships that both parties depend on for survival.



Logging in the Choco rainforest, Ecuador. (Juan Pablo Moreiras, FFI)



Land clearance in northern Madagascar. (Alicky Davey, FFI)

The greatest threat to tree species is forest clearance and degradation, and the loss of other types of habitat. But the uniqueness of each of the nearly 60,000 different tree species means they often face their own individual challenges, from selective harvesting and overexploitation to pests and diseases to climate change. While the *State of the World's Trees* reports that over half of threatened tree species are recorded in at least one protected area, this does not necessarily guarantee their survival. Many threatened species require targeted, proactive management to ensure they can persist and thrive, fulfilling their unique ecological niche and contributing to the healthy, resilient ecosystems that are so vital to meet the overwhelming challenges that currently face our world.

While the challenges and scale of the problem in maintaining tree species diversity are significant, we can do something about it. It is crucial that we use the information now available from the Global Tree Assessment to guide tree conservation action, as well as to learn from past experiences. This report outlines tried-and-tested approaches by Global Trees Campaign (GTC) partners that effectively conserve tree species, aiming to share examples and learning on how to save threatened trees with a wider audience. Alongside the *State of the World's Trees*, it is a "call to action" to scale up efforts, aiming to encourage and catalyse new players to engage in this vital work.

Safeguarding the world's tree species is a global challenge, but our aim is to demonstrate that together, through effective conservation action, we can address the threats to these cornerstone species, saving highly threatened trees from disappearing altogether and preventing vulnerable species from further declines.

Accurate information to guide tree conservation efforts

Prior to the launch of the *State of the World's Trees*, comprehensive information was lacking on which tree species are threatened with extinction and where conservation efforts should be directed. Some assessments were available on the IUCN Red List of Threatened Species and in national Red List publications, but the information was not easily accessible and the scale of the problem was not known.

The *State of the World's Trees* shares the results of the first conservation assessment of all of the world's trees, and reveals that 17,510 species - 30% of all tree species - are threatened with extinction. Conservation assessments provide detail on the distribution, population status and identified threats for each species. With this information, species can now be prioritised for action, key countries and sites for conservation efforts can be identified and appropriate conservation actions planned and implemented. The *State of the World's Trees* report can be accessed [here](#).

The *State of the World's Trees* reports that 56% of threatened tree species are found in at least one protected area. Global Tree Assessment data can now be better incorporated into protected

area planning, linking for example with the identification and protection of Key Biodiversity Areas, Important Plant Areas and Alliance for Zero Extinction (AZE) sites to ensure that a higher proportion of threatened trees are brought into the protected area network.

The *State of the World's Trees* also tells us that currently, 21% of threatened tree species are reported as occurring in botanic gardens or seed banks. This provides useful information on where living plant material is held that could be used to initiate recovery programmes, means that there is some level of propagation, seed storage or horticultural knowledge for these species and helps to guide efforts to bring the threatened tree species that are currently absent from collections into ex situ conservation and propagation programmes.

Conservation assessments for many little-known tree species are often based on historic herbarium records. Further ground survey work is therefore required to update information on baseline populations, threats and conservation status. In several cases, recent survey efforts have yielded important results and led to significant conservation gains for highly threatened species.

CASE STUDY

GLOBALTREE PORTAL

<https://www.bgci.org/resources/bgci-databases/globaltree-portal/>

The GlobalTree Portal is a major new tool resulting from the Global Tree Assessment to support forestry, tree conservation and climate change policy and action for tree species.

The GlobalTree Portal provides information at different levels: global, national and species level. As well as highlighting the scale of the problem facing tree species, it provides information on the numbers of species that are found in at least one protected area and those that are not represented in any. It also shows which species are present in, or absent from, ex situ collections. The data can be used to highlight where the need for tree conservation is greatest, including identifying priority countries and species.

The Conservation Tracker, accessed via the species pages on the GlobalTree Portal, provides real-time information on who is taking conservation action for which species, to identify gaps and further prioritise where additional efforts are required.



Tree diameter measurement of *Canarium* sp., Raja Ampat, Indonesia. (Yanuar Ishaq Dc, FFI)

CASE STUDY

REDISCOVERY OF PRADOSIA ARGENTEA IN PERU

CR *Pradosia argentea* is an endemic tree species in the Marañón valley, Peru. This tree was assessed as Extinct in the 1998 IUCN Red List. However, 20 years later, in February 2018, Professor Marcelo Peña from Universidad Nacional de Jaén found five individuals with fruits and flowers. In 2020, a project in collaboration with Professor Marcelo Peña resulted in the discovery of a further population with more than 22 mature individuals. Seeds were collected, propagation protocols established and seedlings are now being grown for the very first time. The IUCN Red List assessment for *Pradosia argentea* has now been updated, and the species is classified as Critically Endangered.



Pradosia argentea (J.L. Marcelo Peña, Universidad Nacional de Jaén)

The availability of accurate baseline information, including a thorough understanding of threats, enables the development of recovery and conservation action plans for threatened species to guide conservation efforts. Recovery plans can be produced for individual species, multiple species or for larger groups of species, and can be invaluable tools to coordinate efforts and monitor conservation progress. In several cases, the development of recovery plans has been the first step in a process that has led to well-coordinated conservation actions for threatened species.

CASE STUDY

SURVEY WORK FOR THREATENED TREES IN SAMOA

EN As part of the GTC, the Government of Samoa, the Samoa Conservation Society and BGCI have been collaborating since 2019 to scale up knowledge of the conservation status of some of the islands' most threatened tree species. These include the

CR Endangered palm *Clinostigma samoense*, endemic to Upolu island, the Critically Endangered *Manilkara samonensis*, and the not yet evaluated *Alectryon samoensis*, both endemic to Savai'i island. Survey work is helping to validate the species' distribution *in situ*, carry out population counts, update conservation assessments and identify key threats to inform conservation actions. Continuing decline in forest area and climate change have been identified as key drivers of threat to the survival of these species and the rest of the islands' other plant species. Required conservation actions identified and initiated so far include collection of material to develop *ex situ* conservation collections at Vaillima Botanical Garden, and propagation trials to generate plants for use in population reinforcement and reintroduction initiatives.

CASE STUDY

REDISCOVERY OF KAROMIA GIGAS IN EAST AFRICA

CR The last known tree of *Karomia gigas* in Kenya was felled in the 1970s. The first recording of this species in Tanzania was in 1993, when a collection of a single seed was made but it was not possible to locate the source. In both countries, coastal forest has been largely cleared for agriculture, and residential and tourism development. Logging is also likely a threat to this tree. The species was assessed as Critically Endangered and flagged as Possibly Extinct in the 1998 IUCN Red List Assessment. However, it was rediscovered in 2011 and subsequent survey work led by GTC partners, the Tanzania Forest Service and the University of Dar es Salaam Herbarium has increased the population count to 40 individuals (21 mature individuals) at two sites in Southern Tanzania. The species remains assessed as Critically Endangered due to its small population. Survey work has provided accurate baseline information for the species to plan appropriate conservation actions and seed has been collected to initiate a recovery programme. In 2021, young trees of this species growing *ex situ* at Missouri Botanical Garden in the U.S.A. produced flowers - the first time flowers of this species have been documented.

Karomia gigas seeds. (Kirsty Shaw, BGCI)



CASE STUDY

MAGNOLIAS OF THE DOMINICAN REPUBLIC

EN

Species recovery plans were developed and launched with government support in 2018 for Critically Endangered *Magnolia domingensis*, Critically Endangered *M. hamorii* and Endangered

CR

M. pallescens. Over the following years, priority recovery actions were scaled up for the species based on the recommendations of the plans. In 2020, a reinforcement planting event of *M. pallescens* took place in the Valle Nuevo National Park, La Siberia, Constanza, and was a highly effective public outreach initiative with the Minister of the Environment and staff in attendance. The government's involvement in the planning and action phase of this project is helping to promote planting of additional threatened tree species in the Dominican Republic.



Magnolia pallescens (Scott Zona)

CASE STUDY



Gigasyphon macrosyphon
(Kirsty Shaw, BGCI)

CONSERVATION PLANNING FOR KENYA'S THREATENED TREES

In 2020, BGCI, the IUCN/SSC Conservation Planning Specialist Group (CPSG), and the Kenya Forest Service led a series of online workshops focused on planning conservation action for Kenya's threatened trees. These workshops used CPSG's "Assess to Plan" (A2P) methodology, which acts as an intermediate step to link single-species status assessment through to stakeholder-inclusive multi-species conservation action planning. The aim was to facilitate the rapid progression of threatened tree species from assessment, through conservation planning, into effective action in Kenya. The workshops provided an opportunity to bring together key stakeholders to discuss and evaluate the results of an A2P analysis for Kenya's more than 140 threatened tree species. This helped to identify priority sites for conservation of threatened tree species in Kenya and to group threatened species together that are likely to benefit from the same conservation activities. During these GTC workshops, a joint vision statement and goals were developed and priority actions were identified at national and regional levels to deliver conservation for Kenya's threatened trees.



Vangueriopsis shimbaensis (Kirsty Shaw, BGCI)

Targeted and effective conservation action

The State of the World's Trees reports that habitat loss is currently the greatest threat to tree species. Conversion of land for agriculture is threatening more tree species than any other known factor, impacting 29% of assessed tree species on the IUCN Red List. Other causes of habitat loss include the conversion and degradation of land for urban and industrial development, mining and changes in fire regimes.

The second most common threat to tree species is direct exploitation, especially for timber, impacting 27% of assessed tree species.

Trees are threatened by a wide range of pests and diseases that are spread by natural and artificial causes, with climate change altering the survival opportunities for many pests and diseases in new environments. Invasive species, pests, diseases and other problematic species threaten at least 5% of assessed tree species.

Climate change is impacting all forest ecosystems and is emerging as a significant threat to individual tree species. Climate change and severe weather are recorded as threats for 4% of assessed tree species.

In most cases, a combination of threats affects survival of the species, and threats may interact to exacerbate the impact of each.

While broader measures such as protected areas can, when managed effectively, provide vital protection against habitat loss, targeted action to address individual threats and protect populations of threatened trees is often needed. The case studies below provide examples of how key threats to trees have been addressed across a range of different contexts, aiming to provide models, share learning and stimulate the development of urgently needed action to tackle the conservation needs of a much greater number of species.

CASE STUDY

Magnolia grandis (Chu Xuan Canh, FFI)



THREAT: AGRICULTURE MAGNOLIA GRANDIS IN VIETNAM

CR Critically Endangered *Magnolia grandis* is known only from small, isolated populations in southern China and three protected areas in northern Vietnam, with the global population totalling fewer than 300 adult trees. The future of Vietnam's *M. grandis* populations was at risk from limited recruitment of new seedlings due to local agricultural practices, in which farmers clear large areas of vegetation - including *M. grandis* seedlings - before planting cardamom, and repeatedly weed out *M. grandis* to maintain their crop.

Since 2013, as part of the GTC, FFI has developed an outreach programme with local cardamom growers at Tung Vai Watershed Protection Area in Vietnam. These efforts are paying off, with local cardamom farmers now willingly maintaining *M. grandis* seedlings, indicating a shift in attitudes and behaviour towards this species. Over the same time period, regular community monitoring and patrolling to protect trees from logging was introduced, resulting in no felling or damage to *M. grandis* individuals at Tung Vai since 2017. In addition, the adoption of fuel-efficient stoves has reduced pressure for fuelwood. Given the low number of individuals, booster planting is also being carried out using nursery-grown seedlings. Natural regeneration of *M. grandis* is now occurring in other areas of the forest where previously there was none, indicating that our work over the last eight years to enable the species to recover has been successful.



Magnolia grandis seedlings growing in the nursery in Tung Vai, Vietnam. (Chu Xuan Canh, FFI)



CASE STUDY

THREAT: GRAZING AND HABITAT DEGRADATION *QUERCUS BRANDEGEEI* IN MEXICO

EN Endangered arroyo oak, *Quercus brandegeei*, is a narrowly endemic oak tree in Baja California Sur, Mexico. One-third of its 3,000 km² range is within a protected area, Sierra La Laguna Biosphere Reserve, a biodiversity hotspot with high levels of endemism and great beauty. In this case, however, simply protecting the species' range does not address the threats causing decline of this species. Since 2017, as part of the GTC, The Morton Arboretum, La Universidad Nacional Autónoma de México and Jardín Botánico de Vallarta, have collected genetic, phenological and ecological data on *Q. brandegeei* to determine specific threats and identify conservation and management actions needed to save it from extinction.

Fenced enclosures were established to quantify the effect of grazing and trampling by free-roaming livestock on seedling survival and growth. Results revealed that cattle and goats eat the seedlings and pigs eat the acorns, which was preventing any natural regeneration from occurring. To combat these threats, Mexican scientists, land managers, ranchers, and international experts are working together to implement a recovery and management plan for this species. Actions include conducting plantings within fenced areas to boost population recovery and encouraging ranchers to adopt oak seedlings and plant them within their fenced gardens, working with land managers to establish larger grazing-free zones within the reserve, and advocating for policies and regulations that will enable this culturally and ecologically important oak species to survive for generations to come.

CASE STUDY

THREAT: PESTS & DISEASES AND GRAZING *MALUS NIEDZWETZKYANA* AND *PYRUS KORSHINSKYI* IN KYRGYZSTAN

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Kyrgyzstan's fruit-and-nut forest is home to several threatened species including Endangered Niedzwetzky's apple, *Malus niedzwetzkyana*,

CR

and Critically Endangered Bukharan pear, *Pyrus korshinskyi*. Both of these species, and the forest as a whole, are under pressure from high levels of grazing, which suppresses natural regeneration. A microbial disease known as fire blight is emerging in the region and extensive firewood collection represents an additional threat.

FFI has supported conservation of Kyrgyzstan's fruit-and-nut forest habitat since 2007, developing capacity amongst local stakeholders and supporting communities to diversify livelihoods to reduce dependency on activities that are harmful to the forest. As part of the GTC, to address the threat to trees from grazing, rangers in four forest units have established fencing around important groups of trees, and seedlings have successfully grown up inside the fenced areas. Although fencing was met with suspicion when first proposed, the evidence of successful regeneration, together with outreach activities on the importance of forest conservation, have resulted in a significant shift of opinion amongst local stakeholders. The trust built up in communities through extensive engagement over a long period of time is also believed to be central to success.

To address the threat of fire blight, the project has been working with the University of Zurich to train forestry department staff in the detection and control of the disease. Trainees develop skills in identification of disease symptoms, taking samples to test for the disease, hygiene practices to prevent further spread and more. Alongside delivering capacity building workshops, training materials have been translated into four languages and are being distributed across the region in a collaborative approach to improving capacity to address the disease at a regional level.



Left: *Malus niedzwetzkyana* (Maksim Kulikov, FFI).
Right: Fencing *Pyrus korshinskyi* trees in Kyrgyzstan.
(Bolot Tagaev, FFI)



Ya'axché ranger in Maya Golden Landscape, Belize.
(Ya,axché Conservation Trust)

CASE STUDY

**THREAT: FIRE
ADANSONIA PERRIERI IN
MADAGASCAR**

CR

Perrier's baobab, *Adansonia perrieri*, is Critically Endangered and just 152 trees remain in fragmented areas of habitat in northern Madagascar.

Frequent fires, resulting from shifting agriculture and the production of charcoal, can kill adult trees and seedlings alike, as well as destroying the forest understory - the only shade in this extreme environment.

As part of the GTC, Madagasikara Voakajy has been supporting land managers to protect threatened baobabs from fire, including providing training in extinguishing fires, installing fire breaks around critical areas for baobabs and supporting local stakeholders to maintain these fire breaks. This work is complemented by ongoing outreach work to reduce threats to baobabs from fire and other threats, including livestock grazing and gold mining. Reinforcement planting has also been undertaken to boost the population of this very rare species.



Adansonia perrieri (Madagasikara Voakajy)

CASE STUDY

**THREAT: ILLEGAL LOGGING -
DALBERGIA STEVENSONII IN BELIZE**

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One of the most biodiverse and topographically unique areas in Mesoamerica, Belize's Maya Golden Landscape supports a high diversity of tree species, including high-value timber trees such as the Critically Endangered Honduran rosewood, *Dalbergia stevensonii*. Illegal logging, driven by international demand for sought-after timber, is a major issue in the landscape.

Ya'axché Conservation Trust (Ya'axché) plays a central role in the conservation of this ecosystem through the management or co-management of three protected areas, which altogether total over 61,000 hectares of forest. Community ranger-led patrols are successfully deterring illegal logging, with zero logging of Honduran rosewood recorded between 2016-2020 in a key area of habitat for the species, and reduced rates of logging for two other threatened tree species. Empowering local farmers to adopt more sustainable land practices such as agroforestry is also helping to reduce threats from wildfires and shifting agriculture.

To support this work on the ground, Ya'axché also catalysed the Belizean government to place a national moratorium on Honduran rosewood logging in 2012 and played an active role in supporting the addition of the species to CITES (Convention on International Trade in Endangered Species of Wild Fauna and Flora) Appendix II in 2013. Ya'axché works closely with the government on overall conservation of Honduran rosewood, and has been able to further influence policy for the species, including the amendment of the Belize Forests Act and an update to the CITES Non-Detriment Finding (NDF). This combination of practical protection and conservation in the field supported by enabling national and international policy means this highly sought-after species has a far more secure future.



Dalbergia stevensonii in the Maya Golden Landscape, Belize.
(Ya'axché Conservation Trust)

CASE STUDY

THREAT: INVASIVE ALIEN SPECIES CAPE VERDE'S THREATENED TREES

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All three of Cape Verde's endemic trees - Endangered phoenix palm, *Phoenix atlantica*, Endangered ironwood, *Sideroxylon marginatum*, and a Critically Endangered subspecies of dragon tree, *Dracaena draco* subsp.

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caboverdeana - survive on Brava, the nation's smallest inhabited island. These three trees are threatened with

extinction, affected heavily by habitat loss and invasive plant species competing with and sometimes completely smothering them. Invasive plants including *Prosopis juliflora*, *Furcraea foetida*, *Lantana camara* and *Ipomoea indica* are known to directly impact around one third of the 400 individuals of the threatened endemic trees that remain on the island.



Above: Manual removal of invasive *Furcraea foetida* in Cape Verde. (Biflores). Below: Sustainable *Protium attenuatum* resin-tapping methods. (Jenny Daltry, FFI)



Dracaena draco subsp. *caboverdeana* (Biflores)

As part of the GTC, local NGO Biflores is working to physically remove the invasive plant species from around the threatened trees and to plant endemic trees in place of the removed invasives. The work has been planned in consultation with the Ministry of Environment and Agriculture and involves local stakeholders including farmers and landowners, whose support is vital to the success of these very practical interventions, including the prevention of re-invasion. Removal of invasives is accompanied by an outreach programme with local stakeholders and schools, to increase awareness of the three threatened tree species and the threats they are facing. Supported by FFI, Biflores is also working to develop a sustainable grazing management plan to combat the further threat to the trees and the wider environment from uncontrolled grazing livestock.

CASE STUDY

THREAT: OVEREXPLOITATION OF NON-TIMBER FOREST PRODUCTS (NTFP) *PROTIUM ATTENUATUM* IN SAINT LUCIA

EN

Endangered *Protium attenuatum*, known as the lansan tree, is native to the Eastern Caribbean. Local extinctions across the species' range have left Dominica and Saint Lucia as the only places where significant populations remain, but here too the tree is declining. The tree's resin is used widely as incense in households and churches, however the traditional method of resin extraction leads to disease, decay and death among the lansan tree population.

In 2015, FFI and the Saint Lucia Forestry Department conducted experimental trials to develop sustainable harvesting methods, with results showing that the application of a weak acidic stimulant solution to a simple cut in the bark promoted high resin yields, but caused no damage to the tree. A new management plan for the lansan tree was subsequently developed, which included local tappers becoming professionally trained and licensed to use this new method of extraction. This work is regarded as a model for other threatened resources in Saint Lucia as it represents a win-win-win for the tappers, local incense buyers and the lansan trees.

**CASE STUDY****THREAT: OVEREXPLOITATION OF NON-TIMBER FOREST PRODUCTS (NTFP) CAMELLIA NITIDISSIMA AND CAMELLIA EUPHLEBIA IN CHINA**

EN Fangcheng Golden Camellia National Nature Reserve (FGCNNR) in China is home to two beautiful Camellias; Endangered *Camellia nitidissima* and Endangered *C. euphlebia*. Both species have high ornamental, medicinal and nutritional value and are sold under the trade name golden camellia. The species have great socio-economic importance, but are threatened by overharvesting of flowers and leaves and extensive removal of seedlings in the wild for trade. Habitat degradation and loss are also threats.

As part of the GTC, in collaboration with FGCNNR, Guangxi Institute of Botany, local golden camellia companies, local communities and BGCI, a stock of approximately 20,000 plants was cultivated to establish a 12-hectare restoration and demonstration plot to increase public awareness of the status of these species and the need for further species and habitat recovery work. Three hundred and sixty five households received training on propagation techniques and are now engaged in golden camellia propagation and cultivation to take pressure off natural and restored populations. Local people are working jointly with local companies that process flowers and leaves into various products, including highly priced golden camellia teas. These partnerships have proved to be very successful and have provided an alternative, sustainable source of income for participating households.



Propagation of golden camellia seedlings. (BGCI)

CASE STUDY**THREAT: CLIMATE CHANGE QUERCUS GEORGIANA IN THE U.S.A.**

EN Endangered Georgia oak, *Quercus georgiana*, is restricted to small populations in the Piedmont Plateau of the southeastern U.S.A. Historic occurrences in South Carolina are now considered extirpated. Climate change is a threat to this species. As *Q. georgiana* is confined to intermittent "soil islands" on granite outcrops which have little or no connectivity, there is no opportunity for migration. The species also displays many of the life-history traits associated with vulnerability to climate change, including limited dispersal ability, slow reproductive rates and specialised habitat requirements. Drought also poses a considerable threat to this species given its restriction to very thin soils, which provide little or no access to groundwater. Climate models project that climate change will contribute to dramatic increases in drought conditions in this part of the U.S.A. Trampling and soil compaction is also a threat to this species as it occurs in popular hiking areas.

The Global Conservation Consortium for Oak is expanding on previous efforts to conserve this species. *Q. georgiana* is recalcitrant, which means its seed cannot be stored using conventional methods, but the species can be successfully propagated *in vitro* and cryopreservation is also being investigated as a back-up conservation measure. This species also exists in living collections in 30 institutions around the world with 50% of accessions from known wild provenance, however genetic work has shown that the accessions were collected from only two subpopulations. Efforts are now focusing on collecting propagation material from additional subpopulations and further examination of the genetic diversity of trees in natural stands and cultivated collections, to ensure the full genetic diversity of this species is backed up in *ex situ* collections and to guide future recovery and potential translocation efforts.

Quercus georgiana
(Valerie Pence)



The threats mentioned above frequently impact a tree's ability to regenerate naturally. Other factors, such as ecological constraints, may also prevent or limit regeneration. Identifying and removing barriers to natural regeneration should be a priority for conservation efforts, and intensive interventions to assist natural processes have, in some cases, proved successful.

For other species, however, natural regeneration may not be possible, for example due to extremely small populations that are not producing seed, or where a population has been completely extirpated from a site and no seed source remains. In such cases, planting can be an important strategy to increase population numbers or reintroduce a species to a site where it was previously found.

Whatever approach is taken to reduce threats, improve natural regeneration or restore populations of the tree species, the full engagement and participation of local stakeholders is key to the success of all tree conservation initiatives. This ensures that the approach is appropriate to the local context, has local ownership and support and is more likely to achieve lasting impact.



Widdringtonia whytei (Kirsty Shaw, BGCI)

CASE STUDY

THREAT: NATURAL SEED SOURCES LOST *WIDDRINGTONIA WHYTEI* IN MALAWI

CR Critically Endangered Mulanje cedar, *Widdringtonia whytei*, is Malawi's National Tree. It is found naturally only on Mount Mulanje in the south-east of the country. The tree is highly valued for its durable and fragrant timber and has been commercially exploited since the 1890s for construction, furniture and panelling. Mulanje cedar recently reached the point of near extinction due to illegal logging. This removed the natural future seed source from the mountain and increasing man-made fires reduced recruitment of remaining seedlings and young trees. Local communities were involved in illegal logging activities, due to limited employment opportunities in the region.

As part of the GTC, a project led by Mulanje Mountain Conservation Trust, the Forestry Research Institute of Malawi and BGCI, set up eight community nurseries around Mount



Widdringtonia whytei seedlings in Malawi. (BGCI)

Mulanje with more than 80 community members taught to propagate Mulanje cedar seedlings, ready to be planted back onto the mountain. Over 400,000 seedlings were purchased from community nurseries and planted on the mountain by local people, providing employment opportunities and vital income. Restoration experts from the Ecological Restoration Alliance of Botanic Gardens are also helping to improve planting practices so that more trees survive and grow better. An extensive network of firebreaks is maintained on the mountain to protect planted seedlings.

During the project timeframe, the species was listed on CITES Appendix II to prevent further international trade. Alternative sustainable uses of Mulanje cedar trees are being investigated that could provide additional benefits to local people. Essential oils can be produced from the tree's wood and leaves, with studies into the components of this oil carried out in order to help identify what products (e.g. soaps) these oils could be used in. Communities around Mount Mulanje have planted Mulanje cedar hedges from which essential oil can be extracted, with distillation equipment and training currently being provided. This aims to offer alternative incomes from the Mulanje cedar to local communities that don't damage Mount Mulanje or its plant resources. *Ex situ* trial plots and woodlots were also planted elsewhere in Malawi. These actions aim to ensure the planted trees on the mountain remain safe for the long term.

CASE STUDY

THREAT: ASYNCHRONOUS FLOWERING *ABIES ZIYUANENSIS* IN CHINA

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The Endangered Ziyuan fir, *Abies ziyuanensis*, is known only from three areas in China, and is thought to number fewer than 600 individuals. The species has a very small distribution due to past heavy logging combined with habitat loss. Within Yinzhulaoshan Provincial Nature Reserve (PNR), Guangxi - one of the few sites where the species remained - lack of natural regeneration threatened the population's long-term survival. It was identified that, possibly due to climate change, male and female Ziyuan firs now rarely flower in synchrony, thus pollination is unable to take place naturally.

Guangxi Institute of Botany worked with Yinzhulaoshan PNR to carry out an artificial pollination experiment, with researchers painstakingly pollinating flowers by hand. This effort was rewarded, with the trees producing seed and a subsequent dramatic increase in seedling numbers, from just a single seedling seen in 2014 to more than 400 in 2015. Although very labour intensive, this type of hands-on intervention can be effective in assisting natural regeneration for very highly threatened trees.

Abies ziyuanensis hand pollination.
(Ding Tao, Guangxi Institute of Botany)



PROPAGATION OPTIONS



Preparing for a seed collecting trip in Brazil.
(Noelia Alvarez de Román, BGCI)

Multiple options exist for the propagation of trees for planting. Seeds are always the preferred option, as each seed is genetically unique and thus helps to maintain a diverse pool of individuals within a population, improving resilience towards external pressures such as pests, diseases and changing future climatic conditions. Vegetative propagation methods such as taking cuttings or grafting can be used as a backup, for example for species with unpredictable or infrequent seed production, but this method is not preferable, as it results in individuals that are genetically identical to the parent tree. In the long term, this can leave the population vulnerable to external pressures as less resilience exists when genetic diversity is lower.



Processing seeds of *Shorea leprosula* in Indonesia.
(BGCI, Orangutan Foundation International)

Building capacity for threatened tree conservation

With over 17,500 tree species known to be globally threatened, it is vital that a wide range of organisations, businesses and other groups are engaged in threatened tree conservation. This includes conservation organisations that have little or no experience with threatened trees, tree planting programmes that do not include threatened trees, newly-formed groups without the necessary institutional skills to run a successful organisation, and more. These groups require the right type and level of skills and knowledge to become part of the growing global taskforce acting to conserve threatened trees.

The technical challenges around conserving threatened trees can be multiple and complex. Understanding population distribution and structure, the barriers to natural regeneration, challenges with species ecology and seed germination are all issues that may have to be overcome in order to effectively conserve a species. Our experience has shown that building stakeholder capacity in these and other technical aspects of tree conservation can improve practices and increase the likelihood of success.

Whilst technical capacity is clearly required to design and implement threatened tree conservation initiatives, organisational capacity is necessary to ensure these programmes can continue and evolve as needed in the future. Supporting the development of the skills and systems required to run a successful NGO, community group or other organisation, such as governance structures, financial management, strategic development and fundraising, in groups keen to engage in tree conservation can be a key strategy to ensure lasting impact.



Training in taking herbarium specimens. (Said Gutierrez, Ya axché Conservation Trust)



Training in threatened tree identification and patrol protocols in Indonesia. (Edy Nordiansyah, FFI)

GTC RESOURCES

GTC has developed a series of resources to build capacity for tree conservation, including: guidance on collecting botanical and other baseline information; conservation planning; collecting and propagating material; species recovery programmes; engaging local communities and monitoring impact. All of the resources are freely available from the GTC website: www.globaltrees.org





Cupressus cashmeriana in Bhutan. (BGCI)

CASE STUDY

CAPACITY BUILDING IN CHINA

China is a hotspot for tree diversity, with over 2,100 endemic tree species. More than 750 of China's native tree species are threatened. Many of these species are found in small, poorly resourced nature reserves and require hands-on management to ensure their long-term viability. China has therefore been a focus for capacity building and public outreach for FFI and BGCI as part of the GTC.

From 2012-2018, FFI developed a comprehensive programme of training, mentoring and direct conservation action, implemented in collaboration with leading technical experts in China. Over this time, we supported staff from nature reserves to learn and use practical tree conservation approaches, leading to new or more effective conservation actions for at least 22 threatened tree species. For those nature reserves with less funding, staff and prior experience in tree conservation, the project provided low-level funding for direct actions in the reserves alongside intense supervision, typically over a period of one to three years, with support gradually decreasing as threatened tree conservation became embedded in the reserve's management. A local Tree Conservation Network, including periodic newsletters, enabled participants to exchange experiences, share learning and draw inspiration from the activities of others.

Since 2008, BGCI's China programme has supported practical conservation efforts of botanic gardens, via almost 40 projects focused on threatened tree species. All projects operate in close cooperation with local authorities and communities, and involve public outreach activities and technical training, focusing on seed collection, propagation, nursery management, population reinforcement and sustainable harvesting. Alongside this, more than 30,000 copies of outreach and training materials have been distributed to technicians from botanic gardens, forest departments, nature reserves, local NGOs and local communities.

CASE STUDY

CUPRESSUS CASHMERIANA IN BHUTAN

The national tree of Bhutan, Near Threatened *Cupressus cashmeriana*, known as tsenden, is of immense cultural and religious significance to the people of Bhutan for the construction of holy buildings (Dzongs) and monasteries. The demand for this tree has put wild populations at risk of overexploitation. The Mayor of Dangchu Valley, where the largest population of this species occurs, requested technical assistance from GTC to identify mother trees and establish a restoration programme. Following training and mentorship provided by GTC and our partners, the people of Dangchu Valley have formed a community nursery that is cultivating, conserving and planting tsenden for future generations. With the assistance of the GTC, the Royal Botanic Garden Serbithang and the Royal Botanic Garden Edinburgh, the people of Dangchu village have planted over 12 hectares with around 41,000 tsenden seedlings propagated from seed collected from genetically diverse local trees.



Cupressus cashmeriana, Dangchu Valley, Bhutan. (BGCI)

Building partnerships facilitates the sharing of skills, knowledge and experience between people and organisations working to conserve threatened trees across regions and taxa. Long-term commitment to such partnerships can be key for impactful conservation, especially when a vital element of the collaboration is around capacity building or establishing enabling conditions necessary for sustainable conservation action. Investing in partnerships over many years can help to ensure that increased capacity is retained and passed on to others within collaborating organisations, rather than staying limited to a few individuals who may move on.



Above: Fagaceae training at Pha Tad Ke Botanic Garden in Laos. (BGCI) Left: Training in Yachang Nature Reserve, China. (Lin Wuying, FFI)



CASE STUDY MAGNOLIA SINICA IN CHINA

CR Critically Endangered *Magnolia sinica* was believed to be restricted to just nine wild trees in 2005, located in southern Yunnan province, China. As a part of the GTC, FFI's China programme worked in collaboration with a number of partners to improve the protection and conservation of the known wild trees and to reinforce the population through planting. The involvement of a range of partners and stakeholders was key to the project's success and the long-term sustainability of outcomes, with local and provincial institutions taking on the support and mentoring of the nature reserve where the trees were found at the end of the project. Building relationships with the statutory forest agencies resulted in the project, the species and the nature reserve gaining a high profile regionally and nationally, improving the prospects for partners to secure resources for continued conservation efforts and leading to the project being promoted as a model for threatened plant conservation in China.

The conservation of *Magnolia sinica* was supported over a period of nearly a decade, from initial surveys in 2005 and direct support for *in situ* conservation until 2011, then through the capacity-building project and associated Tree Conservation Network from 2012-2018 mentioned above. This level of sustained involvement by local, national and international partners was undoubtedly a factor in ensuring interest and momentum was maintained long enough to achieve lasting outcomes for the species.



Magnolia sinica (Xu Jian, FFI)

Scaling up conservation action

With such a vast number of trees at risk of extinction across the world, a significant scaling up of conservation action is urgently needed. To increase effectiveness and avoid duplication of effort, approaches that coordinate and mobilise tree conservation at national and taxonomic levels are suggested.

Species within the same taxonomic group share many characteristics, and they may also be subject to the same or similar threats. For example, 90% of endemic Borneo dipterocarps are threatened by logging. Related species are therefore also likely to benefit from the same conservation actions, and planning and coordinating conservation action at the taxonomic level can be very beneficial for groups with a high number of threatened species. Sharing technical expertise

can also be effective at this level, for example germination requirements are often shared across species of the same genus, or genera within the same family.

National coordination of tree conservation efforts is also a valuable approach. The information in the *State of the World's Trees*, as available in the GlobalTree Portal, gives us the opportunity to identify countries with high numbers of threatened tree species, especially those with high numbers of threatened endemics. These countries are priorities for tree conservation and coordinating action at the national level can be an effective way to identify priority sites, engage new partners, build capacity and generate government support. National actions, such as awareness raising programmes, can benefit multiple species at the same time.

CASE STUDY

COORDINATING ACTION FOR TAXONOMIC GROUPS - GLOBAL CONSERVATION CONSORTIA

BGCI and the botanic garden community have established a methodology for developing comprehensive conservation strategies for priority tree groups. Global Conservation Consortia (GCC) aim to catalyse groups of institutions and experts to collaboratively develop and implement comprehensive strategies to prevent extinction of priority threatened tree groups. The GCC focus on highly threatened taxonomic groups identified by the results of the Global Tree Assessment and utilise the unique knowledge and skills held within the botanic garden sector. However, the GCC are mobilising not only botanic gardens but also related partners across the world to work to conserve threatened tree species.

Target genera include those that are technically challenging to manage, including those that cannot be seed banked, as well as tree groups that are overlooked by other sectors and those that provide opportunities to build capacity for tree conservation in centres of diversity. Primary objectives of the GCC include coordinated *in situ* and *ex situ* conservation efforts and dissemination of species recovery knowledge. As of September 2021, GCC have been developed for six tree groups; Acer, Dipterocarps, Magnolia, Nothofagus, Oak, Rhododendron. These groups include more than 800 threatened species and the model is now also being applied to highly threatened non-tree groups.



Global Conservation Consortium
Acer



Global Conservation Consortium
Dipterocarps



Global Conservation Consortium
Magnolia



Global Conservation Consortium
Nothofagus



Global Conservation Consortium
Oak



Global Conservation Consortium
Rhododendron





Seed collecting mission in the Shimba Hills, Kenya. (African Forest)

CASE STUDY

MOBILISING NATIONAL ACTION FOR TREE CONSERVATION IN KENYA

In Kenya, there are more than 140 threatened tree species, more than 30 of which are endemic. As a result of the conservation planning workshops carried out in Kenya (as highlighted on page 8), a Kenya Threatened Trees Consortium has been established to guide and mobilise action for Kenya's threatened tree species. This is jointly coordinated by the Kenya Forest Service and the BGCI Africa office, who host meetings of consortium members, have set up a website for the initiative and are tracking conservation efforts for each threatened tree species. This approach also facilitates capacity building and sharing of resources, development of joint funding applications and projects, and so far more than 50 threatened tree species are covered by the collective action of the group.

CASE STUDY

NATIONAL COLLABORATION IN INDONESIA

Indonesia has almost 700 threatened tree species, with ongoing habitat- and species-level threats providing little chance for their recovery without dedicated conservation action. While many large-scale conservation programmes are dedicated to the country's flagship animals (e.g. elephants, orangutans and tigers) or to large areas of high-carbon forest, few initiatives are specifically designed around the conservation needs of individual threatened tree species *in situ*.

FFI, through the GTC, has helped to mobilise government engagement in threatened tree conservation - first establishing

the Indonesian Forum for Threatened Trees (a group of more than 70 members from at least 30 different institutions dedicated to advising and influencing conservation for threatened trees) and, through this forum, aiming to persuade the Ministry of Environment and Forestry to add 12 threatened tree species to their list of priority species. So far, one of these trees, Critically Endangered *Vatica javanica* subsp. *javanica*, has become a National Protected Species. In 2019, the Forum, along with the Indonesia Science Institute (LIPI), published a ten-year national conservation strategy for the 12 priority species. Alongside supporting the Forum to drive threatened trees up the conservation agenda in Indonesia, FFI is also seeking to build capacity for organisations working on threatened trees and catalyse new action for priority species.

There is currently huge interest in large-scale tree planting. 2021 - 2030 is the UN Decade on Ecosystem Restoration, more than 60 countries have jointly pledged to restore 170 million hectares of degraded land under the Bonn Challenge, and huge tree planting targets have been set in many countries. Tree planting pledges and restoration projects provide an important opportunity to deliver conservation, by planting native and threatened species and through assisted natural regeneration (ANR). However, often this opportunity is missed, by focusing only on exotic species or a small number of native species.

This current worldwide enthusiasm for restoration and tree planting can be harnessed to benefit threatened trees. Incorporating threatened trees in restoration programmes, or planting threatened species on farms, community land and other sites could contribute significantly to the recovery of threatened tree species, whilst also providing carbon capture and supporting livelihoods. The establishment or scaling up of associated supply chains for genetically representative seed and seedlings of threatened tree species will be required to achieve this.



Planting seedlings of *Paubrasilia echinata* in Brazil. (Guaraci M. Diniz Jr., Jardim Botânico Araribá)

CASE STUDY

PROMOTING THREATENED TREE SPECIES IN RESTORATION JARDIM BOTANICO ARARIBA, BRAZIL

Jardim Botânico Araribá (JBA) is located in one of the few remaining fragments of Brazilian Atlantic Forest. Despite its status as an important biodiversity hotspot, the Atlantic Forest is recognised as one of the most degraded ecosystems on the planet. JBA is situated on a 30 hectare site. The JBA team has been working to restore Brazilian Atlantic Forest since 1987, and the current restoration efforts intend to restore not only specific plant species, but also the ecosystem as a whole. So far, 20 hectares have already been brought under restoration with native species. After 30 years of restoration practices, four headwaters have reappeared which feed the closest city from the botanic garden (Amparo – São Paulo, Brazil). The restored forest protects the river banks, preventing silting up, and protecting the river water quantity and quality.

JBA integrates threatened tree species into restoration, including Endangered *Paubrasilia echinata*, Vulnerable *Cedrela fissilis*, Critically Endangered *Chloroleucon tortum*, and Vulnerable *Zeyheria tuberculosa*. The plants for the restoration project are grown in partnership with a commercial nursery "Ambiental mudas" that is also supplying these native tree seedlings to customers for planting in their local area. As a result, the species are becoming part of the local supply chain of native tree species in Sao Paulo.



Chloroleucon tortum (Noelia Alvarez de Román, BGCI)



Monitoring growth of planted *Chloroleucon leucum* seedlings, Jardim Botânico Arariba Brazil. (Noelia Alvarez de Román, BGCI)



Sociedade Chauá's tree nursery with 215 native species. (Sociedade Chauá)

CASE STUDY

MOBILISING NURSERIES AND PLANTING ORGANISATIONS SOCIEDADE CHAUÁ, BRAZIL

Sociedade Chauá (Chauá) is a Brazilian NGO working in southern Brazil's Araucaria forest, 99% of which has been lost to farming. Tree planting has the potential to play a significant role in recovery of the region's large number of threatened species, however these species are rarely included in planting projects.

As part of the GTC, Chauá conducted extensive field surveys, seed collection and germination trials from 2012-2020, which led to the inclusion of 215 native tree species in their nursery, 40 of which are threatened. Through outreach and training, they also aimed to catalyse a change in restoration practice in the region by mobilising nurseries and planting organisations to adopt threatened species within their ongoing operations. Over the length of the project, more than 50,000 seedlings from 40 threatened species were planted by 27 different stakeholders.



Planting seedlings of *Paubrasilia echinata* in Brazil. (Noelia Alvarez de Román, BGCI)

Mobilising a global community for threatened tree conservation

In contrast to the numerous well-known flagship animal species, threatened trees have gained little attention from governments, funders, conservation organisations, the corporate sector and the general public as a conservation priority. With 30% of tree species shown to be at risk of extinction, this needs to change.

The global challenge of conserving the world's threatened trees requires a concerted response from the global community, with all different regions and sectors engaging and taking action at a variety of scales. The *State of the World's Trees* highlights the scale of the problem and Global Tree Assessment data available in the GlobalTree Portal enables all actors to pay increased attention to threatened trees.

Several key stakeholder groups are vital to an effective response to the threatened tree crisis.

Policymakers at all levels (global, national and local) need to incorporate and prioritise threatened trees within policy and legislative frameworks. Using the Global Tree Assessment data, governments can set data-driven national-level priorities and action plans for threatened trees.

Intergovernmental and international organisations need to promote the use of Global Tree Assessment data with their networks and incorporate threatened tree conservation into their programmes to remove or reduce threats and restore trees.

The corporate sector has an expanded role to play, particularly timber, agriculture and extractives companies that are having a direct impact on tree species and their habitats, by reducing or



Quercus brandegeei team in Mexico. (The Morton Arboretum)



Warburgia salutaris conservation team in Zimbabwe. (BGCI)

mitigating their impact and taking an active role in the protection and restoration of threatened tree species.

Land managers, including governments and the private sector, are key actors in securing important habitat for threatened trees and prioritising actions to address their particular conservation needs.

The conservation movement, including large international NGOs, smaller locally based groups, and everything in between, need to prioritise threatened trees within their strategies and programmes, increasing action on the ground, supporting communities to manage tree resources, developing capacity for tree conservation, and generating a higher profile for the urgent needs of threatened tree species.

The tree planting and habitat restoration sector have an unrivalled opportunity to integrate threatened trees within their work, contributing significantly to saving species as well as meeting their other goals.

There is a role too for the research community, in filling information gaps on species populations, distributions and ecological requirements, and demonstrating the role of tree species diversity in ecosystem resilience, which is so vital to addressing the challenges of today's changing world.

All this action needs to be enabled by a greater level of resourcing, with both statutory and private-sector donors and philanthropists providing funds for threatened tree conservation and prioritising tree species conservation within their donor strategies.

This report demonstrates that saving threatened trees is not only achievable, but brings wider benefits to people and nature.

Now is the time for collective action to halt and reverse the trend for threatened trees.

Resources to support tree conservation

Below are some useful resources that can help with the design and implementation of tree species conservation.

State of the World's Trees <https://www.bgci.org/our-work/projects-and-case-studies/global-tree-assessment/>

GlobalTree Portal <https://www.bgci.org/resources/bgci-databases/globaltree-portal/>

Global Trees Campaign guidance briefs for tree conservation (currently available in Chinese, English, French, Portuguese and Spanish) <https://globaltrees.org/resources/resource-type/act/>
Including guidance briefs on:

- How to survey an area for threatened trees
- How to collect botanical information for identification
- How to make a monitoring plan for threatened trees
- How to design and manage a tree nursery
- How to collect seeds from threatened tree species
- How to store seeds and prepare them for germination
- How to germinate seeds and care for young seedlings
- How to solve germination problems
- How to plant and establish trees in the wild
- How to red list a tree species



Copaifera religiosa (Xander van der Burgt, RBG Kew)



Araucaria angustifolia (Zig Koch)

Integrated conservation of tree species by botanic gardens: a reference manual https://globaltrees.org/wp-content/uploads/2013/11/tree_species_low.pdf

BGCI's online training platform <https://www.bgci.org/our-work/training-and-capacity-building/bgci-online-training-platform/> including modules on vegetative propagation of threatened trees and scaling up biodiverse forest restoration.

Capacity for Conservation website <https://capacityforconservation.org/>

Ex situ gap analyses for taxonomic groups of trees <https://globaltrees.org/resources/resource-type/assess/> including for conifers, ebonies, magnolias and oaks.

Conservation planning resources for trees including species recovery plan template and examples. <https://globaltrees.org/resources/resource-type/plan/>

BGCI's Directory of Expertise for Tree Conservation <https://www.bgci.org/resources/bgci-databases/directory-of-expertise/bgci-directory-of-expertise/>

Additional examples of Global Trees Campaign projects <https://globaltrees.org/projects/>

Funding opportunities and project case studies from Fondation Franklinia <https://fondationfranklinia.org/>



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Cover images:

Front: *Swietenia macrophylla*
(Juan Pablo Moreiras, FFI)

Back: Top - *Boswellia ogadensis*
(Mats Thulin, Uppsala University)

Bottom - Collecting data on trees in West
Waigeo Nature Reserve, Raja Ampat,
Indonesia. (Yanuar Ishaq Dc, FFI)

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