

Journal of Botanic Gardens Conservation International

# BGjournal

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**The Global Tree  
Assessment and  
botanic gardens:  
linking assessment  
to conservation action**



**BOTANIC  
GARDENS**  
CONSERVATION  
INTERNATIONAL



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**Cover Photo:** *Koompassia excelsa* (EN) (Jake Anderson)

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# EDITORIAL: GLOBAL TREE ASSESSMENT



A longstanding aim of the IUCN SSC Global Tree Specialist Group (GTSG) has been to assess the conservation status of all the world's tree species. With support and

leadership from BGCI, this aim has now been achieved. In this issue of *BGjournal* we celebrate the success of the Global Tree Assessment (GTA) which has resulted in every tree species having an IUCN Red List conservation category or equivalent conservation assessment. This hugely impressive achievement has involved over 60 institutions and 500 botanists and ecologists working together in a major coordinated global effort.

The success of the Global Tree Assessment clearly demonstrates the convening power of BGCI. Two of the core databases maintained by BGCI, namely GlobalTreeSearch and ThreatSearch have been essential in processing baseline data and keeping track of progress for the tree species assessments. BGCI has maintained the Secretariat for the GTSG since 2005 enabling strong links to be developed between the work of this IUCN specialist group and the global network of botanic gardens. The Red List team at BGCI has, since 2015, undertaken priority tree species assessments, assigned assessment work to others and provided essential training and support. How the Global Tree Assessment has been achieved is explained in the interview with Malin Rivers and the article by Megan Barstow.

Leading BGCI members around the world have been important partners in the GTA. Royal Botanic Gardens (RBG), Kew and Missouri Botanical Garden are, for example, members of the IUCN Red List Partnership along with BGCI and have their own well-established international

plant Red List programmes. The Morton Arboretum has generously supported the goals of the GTA through, for example, coordination of the assessment of the US trees as explained in the article by Abby Hird which also highlights the tree conservation efforts of the US Botanic Garden. Many other botanic gardens, both large and small, have undertaken national tree species assessments, contributed to species reviews and hosted tree Red List workshops. Several examples are provided in this issue.

Through the Global Tree Assessment, we now know that 30% of tree species are threatened with extinction, and the main threats to these species are clearance of forests for agriculture and other forms of habitat loss, direct exploitation mainly for timber and the spread of invasive pests and diseases. Climate change is also having a clearly measurable impact. The information compiled through the Global Tree Assessment is of critical importance in planning for conservation action and helping to tackle climate change. Botanic gardens, of course, have essential roles to play. Botanic gardens display the diversity of trees, particularly of attractive species groups such as the magnolias and conifers and provide interpretation on their conservation status and conservation needs.

In this issue the articles from the Bahamas, Costa Rica and US provide examples of how the tree Red List data is being used in botanic garden settings. Botanic gardens are renowned for their role in *ex situ* conservation of trees and are also involved in many forms of *in situ* conservation. One example provided here is on the collaborative *in situ* conservation work undertaken by RBG Kew in Guinea.

The Global Tree Assessment results support global policy initiatives such as the CBD's Global Strategy for Plant Conservation together with national



*Alstonia angustiloba* (Santhana Ganesan)

conservation planning and action. Tree conservation action is clearly needed at all levels; single species conservation as highlighted in the articles by Anurag Dhyani and Yvette Harvey-Brown, species groups as highlighted by Jean Linsky or at a wider landscape level. The Global Tree Assessment results will help to ensure that trees and the forests of which they form part are conserved and that degraded forests are restored using the right tree species, at the right time in the right place.

As well as all the contributors from our assessors and reviewers, the success of the Global Tree Assessment and the progress made in conserving threatened tree species would not have been possible without the generous support of donors. In this respect, all members of the GTA team are particularly grateful to the Foundation Franklinia for their support from the outset as the major sponsor of the Global Tree Assessment.

**Sara Oldfield**  
Co-chair of IUCN  
Global Tree Specialist Group



# FEATURES

## NEWS FROM BGCI

PLANT HUNTING TALES:  
BACK FROM THE BRINK:  
*BUCHANANIA BARBERI* IN INDIA

FEATURED GARDEN:  
OMAN BOTANIC GARDEN AS A  
CONSERVATION CAMPAIGNER  
FOR THREATENED AND ENDEMIC  
ARABIAN PLANTS

TALKING PLANTS: INTERVIEW  
WITH MALIN RIVERS



# NEWS FROM BGCI

Here we present a selection of the most recent news stories from BGCI. Please browse our website to keep up-to-date with the latest news and events from BGCI and the botanic garden community. [www.bgci.org](http://www.bgci.org)



## BGCI's Global Botanic Garden Fund Open for Applications

We are pleased to announce that BGCI's Global Botanic Garden Fund is open for applications. The call for applications will be open until 17:00 GMT on 10 September 2021.

BGCI's Global Botanic Garden Fund aims to drive plant conservation, sustainability efforts, and global partnerships with a focus on smaller botanic gardens and arboreta in developing countries and biodiversity hotspots. The Fund is open to BGCI Member Institutions only. Non-members may apply, but a membership fee must be paid prior to the application deadline.

Grants will be available from four different funds in 2021:

- BGCI Global Botanic Garden Fund
- BGCI/ArbNet Partnership Programme
- BGCI/Minnesota Landscape Arboretum Fund
- BGCI Covid Relief Fund

Further information and details of how to apply are available at: *BGCI's Global Botanic Garden Fund Open for Applications | Botanic Gardens Conservation International*

## BGCI launches a new on-line training platform

BGCI's new online training platform will provide online and blended learning training courses to BGCI members and other interested individuals. The platform,

which is Moodle based, allows the creation of a range of interactive content with resources designed to complement BGCI's existing face-to-face training courses, projects and publications.

Our focus initially is to develop a Botanic Garden Basics series. These introductory modules are aimed at small and resource challenged gardens to provide practical training to complement the publication *'From Ideas to Realisation – BGCI's Manual on Planning, Developing and Managing Botanic Gardens'* (2016).

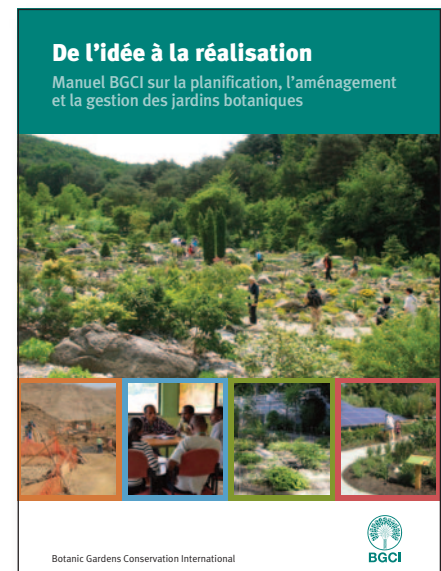
Modules available so far include:

- Defining a botanic garden (Botanic Garden Basics series) – free to members;
- An introduction to interpretation – free to members;
- Vegetative propagation of threatened trees – free to all;
- Introduction to evaluation – free to members;
- Introduction to master planning – free to members;
- Scaling-up biodiverse forest restoration - Part 1 – free to all.

Details about each module can be found on the training platform: *Botanic Gardens Conservation International (bgci.org)*

## Le Manuel BGCI sur la planification, l'aménagement et la gestion des jardins botaniques - Dès maintenant disponible aussi en français!

We are delighted to announce that BGCI's Manual on Planning, Developing and Managing Botanic Gardens is now also available in French. The translation of the manual from English to French has been made possible owing to the



dedicated and often voluntary contribution by a large number of experts and organizations. The production of a French version of this manual presents a major step forward and makes this resource better accessible to botanic gardens in French-speaking countries. The manual can be downloaded from the BGCI website in English, French and Spanish.

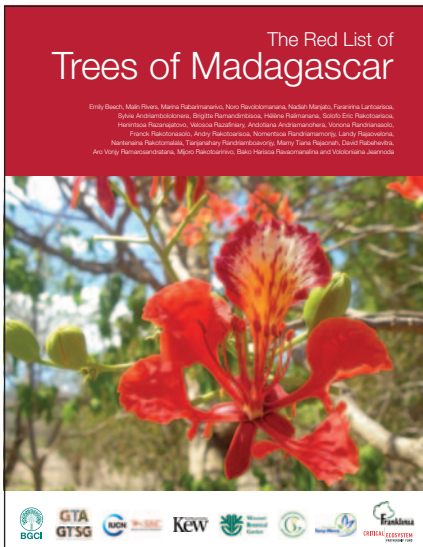
*BGCI's Manual on Planning, Developing and Managing Botanic Gardens | Botanic Gardens Conservation International*

## Two-thirds of Madagascar's endemic tree species are threatened with extinction

Like many islands, Madagascar is home to an incredible diversity of endemic species, but a new BGCI report reveals that 63 per cent of Madagascar's endemic tree species are threatened with extinction.

Until relatively recently there has been limited data available about the conservation status of the country's trees. BGCI's Red List of Trees of Madagascar provides the first comprehensive assessment of the conservation status of Malagasy trees.





*The Red List of Trees of Madagascar* aims to both provide information to prioritise conservation efforts and inspire action to improve the conservation status of those trees most at risk of extinction, to maintain this unique diversity for years to come.

For more information, visit: *Report: Two-thirds of Madagascar's endemic tree species are threatened with extinction | Botanic Gardens Conservation International (bgci.org)*

### BGCI ACCREDITATION SCHEME

The following institutions have achieved BGCI accreditation since the last issue of BGJournal. Congratulations to all:

Institution	Country	Accreditation
Bayard Cutting Arboretum	United States	BGCI Accredited Botanic Garden
Preston B. Bird/Mary Heinlein Redland Fruit & Spice Park	United States	BGCI Accredited Botanic Garden
The Arboretum, University of Guelph	Canada	BGCI Accredited Botanic Garden
The Linnaean Gardens of Uppsala	Sweden	BGCI Accredited Botanic Garden
Hortus Botanicus Amsterdam	Netherlands	BGCI Accredited Botanic Garden
The Key West Tropical Forest & Botanical Garden	United States	BGCI Accredited Botanic Garden
SCCV Château Pérouse	France	BGCI Accredited Botanic Garden
Nezahat Gökyigit Botanic Garden	Turkey	BGCI Accredited Botanic Garden
Sireeruckhachati Nature Learning Park	Thailand	BGCI Accredited Botanic Garden
United States National Arboretum	United States	BGCI Accredited Botanic Garden
Gold Coast Regional Botanic Gardens	Australia	BGCI Accredited Botanic Garden
Brackenhurst Botanic Garden	Kenya	BGCI Accredited Botanic Garden
FossilPlants	United Kingdom	BGCI Accredited Conservation Practitioner
Průhonice Botanic Garden	Czech Republic	BGCI Accredited Conservation Practitioner
Jardin Botanique de l'Université de Fribourg	Switzerland	BGCI Accredited Conservation Practitioner
National Tropical Botanical Garden	United States	BGCI Accredited Advanced Conservation Practitioner

### Special Issue of the Sustainability Journal "Botanic Gardens and Their Contribution to the Sustainable Development Goals"

BGCI has been invited to guest edit a special edition of MDPI's Sustainability journal entitled "*Botanic Gardens and Their Contribution to the Sustainable Development Goals*".

This special issue of Sustainability will focus on the work of botanic gardens in influencing visitor behaviour in areas such as energy use, water consumption, food, responsible sourcing, waste and recycling. In addition, more broadly, we will showcase contributions that botanic gardens make to the Sustainable Development Goals through research and practice related to the conservation and use of plants. Our main purpose is to share some of the best practices in the botanic garden sector (and outside it), then mainstream and scale up such approaches.

The deadline for manuscripts is November 2021.

For more information about the issue and how to submit a paper, please visit: *Sustainability | Special Issue : Botanic Gardens and Their Contribution to the Sustainable Development Goals (mdpi.com)*

### Events



### South America regional meeting: Global Conservation Consortium for Magnolia

The Global Conservation Consortium for Magnolia, Atlanta Botanical Garden and BGCI will be hosting a South America regional meeting via Zoom on **August 24th, 2021** from 10:00 – 12:00 local time in Medellin, Colombia. Botanic gardens and others in the region are invited to attend.

The objective of this meeting is to create synergies, opportunities and knowledge for botanical gardens, botanical and research institutions interested in the conservation of Magnolias in South America and to invite them to actively participate in the Global Conservation Consortium for Magnolia. The meeting will be held in English, Spanish and Portuguese, with simultaneous translation available.

To learn more about the meeting and the GCCM, visit: *South America regional meeting: Global Conservation Consortium for Magnolia | Botanic Gardens Conservation International (bgci.org)*





## ArbNet 10th Anniversary Virtual Conference: Partnering to Plant & Protect Trees

This conference, which will run from **14-16 September, 2021**, will provide valuable content that is specific to the needs of arboretum staff in growing, curating, interpreting, and conserving trees. Attendees will learn best practices and standards of excellence in the arboretum community, develop collaborations with peers and expand their network.

*More information: [Arbnet](#) | [ArbNet 10th Anniversary Virtual Conference: Partnering to Plant & Protect Trees](#) ([ArbNet logo](#))*

## 1st International Congress of Historic Botanic Gardens

The 1st International Congress of Historic Botanic Gardens (ICHBG) will be held from **11-12 October, 2021** in Lisbon, Portugal, hosted by the Museu Nacional de História Natural e da Ciência/Museus da Universidade de Lisboa (MUHNAC/MULisboa).

Registration and abstract submission is now open – the deadline for submission of abstracts is now extended until 4 September 2021

## Virtual Global Symposium and Workshop, Conserving Exceptional Plants: Cryobiotechnology and the Model of Oaks

Cincinnati Zoo & Botanical Garden and partners are hosting a free virtual symposium and workshop, *Conserving Exceptional Plants: Cryobiotechnology and the Model of Oaks*, from **19-21 October, 2021**. The three-day symposium will feature experts covering:

- What exceptional plants are and the use of cryobiotechnology as an alternative conservation strategy for these species;
- The multifaceted ways cryobiotechnologies can be applied, using oaks as a model group for what is being done and the potential for the future;

- A workshop demonstrating methods used for banking exceptional plant tissues, using oaks as a model for methods that can be applied broadly to exceptional species.

Short contributed papers will also be welcomed.

*For more information and to register interest, please visit the conference website: - [Cincinnati Zoo & Botanical Garden](#)*

## Anthropology and Conservation Virtual Conference

This major interdisciplinary conference on Anthropology and Conservation will be held from **25-29 October, 2021**. The conference will explore ways in which conservation and people go together, with a particular focus on the role of Indigenous Peoples in conservation. Members of BGCI are eligible to join the conference at a reduced rate.

Registration opens on 2 August. More information is available from the conference website: [Anthropology and Conservation 2021](#) ([therai.org.uk](#))

## Cancellation of the 11th International Congress on Education in Botanic Gardens

BGCI has taken the difficult decision to cancel the next education congress due to take place in Buenos Aires, Argentina in March 2022, due to the impact of the ongoing pandemic. This decision was made in conjunction with the team in Buenos Aires. However we are pleased to announce that a stronger educational theme will be embedded in the upcoming 7th Global Botanic Gardens Congress due to be held in Melbourne, Australia, from **26-30th September 2022**. The first day of the congress, will now be entirely devoted to educational sessions and in addition, multiple workshops and lectures will be embedded throughout the rest of the week.

We would like to thank Jardín Botánico “Carlos Thays” in Argentina for all their enthusiasm and efforts in trying to organise an International Congress on Education, during the pandemic and we look forward to seeing as many of you as possible in Melbourne at the Global Botanic Garden Congress in 2022.

## New publications

### Around the World in 80 Plants by Jon Drori

In his follow-up to the bestselling *Around the World in 80 Trees*, Jonathan Drori takes another trip across the globe, bringing to life the science of plants by revealing how their worlds are intricately entwined with our own history, culture and folklore. With a colourful cast of characters, all brought to life by illustrator Lucille Clerc, this is a botanical journey of beauty and brilliance. *Around the World in 80 Plants* is 80 reasons why we can't live without plants, why they fascinate and why we should care.

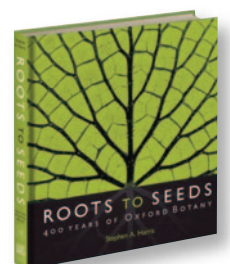
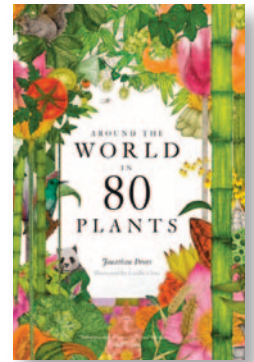
BGCI Members receive 25% off the purchase of this book using the code BGCI25 when purchasing here: *Around the World in 80 Plants* - Laurence King

### Roots to Seeds: 400 Years of Oxford Botany by Stephen A. Harris

Since 1621, and the foundation of the Oxford Botanic Garden, Oxford has built up an outstanding collection of plant specimens, botanical illustrations and rare books on plant classification, collecting and plant biology. These archives, and the living plants in the Garden, are integral to the study of botany in the University.

This fascinating book profiles the botanists and collections which have helped to transform our understanding of the biology of plants over the past four centuries, focusing on plant classification, experimental botany, building botanical collections, agriculture and forestry and botanical education.

The online Bodleian Shop is offering BGCI members a 10% discount on this title when purchasing through their online shop. To receive the discount please use the following code at the online checkout: 10BGCI21. Order here: *Roots to Seeds: 400 Years of Oxford Botany* – Bodleian Libraries ([bodleianshop.co.uk](#))







Conservation awareness program at school (Anurag Dhyani)

### The beginning of the journey

The story began when I joined the Jawaharlal Nehru Tropical Botanic Garden and Research Institute (JNTBGRI), the biggest conservatory garden in Asia, in March 2016. The beautiful botanical garden is located in Thiruvananthapuram district of Kerala.

The garden was opened 42 years ago with the aim of setting up a botanical garden for the tropical plant resources of Kerala and India. The Institute's mission is to promote the knowledge, enjoyment and conservation of plants through excellence in biodiversity research management, horticulture displays and educational programmes. During my first few days at JNTBGRI, I visited the different sections of the garden - ornamental plants, arboretum, anthuriums, orchids, ginger germplasm collection, carnivorous plants, medicinal plants, palm collection, ficus collection, bromeliads, cacti and succulents, fernery, gymnosperms and bambusetum and was hugely impressed by the dedication of the organisation's horticultural and scientific staff. This 300-acre garden has always been a magnet for plant conservationists

## PLANT HUNTING TALES BACK FROM THE BRINK: BUCHANANIA BARBERI IN INDIA

as the institute preserves more than 50,000 accessions of 5,000 plant species, among the highest number of plant species conserved by botanical gardens in Asia.

Being a scientist in the garden provides a marvellous window for me to study the abounding diversity of the Western Ghats - a renowned UNESCO World Heritage site and one of the eight most biodiverse hotspots in the world. It covers an area of 164,280 km<sup>2</sup>, five percent of the total area of India. The Ghats stretch into six states, namely Gujarat, Maharashtra, Karnataka, Kerala, Goa and Tamil Nadu. The Western Ghats is home to more than 7,402 species of flowering plants, 1,814 non-flowering plants, 139 mammals, 508 species of birds, 179 amphibians, 6,000 insects and 290 species of freshwater

fish. For conservationists, the Western Ghats is habitat to 325 globally threatened species, among these 51 species are Critically Endangered, 145 are Endangered and 129 are assessed as Vulnerable. Among tall evergreen trees, approximately 352 species are endemic to the region and make this place special for tree enthusiasts.

### Finding my species

To begin my conservation efforts, I started searching for and reading literature on threatened plants of the region and flora of Kerala. I invested weeks turning pages of research papers, books and conservation magazines. After several months, I encountered an engrossing article on the priority list of endangered plants.





The author holding *Buchanania barberi* seedling and interacting with students (Anurag Dhyani)

The piece highlighted herbs, shrubs and tree species that urgently require recovery, otherwise they will face extinction. I scribbled the species' names in my record book and rushed to my computer screen to examine the conservation status of each species on the IUCN Red List of Threatened Plants. Later I rechecked it with a List of Threatened Endemic Trees of India provided by BGCI. The screening brought to light a 15-meter tall tree seeking the attention of a conservationist. As if it was saying: "I am on the verge of extinction and surviving with only two trees in the wild, I am *Buchanania barberi*." My immediate questions was: "but where are you"? My fingers on Google showed me the destination and my heart decided to meet this rare tree in the wild and take action to conserve it.

The next morning, I paid a call to Dr. E. S. Santhosh Kumar, the plant taxonomist who rediscovered *Buchanania barberi* after a gap of 97 years, and who has been exploring the Western Ghats for over 30 years. He told the story of accidentally finding the tree in 2002 and described salient identification features and the natural habitat of the species. While displaying the digital herbarium specimen he said "Dr. Dhyani, the tree is locally known as *Malamavu* and is growing near Palode, just 6 km from our institute". He could see the spark of happiness in my eyes. We decided to visit Palode the next day for a first look at this rare tree.

At 9 am sharp, we packed our bags for the location, Dr. Santhosh rented a jeep and I grabbed my Sony DSLR camera to capture the rare tree. After 20 long minutes, we reached the species location and got down from the jeep. I saw

reserve forest on the one side of the road and the Vamanapuram river on the other. Dr. Santhosh pointed his index finger towards a medium size tree and said "here it is". He asked me to follow and took me to the middle of road, telling me to take a closer look at the tree's smooth bark and crowded leaves on the tips. He walked towards the tree and lifted a few leaves from the road, and showed me the identification feature of this species. What is that, I asked eagerly? He replied: "please see and feel the soft hairs beneath the leaves". While touching the hairs I was pondering about the future of the tree: would road expansion lead it to extinction or would I be able to collect seeds of hope?

### Gaining support

Considering the dire need of conservation, I submitted a proposal to BGCI's Global Seed Conservation Challenge (GSCC) Fieldwork Fund. In July 2016, we received an award letter for a project to collect and store seeds of six endemic and threatened trees of the Western Ghats (as identified on the IUCN Red List). The project supported regular monitoring of *Buchanania barberi* trees for flowering and fruiting in Palode region. During an October visit, I spotted small young buds on a few branches and creamy-white flowers on the top of the tree. The sunshine on the small flowers made me hopeful for upcoming fruits. I clicked some images, collected some buds and flowers, and brought them to the laboratory to observe the pollen morphology under the microscope. Next morning, while sipping tea and

Right: Team collecting fruits of *Buchanania barberi* (Anurag Dhyani)

looking at the pollen images on the desktop, I was imagining the seeds of this tree. After few months, I again visited the site, got down from the jeep and caught sight of a few red mature fruits hanging down from the branches. The number of fruit on the tree was very low compared to the bumper flowering. Suddenly a bird appeared and plucked the red fruits, before flying away. The birds were eating these tasty fruits and reducing the availability of seeds and also, consequently, lowering the seed bank under the canopy. Other mature seeds were falling on the road where the chance of germination is nil. Luckily, we managed to hire a tree climber to reach the top of the tree and prune small branches of these fruits. We also collected seeds from the roadside, packed it in zipped bags, and returned with a great sense of satisfaction. The GSCC fund supported us to conduct several field visits to observe these trees in the Palode region. One day while surveying in the region we noticed two additional trees but unfortunately, neither has produced flowers or fruits to date. We have been continuing our observations on these individuals and I believe they will soon produce flowers and viable seeds to continue its survival.

### Conservation assessments

During 2018, I received an invitation to review the assessment of *Buchanania barberi* for the IUCN Red List of Threatened Species. Based on our field experience, published information and the limited species range in the region, we reassessed *Buchanania barberi* as Critically Endangered. This red list category assigned to a species means it is facing an extremely high risk of extinction in the wild and is in need of urgent action. The current population trend of this species is also declining.







Mature fruits of *Buchanania barberi* (Anurag Dhyani)

I further noticed other species of the genus in the IUCN Red List. For example, *Buchanania vitiensis*, *B. lanceolata* and *B. platyneura* are categorized as Vulnerable and *B. obovata* and *B. insignis* as Least Concern in the IUCN Red List. The overall picture inspired me to develop a conservation action plan for *B. barberi*, which could also help to conserve other species of genus *Buchanania*.

### Expanding the work

In 2019, I submitted a proposal 'Conservation of endemic and Critically Endangered *Buchanania barberi* in India' to The Mohamed Bin Zayed Species Conservation Fund, UAE. The fund board members decided to support our work. Our team again visited the natural habitat of target species and recorded the associated species with *Buchanania barberi*. During the fruiting period, we collected maximum seeds, brought these to the laboratory, and placed them in open trays. To germinate the seeds, we removed the pulp from the seeds and placed them in petri dishes. The seeds take approximately 20-30 days to germinate. The germinated seeds were then transferred to growing media in polybags. These polybags were placed in a plant nursery, nurtured for a few months, and then transplanted. Our project team visited schools near to the natural habitat of *Buchanania barberi* and conducted awareness activities to conserve the tree. We shared information about the identification features of the tree, characters of flower, fruits, and major threats. Conservation awareness material viz., cotton bags, water bottles, coffee mugs and posters were distributed among students to raise their enthusiasm and love for rare trees.

### Acknowledgements

This work was supported by The Mohamed bin Zayed Species Conservation Fund, UAE (grant number 180519970) and Global Seed Conservation Challenge Fieldwork Fund, BGCI, United Kingdom.



Seedlings ready for transplant (Anurag Dhyani)

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**Thiruvananthapuram, PIN- 695562,**  
**Kerala, India**

*Buchanania barberi* is an evergreen tree belonging to family Anacardiaceae and endemic to the South Western Ghats of India. Dr. C. A. Barber was the first person to collect specimens of this tree in Nadarai, Thiruvananthapuram in 1904. Twelve years later, in 1916, Dr. J. S. Gamble described the species. Due to its rarity and limited distribution, the species was assessed as Endangered in the Red Data Book of Indian Plants in 1990. Subsequently it was published as Critically Endangered on the IUCN Red List of Threatened Species in 1998. JNTBGRI researchers rediscovered the species in 2002 (Kumar *et al.*, 2002) and we reassessed the species with new data as Critically Endangered in 2018 (Dhyani and Anilkumar 2017; Barstow, 2018). JNTBGRI is continuing its efforts to save rare trees of the Western Ghats.



Team after fruit collection (Anurag Dhyani)



# FEATURED GARDEN OMAN BOTANIC GARDEN AS A CONSERVATION CAMPAIGNER FOR THREATENED AND ENDEMIC ARABIAN PLANTS



*The near-endemic Terminalia dhofarica (Combretaceae) (Annette Patzelt)*

## The motivation for Oman Botanic Garden

**B**otanic gardens are key players in addressing the loss of plant diversity. In response to the global biodiversity crisis, botanic gardens are increasingly taking on plant conservation as a focus of their work. For conserving threatened and endemic plant species, gardens are institutions that have the botanical, horticultural, and educational expertise, as well as the specialist facilities required to cultivate, conserve and showcase the world's threatened plant species.

The Oman Botanic Garden (OBG), 430 ha in size, is a new botanic garden, currently under construction in Muscat, Oman. The garden is a substantial investment as the government of Oman recognizes the critical role botanic gardens play in a

scientifically informed, coordinated endeavor to rescue plants from extinction. The garden focuses on the native Omani flora, the rich ethnobotanical relationships between plants and people, and the promotion of sustainability through all stages of design, construction and operations. OBG encompasses horticulture, botanical science, and public education; these interwoven elements are at the heart of the garden's ethos. Cultivating and showcasing Oman's native flora in carefully designed naturalistic habitats OBG represents a new model for botanic gardens and is a pioneering project of *ex situ* conservation in Arabia.

The design of the garden was inspired by the complexity and the richness of Oman's flora, habitats and ethnobotanical traditions. The design created innovative and individual solutions that are inextricably linked and respond to the

local site conditions. A holistic, multi-disciplinary, and integrated approach proved to be critical for the success during the design process (Patzelt & Anderson, 2016).

There are very few botanic gardens in the Middle East and South-West Asia (Aplin, 2014) and the flora of the region is consistently underrepresented in botanic gardens. Oman Botanic Garden is filling this gap and represents a powerful institution for preserving Oman's plant diversity including its threatened and range-restricted species. With 60% of all species on the Oman Red List being in the collections at Oman Botanic Garden, out of which 28% are threatened species, Oman Botanic Garden has made respectable progress towards GSPC Target 8, calling for at least 75% of threatened plant species (species which qualify into the categories of 'Vulnerable',



'Endangered' or "Critically Endangered" as per IUCN criteria) in *ex situ* collections by 2020. This figure is impressive, as threatened species are often harder to find and more difficult to cultivate and manage. Globally, in 2017, only 41.6% of all plant species assessed as threatened were held in living collections (Mounce *et al.*, 2017).

### Overview of Oman's flora, including conservation threats

Oman in the southern Arabian Peninsula is characterised by arid habitats, with much of the region occupied by sand dunes or rock and gravel desert. Endemic species are found in all vegetation types throughout the country; five regional centers of endemism have been recognized and the flora of the country is estimated about 1,407+ taxa (Patzelt, 2015). The Oman Plant Red Data Book (Patzelt, 2014) includes 261 taxa and outlines the most up-to-date statistics relating to Oman's endemic and threatened species with 189 range-restricted taxa (15.8% of the total flora). 78 plant species are strictly endemic to Oman, 48 species are near endemic (species occurring in one geographical entity, but in two countries), and 63 species are regional endemic to the Arabian Peninsula; an additional 72 species are threatened but not range-restricted.



*The near-endemic Kleinia saginata (Asteraceae)* (Annette Patzelt)



*The endemic Hyoscyamus gallagheri (Solanaceae)* (Annette Patzelt)



*The endemic Wadithamnus artemisioides subsp. batharitica (Amaranthaceae)* (Annette Patzelt)

The percentage of range-restricted species in the country rose from an estimated 5% in 1991 (Miller & Nyberg, 1991) to 15.8% 23 years later (Patzelt, 2014). Unfortunately, considerable degradation of the natural vegetation is rapidly increasing and no protected area has been identified solely on the basis of its flora and vegetation. Current *in situ* conservation activities are inadequate for the long-term preservation of the country's biodiversity. Grazing and development are the main threats to range-restricted and threatened species; climate change is suspected to present an increasing threat to the survival of many species and whole ecosystems (Patzelt, 2014).

### Rare and range-restricted plants in the garden collections

An important mid- to long-term aim of Oman Botanic Garden includes building up a comprehensive *ex situ* collection of threatened and range-restricted species of Oman. Oman Botanic Garden holds the largest documented Arabian plant collection in the world. For the most part, the species in cultivation are not grown in any other institution worldwide (Patzelt *et al.*, 2008, 2009; Lupton *et al.*, 2017). All material is collected in the wild or from wild material in the garden's nursery; all

collections are verified. Collecting and managing this vast array of botanical diversity has been an enormous task involving extensive field work, plant identification and verification, data recording, propagation, cultivation and seed processing. A key role in guiding and directing the plant collection and cultivation has been the development early on of a detailed production list. The list was an essential tool during the design process and the current planting phase and is continuously updated to reflect the latest status of the collection.

For the analysis, the Oman Plant Red Data Book has been used, and compared against the current figures of the living collections and seed bank. A few taxa were added to the analysis, mostly species newly described after the publication of the Red List (e.g. *Lavandula nooruddinii* Patzelt & Al Hinai).

A total of 82 species (31% of all RL species) are currently in cultivation. The threatened and range-restricted taxa cultivated belong to different life-forms and originate from different habitats. An additional 36 species (13.8%) were in cultivation at some stage but have unfortunately been lost as their cultivation did pose a challenge.

						Total
<b>Living Collections</b>	In cultivation	In cultivation	Formerly in cultivation	Formerly in collection	Never in collection	
<b>Seed bank</b>	Absent	Present	Absent	Present	Present	
<b>Number of species</b>	24 (9%)	58 (22%)	21 (8%)	15 (5.8%)	38 (15%)	<b>156 (60%)</b>

Table 1: Summary of Red List species in the collections (absolute numbers; % of Red List species)



Threat Categories	Critically Endangered	Endangered	Vulnerable	Near Threatened	Least Concern	Data Deficient	Total
LC present; SB present	5	5	19	12	17	0	58 (22.2%)
LC present; SB absent	3	1	9	8	2	1	24 (9.2%)
Formerly LC; SB present	0	0	8	2	5	0	15 (5.8%)
Formerly LC; SB absent	4	3	5	4	4	1	21 (8%)
LC absent; SB present	1	3	8	11	12	3	38 (14.6%)
<b>Sum</b>	<b>13 (5%)</b>	<b>12 (4.6%)</b>	<b>49 (18.8)</b>	<b>37 (14.2%)</b>	<b>40 (15.3%)</b>	<b>5 (1.9%)</b>	<b>156 (59.8%)</b>

Table 2: Proportion of Red List species in the collections (absolute numbers; % of Red List species) (LC= living collection; SB= seed bank)

Further research is required for all species as most plants were never cultivated before in any institution worldwide and therefore no previous experience of cultivation conditions exists. 112 species (43% of all RL species) are currently in the seed bank at Oman Botanic Garden. The current seed bank is a preliminary facility; a final seed bank is planned for a later stage.

All collections are formally verified and data on their origin and habitat are fully recorded. As part of a systematic approach to assess the status of the collections, regular auditing and evaluation of the living collections is undertaken. This includes weekly inspections, supported by routine curatorial practices, such as producing inventories, and applying the latest taxonomy.

### Cultivation of rare and threatened plants at OBG

The nursery is at the core of the gardens' operations, it is where plants begin their journey from propagation to cultivation and eventual planting out. In general plant cultivation focuses on the production of the 100,000+ plants required for the enormous planting plan. However, there is also a concerted focus on the development of an *ex situ*-conservation collection. As with any pioneering project this has met with a wide range of challenges. Cultivation success or failure has not been confined to any particular life-form, however, trees and large shrubs, in general have proven to be more successful. Tree species such as *Dracaena serrulata*, *Juniperus seravschanica* and *Terminalia dhofarica* have been effective from seed; however,



The regional endemic *Seddera glomerata* subsp. *dhofarensis* (Convolvulaceae) (Annette Patzelt)



The threatened *Juniperus seravschanica* (Cupressaceae) (Annette Patzelt)

the percentage germination value is often low so large quantities of seed must be sown to achieve cultivation targets. OBG employs a policy of sowing 5x the cultivation target to compensate for low germination rates and the potential loss of young plants during the early phases of cultivation. Conversely there are a number of tree species which continue to allude the best efforts of the propagation team. Despite numerous attempts *Pistacia falcata*, found in scattered clusters in Oman's southern mountains has never been successfully propagated at OBG. *Boscia arabica*, another infrequent tree from southern Oman has proven extremely difficult – a combination of low levels of seed production, low viability and slow establishment rates means *B. arabica* has not established at the garden.





*The endemic Aloe whitcombei (Asphodelaceae) (Annette Patzelt)*

Experimentation including seed treatments, variations in the time of collection and sowing, and varying compost ingredients play an important role in cracking the enigmatic germination requirements of certain species. The germination of *Berberis integerrima* proved impossible for many years until it was decided to sow seeds immediately following collection in the field; in this case sowing untreated, fresh seeds was the key to success. In the absence of detailed cultivation literature for most of Oman's native plants the garden team is required to tackle germination step-by-step. Propagation and cultivation methods for all species are recorded on the garden's collections database (BG Base). The database represents an important repository of information, essential for the development of a viable *ex situ* conservation programme for the flora of Oman and the wider region.

### **Future plans for plant conservation in Oman Botanic Garden**

The world's botanic gardens and arboreta grow at least 105,634 species, equating to 30% of all plants on earth; they conserve at least 41% of the world's known threatened plant species (Mounce *et al.*, 2017). However, an average of only 14% of accessions are from known wild

origin and only 32% of accessions are verified (Aplin, 2014). Close to 100% of Oman Botanic Garden's living collections are fully verified and of known wild origin, making the collections unique internationally. 52% (136 species) of Oman's Red list species are currently in the living collections and seed bank, with new accessions being added regularly.

The conservation value of a collection is highly dependent on the level of its genetic diversity. An effective *ex situ* conservation collection must include up to hundreds of individuals of known wild origin, collected from multiple mother plants across the range of the species (Guerrant *et al.*, 2004). Although Oman Botanic Garden plant collections hold intrinsic conservation value they are unlikely to represent the levels of genetic diversity outlined by these ambitious standards in the near future. This is largely due to the nature of garden's current collection policy which was designed to capture large numbers of seeds for the cultivation of large numbers of plants. Future plans include strengthening the conservation value by extending the genetic diversity of its collection.

With its sophisticated facilities and botanical and horticultural expertise, Oman Botanic Garden is uniquely positioned to address many of the challenges associated with conserving plant diversity in an arid region. One exciting opportunity for the garden is to develop as a regional centre in the science and practice of ecological restoration of arid ecosystems. Linking with ecological restoration OBG also has the opportunity for the large-scale production of native plants for ornamental horticulture; an increasingly important element of city planning in hyper-arid regions of the world.



*The near-endemic Aloe dhufarensis (Amaranthaceae) (Annette Patzelt)*





The Oman Botanic Garden liner house is a transition between the propagation unit and the nursery (Darach Lupton)



The regional-endemic *Dracaena serrulata* (Asparagaceae) (Annette Patzelt)

To promote its unique plant collection, Oman Botanic Garden needs to engage with the broader society. It is vital that the garden provides advice, skills, and plant material to a wide range of stakeholders, including government, educational institutions, and society. The garden needs to widely promote its unique skills and potential as a regional leader in plant conservation. Engaging and inspiring people about the value of plant diversity is a key step to mobilizing funds and addressing the plant extinction crisis. Oman Botanic Garden will become an impactful institution for presenting science-based messages and information on the fundamental importance of Oman's plant biodiversity and its threatened and range-restricted species as well as on topics such as habitat degradation and climate change.

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# INTERVIEW TALKING PLANTS

For this issue of *BGjournal*, we were delighted to interview **Malin Rivers**, Head of Conservation Prioritisation at BGCI and leader of the Global Tree Assessment.



## *Why do we need a Global Tree Assessment?*

Trees are iconic species in the landscape, providing essential ecosystem services to our planet and humanity; they also provide habitats, food and shelter for an even wider range of biodiversity. The widespread loss and degradation of native forests (and other habitats) is recognized as an environmental crisis; however, the impacts of the decline and loss of tree species have until now been largely unknown.

The Global Tree Assessment (GTA), with complete global assessments of the conservation status of all tree species is an urgent priority, to ensure that the best available information is used when making conservation decisions, allowing prioritisation of plant conservation action on a species, local, national and international level. Making more conservation assessments available for trees, enables limited resources to be channelled towards those species identified as most at risk of extinction.

## *What is the goal of the Global Tree Assessment?*

The GTA aims to have a conservation assessment for every tree species in the world. The initiative is mobilising expertise and providing information to prioritise conservation action for trees. The GTA is a huge collaborative operation, although managed and coordinated by BGCI and the Global Tree Specialist Group alongside the IUCN; it has only been made possible with all the many national and local institutions and individuals that have contributed their expertise. The ultimate goal is that this information will inspire, catalyse and enable conservation action to ensure that no tree species becomes extinct.

## *You have many botanic gardens as key partners in the GTA. Why are botanic gardens ideal partners?*

Botanic gardens play a very important part in the GTA. We have teamed up with large and small gardens worldwide in order to assess the world's trees. Botanic gardens have important collections, which are widely used in the GTA – living plants, seed collections, herbaria, libraries, etc. But perhaps more importantly, the expertise and people that work in botanic gardens are invaluable to the red list assessment process. Botanic garden staff have unique and essential information on tree species: field knowledge, taxonomic expertise as well as propagation experiences.

## *Why do we use the IUCN Red List Categories and Criteria to assess extinction risk?*

We assess all trees using the IUCN Red List Categories and Criteria, as this is the most widely used system for assessing the probability of extinction for species. The IUCN Red List assign species to different categories of extinction risk based on five quantitative criteria, including measures of population sizes, restricted geographic distribution and rate of decline. Information from the IUCN Red List is also widely used to inform conservation policies and legislation, as a tool for environmental monitoring and reporting, and to

prioritise areas for conservation action; it has also been used at the global scale to monitor biodiversity loss.

## *How much more data is now available for tree conservation and how can conservation practitioners use it?*

When we started the GTA in 2015, there were approximately 10,000 tree species listed on the IUCN Red List. Today there are over 32,000 tree species listed. These assessments are freely accessible from the IUCN Red List website, including supporting information and spatial data. In addition, a further 10,000 tree species have been assessed outside the IUCN Red List for national or regional Red List initiatives. Since the start of the GTA, we have published a checklist of the world trees in the database GlobalTreeSearch and a compilation of conservation assessments of all plants in the database ThreatSearch, both databases are available on the BGCI website. Coming very soon, we will also be launching our Global Tree Portal to provide further focus on trees and their conservation status. All this data can be combined to prioritise trees of conservation concern for practical, field-based conservation action to prevent tree extinctions. Information included across the databases and within assessments can show what the major threats to the species are and can provide insight into the conservation needs of the species. In general, assessments help inform conservation decision making at different levels of society and for different funding levels.

## *The Global Tree Assessment has been running for around five years now, do you have a particular highlight from your time working on the initiative?*

One of my personal highlights of the GTA was a Borneo assessment workshop held at Flora Malesiana in 2019, in Brunei Darussalam. At this meeting we worked with experts from three countries, covering all regions in Borneo (Sabah, Sarawak, Brunei, Kalimantan), collaborating across national borders, combining their datasets as well as their expertise to assess the endemic species of Dipterocarpaceae of Borneo. Previously, assessments had been made on a local (state-level) scale, but this was the first time a collaborative approach was taken on these.



# ARTICLES

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THE PEOPLE BEHIND THE RED LIST ASSESSMENTS

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**THREATENED TREE ASSESSMENTS AND  
TROPICAL IMPORTANT PLANT AREAS**



# THE MAKING OF THE GLOBAL TREE ASSESSMENT: THE PEOPLE BEHIND THE RED LIST ASSESSMENTS



*Regional Global Tree Specialist Group Meeting and Central America Red List Training Workshop, La Selva Costa Rica 2019*



The Global Tree Assessment, led by BGCI and the IUCN Species Survival Commission (SSC) Global Tree Specialist Group (GTSG), aims to assess the conservation status of every known tree species.

## Introduction

On the face of it, the Global Tree Assessment (GTA) is an initiative to produce conservation assessments for all the world's tree species and prioritise conservation action for those most at risk of extinction. However, in practise it is much more than this. The GTA is the most comprehensive assessment for trees to date, evaluating

the extinction risk for over 58,000 tree species. And to complete such a feat requires innovative action, capacity building and most importantly a vast network of tree expertise from botanic gardens, forestry institutions and other organisations. Therefore, within BGCI, the GTA has created a dedicated network of global tree assessors and experts.

The GTA began in 2015, when the number of tree species present globally was unknown and there were only around 10,000 assessments for tree species published on the IUCN Red List of Threatened Species. In the midst of our current biodiversity crisis, without this global analysis it was not possible to know which tree species were in most need of conservation action and protection.



*Ethiopia Red List Workshop 2018 (Emily Beech)*



**BOTANIC  
GARDENS**  
CONSERVATION  
INTERNATIONAL



**SSC**  
Species Survival Commission

**GTSG**  
GLOBAL TREE SPECIALIST GROUP



## Foundations of the GTA

The first stage of the GTA was to create a database of the world's tree species. From 2015 to 2017, a checklist of the world's tree species and their country level distribution was collated, using online species lists, published floras, scientific papers and monographs.

GlobalTreeSearch, the first comprehensive list of all the world's tree species was published in April 2017 (Beech *et al.* 2017). It is continually updated to reflect changes in tree taxonomy and additional information on the distribution of different tree species. GlobalTreeSearch currently lists 58,498 unique species of tree (GlobalTreeSearch 2021).

GlobalTreeSearch was the starting point for building a network of engaged tree experts and enthusiasts. This began by enlisting the help of the IUCN Species Survival Commission (SSC) Global Tree Specialist Group (GTSG). As the host of the Secretariat to the group, BGCI was well placed to engage with the GTSG as well as the recently renewed botanic garden networks coordinated by BGCI. These included the Southeast Asia Botanic Garden Network (SEABG) and the African Botanic Garden Network (ABGN). Additionally, existing Global Trees Campaign (GTC) partners were called upon to help.

In developing GlobalTreeSearch, members of the GTSG and botanic garden networks were asked to contribute their own tree lists but also to review lists of tree species per country, region, family or genus of interest. Many of these individuals and their organisations went on to become GTA partners and assessors.

Another first for the Global Tree Assessment, was the production of the ThreatSearch database ([https://tools.bgci.org/threat\\_search.php](https://tools.bgci.org/threat_search.php)). Although not tree specific, this database compiles available conservation assessments for plants including assessments on the IUCN Red List, national Red Lists, Red Data Books and conservation assessments included in other published literature. The initial production of the dataset involved collaboration between BGCI, IUCN, the Zoological Society of London and the Royal Botanic Gardens, Kew but since this time, thousands of additional assessments have been added. Many more individuals and organisations have made contributions to the database including NatureServe and CNCFlora.

With the completion of the GlobalTreeSearch and ThreatSearch databases, the Global Tree Assessment was able to identify which trees were without a conservation assessment and where. New partnerships with those who



*GlobalTreeSearch and ThreatSearch*

had contributed to GlobalTreeSearch could be forged and assessment work could become more focused on under-represented groups and large tree families (Annonaceae, Sapotaceae and Lauraceae), identified through analysis of data in the new databases.

GTA partners could also begin to undertake assessments for an entire nation's endemic tree flora in earnest. To mobilise this conservation assessment action, the next steps were training the GTA's network of assessors, working with new technologies and establishing new workflows for assessment and review.

## Building partnerships and establishing a network of tree assessors

Over the last three to five years, the Global Tree Assessment has established over 60 partnerships for tree conservation assessments. When developing partnerships with both individuals and organisations, we have taken a range of approaches including taxonomic, national or regional. For example, to assess Lamiaceae and Lauraceae species we worked with an individual, Rogier de Kok, a taxonomic expert, while for Central America we worked with regional specialists. We have also worked with a plethora of different organisations. Examples include Maastricht University whose researchers are assessing species of Annonaceae, Royal Botanic Gardens Edinburgh are assessing trees in the Sapotaceae and the Sabah Forestry Department has worked on assessments for all trees endemic to the Malaysian state. In South America, we work with some well-established red listing organisations, including CNC Flora in Brazil who are contributing assessments for all Brazilian endemic trees, building on their on-going work. We have worked with IUCN Plant Specialist Groups, including Colombia, Indonesia and Madagascar who have reviewed and produced assessments for endemic trees over the past several years.



*Dipterocarp Review Meeting at Flora Malesiana in 2019 in Brunei Darussalam (Megan Barstow)*

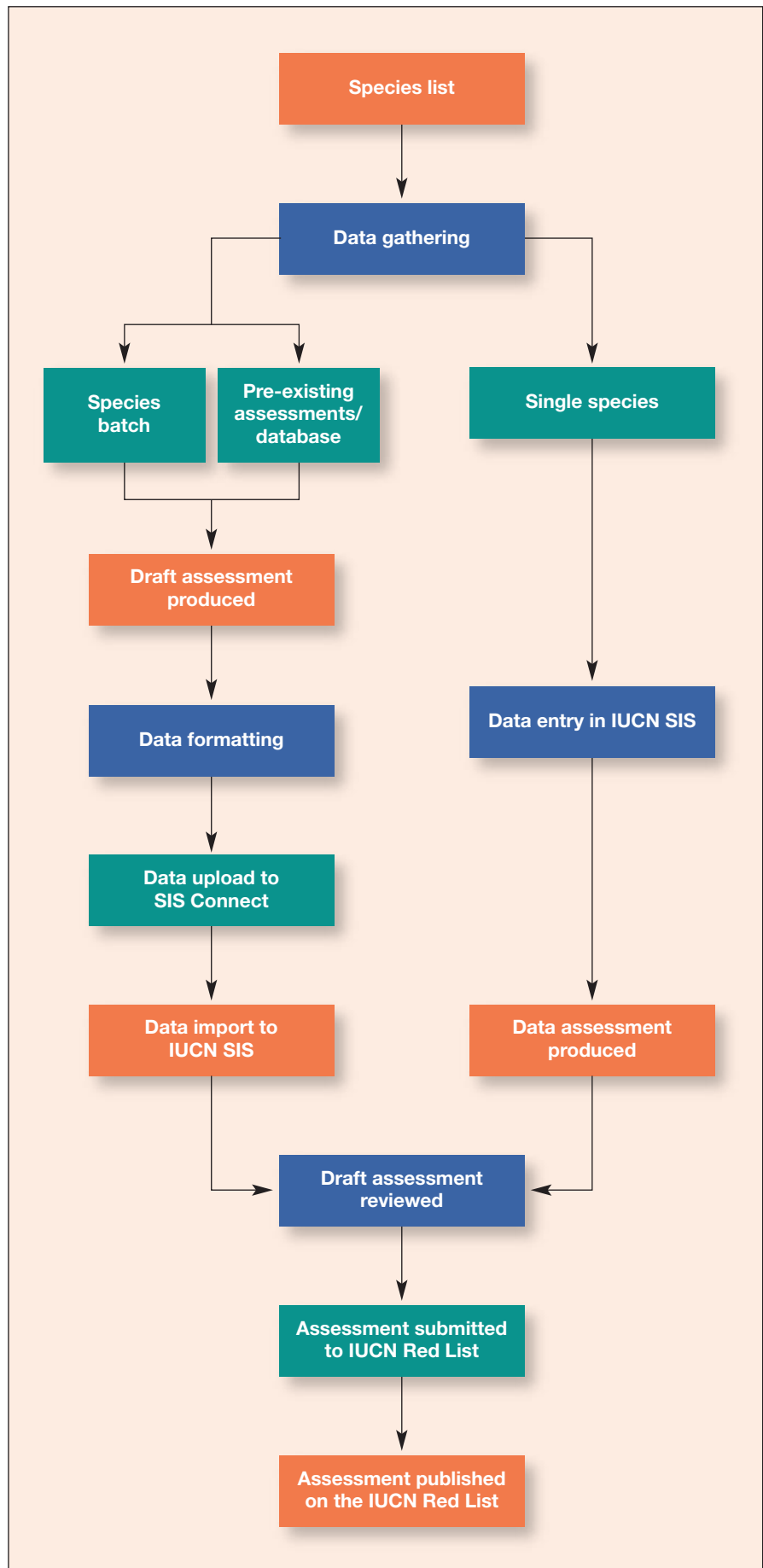


In addition to the individuals carrying out Red List assessment (assessors), each assessment also requires an expert review before publication (reviewer). Some individuals are not part of the assessment or review, but are contributing their information and expertise (contributor). Assessors and contributors can be involved in the data gathering phases of the assessment, including producing maps to support the assessments, but only the assessors are involved in the final decision of which Category and Criteria to use to assess the species. It is then the job of the reviewer to ensure the data in the assessment is correct and enough evidence is provided to support the final assessment of the species. Due to this process in total, the number of people we have worked with as assessors, contributors and reviewers in the last five years totals several hundred.

*The Global Tree Assessment remains open to all botanists and taxonomists who are encouraged to contribute to red list assessments of trees they have recently described, they are preparing monographs for or information they have collated during the completion of country level floras .*

### Capacity building

As well as our partnerships being flexible and tailored, we also deliver red list training in a variety of ways to best suit the interests and needs of partners. For example, face to face training to a single organisation was delivered to staff at Papua New Guinea’s Forest Research Institute to build capacity towards the completion of assessments for all trees endemic to Papua New Guinea, while other meetings brought experts together in red list workshops that spanned whole regions (Caribbean, Central America, South Pacific, Southeast Asia). Generally, our focus for red list training is in tree diversity hotspots and areas where conservation assessments for trees are lacking. Global Tree Assessment training meetings give specialists confidence to use the IUCN Red List Categories and Criteria with the data that is readily available and without the need for additional survey work, a keystone to the delivery of the initiative. The meetings also give individuals time to put their skills into action and to begin writing red list assessments, which will ultimately be published by IUCN and count as scientific publications.



*Flow diagram showing the process for producing a Red List assessment using IUCN SIS Connect or IUCN SIS Database*





*Red List workshop in the Philippines, 2019 (Energy Development Corporation)*



*Red List workshop in Papua New Guinea, Papua New Guinea Forest Research Institute Lae (Megan Barstow)*

Over the course of the Global Tree Assessment so far, over 390 people from 18 countries representing 140 institutions have been trained. This capacity building work not only results in additional tree conservation assessments but also enables trainees to support others, to use the assessment methodology for other non-tree groups and to better use and understand the IUCN Red List for conservation action. Training workshops provide great opportunities for BGCI staff to meet GTA partners and, by bringing assessors together, they also promote future collaboration and strengthen connections between regional botanical experts.

These training sessions also often allow time to review assessments completed by others, such as those done by BGCI, by other in-country GTA partners, or for species that might be Least Concern (using the LC Workflow – see below).

These meetings truly highlight the collaborative nature of the IUCN Red List assessment process and help to build relationships and networks within regions. It is through these workshops we were able to complete assessments for the total Malagasy Tree Flora (Beech *et al.*, 2021) and all Dipterocarps endemic to Borneo (in prep).

The GTA has a global mission, to raise awareness and help others lead and produce global tree assessments. To that end, workshops for tree assessments have also been carried out by other GTA partners, with RBG Kew, Missouri Botanical Garden and Morton Arboretum playing a particularly central role in assessments for West Africa, Ebonies and Oak/US trees respectively. As well as these large gardens, smaller gardens also have a role to play. For example, Vailima Botanical Garden in Samoa, Jardin botanique des Cayes in Haiti and Nassau Botanical

Gardens in the Bahamas have all hosted tree red listing workshops and training in recent years. We have also inspired other IUCN SSC Groups and Red List Authorities (RLA) to get involved, with the West African RLA, East African RLA, and the Indonesian Plant Specialist Group all contributing assessments and the Central African RLA and Palm Specialist Group reviewing many species of tree before submission to the IUCN Red List Unit.

### **Novel tools and technologies**

Work at BGCI on tree assessments has not stopped since 2015. As well as establishing partnerships, GTA staff at BGCI have been working on their own tree assessments and developing new methods to rapidly assess and review tree species. To that end, GTA developed a rapid assessment workflow also known as the Least Concern, or LC, workflow. This workflow combines point data from the Global Biodiversity Information Facility (GBIF), GlobalTreeSearch and ThreatSearch. If, according to the data, the range of a species is calculated to be much larger than the IUCN Red List thresholds, and there is no indication of population decline or small population size, then a preliminary Least Concern assessment is generated. These generated assessments are then sent for specialist review, when any species considered to be of conservation concern can be removed from the workflow for more detailed assessment. Assessments that pass the review are uploaded through the IUCN Red List Unit's batch uploading toolkit, SIS Connect, for publication on the IUCN Red List. Developing the process of identifying Least Concern species, by utilising freely available databases has allowed us to rapidly identify and publish over 5,000 Least Concern IUCN Red List assessments.

Traditionally IUCN Red List Assessments are completed online using the IUCN Species Information Service (SIS). This is the central database used by IUCN to store and manage species accounts and assessments for publication on The IUCN Red List and is how the majority of assessments are being completed for the GTA. SIS Connect allows assessments from external databases to be imported into SIS. For this to happen, the data must first be migrated into formats compatible with SIS, and then pass the validation process.



The use of the IUCN tool SIS Connect was new for the GTA team at the start of the project. However having learnt how to use this tool for our own workflows, we now pass on our knowledge to partners assessing large groups, and those who have pre-existing threat assessment databases are submitting their assessments through this process. For example, our Brazilian partners, CNC Flora, had already assessed many trees and all the data for these species had been gathered. By using SIS Connect and matching the two databases, assessments for Brazilian trees could more quickly and easily be submitted for review and publication on the IUCN Red List. Not only were the Brazil assessments some of the first threatened tree assessments to be completed through SIS Connect, they were also some of the first assessments in Portuguese and a foreign language to be published on the IUCN Red List.

### The pay-off

Using our multifaceted approach to tree red list assessments and tree assessment partnerships, we have been able to increase the number of tree assessments available on the IUCN Red List of Threatened Species to 32,070 (IUCN 2021). Additionally, data gathered on ThreatSearch shows that 42,681 trees in total have a global assessment and 15,319 are threatened with extinction (globaltreeassessment.org 2021). The success of our partnerships has meant that there has been a tripling of published tree assessments since 2015. But there is still more to be done to complete the GTA and for this to be followed up with practical, on the ground tree conservation action.

It is not over yet for the GTA, as 15,817 species of tree still require assessment for the IUCN Red List. Therefore, over the next two and half years, GTA partners will remain active and will continue to contribute to our goal of completing assessments for all the world's tree species. As well as assessing new species we will also focus on updating assessments for trees that are over 10 years old on the IUCN Red List. A new challenge for GTA will be engaging with national red list units, to amend National assessments for inclusion on the IUCN Red List. All in all, over the next few years



South Pacific Tree Red List Workshop, Samoa 2019 (Emily Beech)

we will be enhancing our networks and upskilling our assessors, so that GTA has a lasting legacy on global tree and plant conservation efforts.

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Tree Red List Workshop 2017, Les Cayes Botanical Garden, Haiti (Emily Beech)





## USBG AND BGCI: A LONG-STANDING PARTNERSHIP AIMED AT BUILDING BOTANIC GARDEN PLANT CONSERVATION CAPACITY

### Introduction

**B**otanic gardens can play a unique role in plant conservation, not only actively collecting, propagating, growing, and repopulating threatened species, but also serving as a source of botanical education and a location for people to connect with plants. For more than 14 years, the United States Botanic Garden (USBG) and the U.S. office of Botanic Gardens Conservation International (BGCI) have been working together to support botanic gardens to conserve plants, including a number of initiatives focused on tree conservation.

This long-standing collaboration has included guiding and tracking international plant conservation progress, assessing and collecting species of conservation concern, and communicating threatened species information to the public. Overall, joint projects have been designed to provide community-wide information, tools, and models to guide plant conservation efforts in the U.S. and across the world.

As the U.S. Botanic Garden celebrated its 200th anniversary in 2020 and has renewed its focus on supporting scientific research and conservation, the Garden is



*Top and above: Native tree assessment  
(Wesley Knapp)*

excited for current projects focused on native species assessment and conservation. The partnership with BGCI provides multiple opportunities to strengthen and grow this work, ranging from the Global Tree Assessment of native US trees to the conservation of native fruit and nut tree wild relatives.



## Assessing and prioritizing the conservation status of native trees

Over the past three years, the USBG and BGCI have begun new conservation projects with a variety of additional partners that have a greater focus on smaller plant groups, especially the assessment of native trees. Collecting and conserving crop wild relatives is an important tool in maintaining crop genetic diversity and their resilience to climate change and biological attacks. BGCI-US, USBG, and Missouri Botanical Garden have created a new initiative focusing on the conservation of North American fruit and nut tree crop wild relatives in 10 genera (*Asimina*, *Carya*, *Castanea*, *Corylus*, *Diospyros*, *Juglans*, *Malus*, *Persea*, *Pistacia*, *Prunus*). The initiative aims to catalyze efforts among botanic gardens, crop gene banks, commercial growers and other relevant research organizations to strengthen conservation of these important crop wild relatives.

Crop wild relatives collaborators convened an initial meeting with over 80 botanic garden, crop gene bank, academic, and other aligned organizations in May 2021 and followed it up with a survey to assess collections, identify current capacities, and create working groups for common areas of interest. These groups will determine

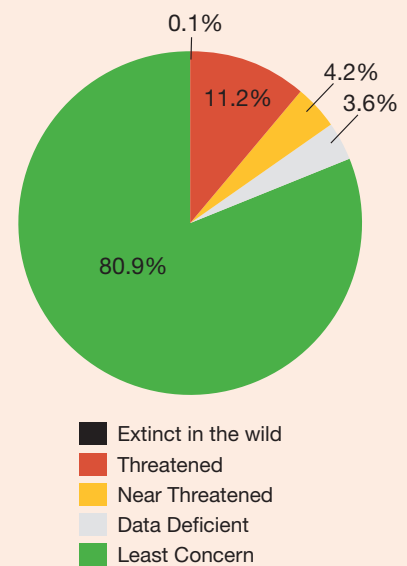
### Box 1: Conservation Assessments of US Trees

The US Trees Group is a collaboration between BGCI-US, The Morton Arboretum., NatureServe, and USBG. A major achievement of this group is the first-ever completion of conservation assessments of all 841 native, continental U.S. tree species, as part of the Global Tree Assessment (GTA). Nearly all assessments have now been completed, and this has revealed that over 11% of U.S. tree species have a threatened status (see Fig. 1). These assessments relied on hundreds of collaborators and species experts across the U.S. who provided essential species information. Our team also sought to leverage as much available information as possible to support species assessments, so we created a novel crosswalk methodology between the IUCN Red List and NatureServe's global conservation status, the two complementary assessment frameworks in North America. We compared information between the two systems, identified misaligned assessments and equivalent assessment fields, and then translated priority NatureServe assessments into the required IUCN Red List format.

Finally, experts and NatureServe collaborators reviewed the assessments and they were published to the Red List.

We are now working to publish our findings, expand the geographic and taxonomic scope of the initiative, update assessment data, and make the resulting tree conservation dataset more broadly available via BGCI.

**Fig. 1: US Tree assessment (all threat categories combined)**



Native tree assessment - Big Bend National Park (Wesley Knapp)

gaps in *ex situ* collections and genetic diversity, create plans to fill identified gaps, and install mechanisms to share plant material between gardens for successful redundancy in collections. This project is just getting underway, so if your garden or organization would like to participate, please reach out to BGCI-US.

Another major project nearing successful completion is the creation of a crosswalk methodology between IUCN Red List and NatureServe assessment frameworks so that U.S. and international organizations and practitioners can benefit from information exchange between these two global conservation assessment systems. This effort also included completing the conservation assessments of all 841 native, continental U.S. tree species for the first time as part of the Global Tree Assessment (GTA). See Box 1.





*Paw paw in bloom (Ray Mims)*

### Threatened plant programs

Thanks in part to USBG-BGCI *ex situ* surveys of living collections, the data from which is combined in BGCI's PlantSearch database, we know that 100,000 of the 391,000 known plant species are grown in botanic gardens. With ever increasing pressure on plant populations around the world, the USBG has partnered with BGCI to support international plant conservation strategies, species conservation assessments, and *ex situ* conservation prioritization to ensure species protection and survival. The USBG has partnered with BGCI to support the creation of many assessments and plans, including the North American Botanic Garden Strategy for Plant Conservation, the Global Assessment of Orchid Collections, the North American Collections Assessment, and more.

Work to advance the most recent foundational North American Botanic Garden Strategy for Plant Conservation began well before it was published in 2016. A strategy team gathered information from U.S. botanic gardens to understand and document plant diversity in their collections and supported botanic gardens in both *ex situ* and *in situ* conservation of plant diversity. The strategy promotes public awareness of the importance of plant diversity and the wise use of resources, builds capacity for

conservation of plant diversity, and demonstrates botanic gardens' support by inclusion of plant and habitat conservation in their institutional priorities and plans.

The USBG and BGCI also embarked on a global assessment of orchid collections, finding that only 36% of orchid species known to be threatened are in garden collections, and a majority of the collections lack provenance information and adequate duplication across institutions. The report called for the expansion of *ex situ* orchid collections to contain a greater diversity of species and sufficient genetic diversity to prevent



*Wesley Knapp and Adam Black making field collections from a mysterious red oak population in an isolated Trans Pecos Texas canyon (Adam Black)*

species extinction. Diversifying orchid collections allows for them to support conservation and restoration programs.

The USBG served as the pilot garden for the BGCI-US conservation value assessment of living collections. After successful completion of the pilot, the process was implemented at several other gardens.

### Supporting unique threatened plants

BGCI and USBG assessed gaps in threatened and extinct-in-the-wild species in *ex situ* collections at botanic gardens, with the goal of increased sharing of genetic materials so that plants can be maintained in multiple gardens' collections. Aroids were determined to be an area of concern, and the BGCI and USBG convened an aroids symposium at the Huntington.

As *Amorphophallus titanum* is now officially listed as threatened, with fewer than 1,000 specimens believed to exist in the wild, a group of botanic gardens led by Chicago Botanic Garden are working together to genetically characterize the collections of corpse flower (*A. titanum*) and create a botanic garden equivalent of a "stud book" to promote active conservation through creating genetically diverse seedlings by being able to track and pair plants with different, known lineages. The USBG has submitted tissue samples for all of its 40+ mature *A. titanum* plants, and was able to receive and donate pollen through this project in 2020.





*Native tree assessment - processing herbarium sample (Wesley Knapp)*



*Top: Native tree assessment (Wesley Knapp)  
Above: Morgan Gostel, Seth Hamby and Farah Khojayori collecting at The John Fairey Garden, Hempstead Texas (Adam Black)*

## Expanding information sharing systems

In expanding system capabilities to further conservation work, USBG is supporting expansion of the capabilities of BGCI's PlantSearch and GardenSearch databases, including the ability to search for crop wild relatives across gardens and species and determine whether a specimen in a collection has a known provenance. In order to assess the current state of conservation investments and efforts at public gardens, USBG supported the development of the North American Plant Conservation and Biodiversity Benchmarking survey. The rollout of the survey was done in collaboration with the American Public Gardens Association and included questions about *ex situ* and *in situ* conservation, funding for conservation activities, scientific research and expertise, education initiatives, communication, and leadership and governance. The project began eight years ago, with the goal of supporting updates to the North American Plant Conservation Strategy and helping gardens compare their programs with those of their peers.

Earlier this year, USBG and BGCI worked with the Global Genome Initiative-Gardens program to support the collection and preservation of tissue and DNA vouchers for living collections at

gardens, arboreta, and other plant-focused organizations worldwide. Funds were awarded to 14 gardens from 9 countries to obtain material missing from existing genomic collections. The Global Genome Initiative aims to collect and make available for research at least one species from each of the approximately 10,000 taxonomic families and at least one species from half of the estimated 160,000 to 200,000 genera of all living organisms. The USBG has been proud to contribute material from our own plant collection to this important project, joining in 2015 as the first participating garden.

The 14 awards given this year target collections of plant genera and families that have not been sampled so far. The awardees are collecting genome-quality plant tissue samples from their living plant collections and preserving them in a network of publicly accessible biorepositories. Both dried and frozen samples are being preserved.

Finally, botanic gardens exist to both grow and conserve plants and also share them with the public. In a typical year, the USBG welcomes more than a million visitors. The more than 3,500 botanic gardens across the world collectively welcome more than 750 million visitors and students each year. That represents a lot of opportunities to educate the public about plants and foster support for plant conservation. Several years ago,

BGCI and USBG worked together to create "Care for the Rare" educational interpretation templates. More than 100 species have fully designed interpretive panels that can be accessed for free, and custom signs can be created using a provided template. To bring this program into the digital world, USBG supported creation of a Care for the Rare app for smartphones, available for free in the Apple and Google app stores.

With over 14 years of successful partnership, dozens of completed projects, and new programs underway, the USBG-BGCI partnership continues to demonstrate how working together can advance shared goals much more effectively than working independently. If you see an area or project that your garden or organization might participate in, both USBG and BGCI would welcome hearing from you and exploring those opportunities.

**Devin Dotson,**  
**Public Affairs Specialist**  
**United States Botanic Garden**





*Thounia discolor* (Sapindaceae) (Ethan Freid)

## Introduction

The Lucayan Archipelago (The Bahamas and The Turks and Caicos) is a series of low-lying limestone islands to the east of Florida and northwest of Cuba covering over six degrees of latitude. With a known flora of over 1,400 species including ~ 1,100 natives, it has 245 tree species including several that are archipelago and regional endemics. Until recently, the only plant conservation work in the archipelago was passive, through the establishment of national parks, and the only plant conservation assessments were being conducted by taxonomists investigating individual species. This changed on March 24th, 2011, with the opening of the Leon Levy Native Plant Preserve (Levy Preserve) as a 30-acre botanical garden on Eleuthera, The Bahamas. The Levy Preserve was created to showcase the native plants of the

Lucayan Archipelago as well as the history of bush medicine and to support early childhood outdoor education. The garden has display beds featuring individual species as well as over 23 acres of natural forest area housing numerous tree species. The living collections include over 400 native species.

The main emphasis of the living collections program at the Levy Preserve is endemic species that are brought in for displays and *ex situ* conservation in the horticulture program. There are 89 species of vascular plants endemic to the

entire archipelago with 24 of them being trees. Of the endemic tree species, half are known to occur on only one or two islands. There are an additional 42 plant species endemic to both the Lucayan Archipelago and Cuba of which 17 are trees. All these highly restricted species are the current focus for assessments and conservation actions.

The Levy Preserve uses the 2011-2020 Global Strategy for Plant Conservation (GSPC) as the backbone of the science and conservation program in particular Targets 2 and 8.

# THE GLOBAL TREE ASSESSMENT AND RED LISTING: DRIVING CONSERVATION ACTIONS AT THE LEON LEVY NATIVE PLANT PRESERVE IN THE LUCAYAN ARCHIPELAGO





Bahamas/Cuba Red Listing workshop (Ethan Freid)

Target 2 of the GSPC is to have conservation assessments of all known species and Target 8 focuses on in-country *ex situ* conservation horticulture to prevent the extinction of threatened species. To even attempt to implement Target 8, countries need to work through assessments of the conservation status of their flora (Target 2), in order to determine which species to focus on for conservation projects. Without the basic information on the conservation status of a species, there is no path to effectively and efficiently spend critically limited conservation funds.

Until 2018 the Lucayan Archipelago was largely unable to conduct internally any level of species conservation assessments as there were no IUCN Red List trained personnel within the islands. Without the internal capacity, the archipelago was left with an *ad hoc* system where only economically important species were assessed and only by individuals with a high-level of taxonomic expertise in those species. In addition, there was no ability to do broad-scale assessments across many taxa and ecosystems. As a result, of the 89 endemic species to the archipelago, only two had assessments completed.

### Building capacity

To implement the GSPC and assist in the Global Tree Assessment (GTA) the capacity had to be created through training in-country personnel to be able to Red List across many taxonomic units. Without this, the assessment of the conservation status of any organism was difficult.

To assist in remedying this situation, the Levy Preserve and the Bahamas National Trust (BNT) hosted a Red List Training workshop in conjunction with BGCI and the Missouri Botanical Garden (MBG) (November 11-17th, 2018).

At the workshop, 13 Bahamians and eight other nationals from around the Caribbean learned how to conduct Red List assessments. The Red List training brought together many botanists that had

never met and highlighted the silo-like nature of the work being done by individual countries, without any regional or global application. For the Bahamas, in addition to the botanists, the training included professionals from the Bahamas National Trust, Department of Marine Resources, Bahamas Environment Science and Technology Commission, and Forestry.

Once the training was completed, it led to two additional Red List workshops with the next taking place in Cuba (April 12-18th, 2019) at the National Botanical Garden that focused on regional Caribbean Red List efforts. A third workshop took place on Eleuthera (September 9-13th, 2019) with a focus on Lucayan Archipelago-Cuban endemics.

Since the initial training more than 50 plant species have been assessed and evaluated and 32 now have Red List designations accepted and published. The 32 species that have been published by participants in the Red List training and workshops since 2018 consist of 2 Critically Endangered, 9 Endangered, 2 Vulnerable and 5 Near Threatened, as well as 14 species that are of Least Concern and are not a current focus for conservation actions.



*Callicarpa hitchcockii* flowers (Ethan Freid)



## **Ex situ conservation efforts at the Levy Preserve and in the Lucayan Archipelago**

To support the GPSC and GTA the Levy Preserve use the Red List process as a means of identifying the highest priorities for conservation and data collection. Without this information it is difficult to prioritize which species need to have the most immediate and pressing focus. The process of mapping distribution helps both determine the known extent of the species and at what level its distribution is documented. It has also been a crucial tool in evaluating how well the Bahamas National Trust Park system supports the conservation of plants (relevant to GPSC Target 7) and how many plant species have some level of *in situ* protection. As many species have initially been determined to be Data Deficient this has led to targeted field work to document their distributions and population size as well as provide living collections for the *ex situ* conservation program (GPSC Target 8) at the Levy Preserve on Eleuthera.

Using the Red List and the Global Tree Assessment as a focal point, the Levy Preserve conducts field work throughout the archipelago to (re)locate all the endemic vascular plant species of the archipelago, and in particular The Bahamas. As species are located, distribution maps are created, as well as obtaining, when possible, both seed and



*Conservation horticulture at the Leon Levy Native Plant Preserve showing the Critically Endangered *Cyperus correllii* (Ethan Freid)*

live specimen collections. These *ex situ* collections are now located at the Levy Preserve on Eleuthera and are part of the plant displays and in the nursery program.

Collection and distribution mapping trips have taken place on 11 islands (Abaco, Andros, Cat Island, Crooked Island, Eleuthera, Exumas, Great Inagua, Grand Bahama, Long Island, New Providence, and San Salvador). The initial focus has

been on tracking single and double island endemics. Of the 89 endemic species there are five species with naturally occurring populations (GPSC Target 7) occurring in the Levy Preserve and an additional 36 have been added to the living collection (GPSC Target 8). Unfortunately, Covid 19 travel restrictions throughout 2020 and 2021 have curtailed distribution and population size mapping as well as living collection expeditions and they are only now beginning again.



*Red List training in Nassau, The Bahamas in 2018 (Ethan Freid)*

The GlobalTreeSearch database currently includes 245 tree species known to occur in the Lucayan Archipelago. The Levy Preserve presently has in its living collection 145 (~59%) of the listed species, including 66 (27%) that have been added to the living collection and 71 (29%) in the naturally occurring forest areas. Efforts continue to have all native trees of the archipelago at the Levy Preserve in the living collection.

While much work is left to be done on the Global Tree Assessment for the Lucayan Archipelago progress is being made. Both the Bahamas and the region is now better able to conduct assessments and direct limited resources to the most “in need” species based on the Red List, the Global Tree Assessment, and the implementation of the Global Strategy for Plant Conservation.





Endemic Agave display bed (Ethan Freid)



Young *Guettarda nashii* (Rubiaceae) tree (Ethan Freid)

## Assessments in action

In support of the Global Tree Assessment the following three Lucayan Archipelago and Bahama/Cuba endemic tree species were evaluated.

*Thouinia discolor* is an endemic tree occurring throughout the entire Lucayan archipelago. The assessment process documented how widespread the species was and how large the reproductive population is. It is now on the Red List as Least Concern and is not a conservation priority target with numerous populations in multiple protected areas.

*Guettarda nashii* is an endemic species only known to occur on Great Inagua in the southern Lucayan Archipelago. The assessment process indicated how little information was known about the species beyond its description and a handful of herbarium specimens. Through the Red List process *Guettarda nashii* was targeted for collections for the Levy Preserve in 2019 and field work was initiated. Over a week-long period, the population and its threats were documented and its extent

on the island mapped. It is now listed as a Vulnerable species due to its small population size and distribution with ongoing threats from rising sea levels from climate change. Living collections were unsuccessful and additional collecting trips have been planned to ensure this species avoids extinction.

*Callicarpa hitchcockii* is a Bahama/Cuba endemic tree that was assessed as Endangered. The populations in Cuba are threatened from habitat fragmentation, development pressures and invasive species, and climate change is an issue in both countries. The Red List and GTA has moved it from a species that was little thought about to the forefront of conservation efforts to secure the species and avoid extinction. At the Levy Preserve there are both naturally occurring populations and it has been brought into the conservation horticulture program and it has already been introduced into the general horticultural trade.

**Ethan Freid**  
**Botanist**  
**The Bahamas National Trust**  
**The Bahamas**



Lucayan Archipelago





Public launch of the Osa Arboretum (Lucy Kleiner)

# THE OSA ARBORETUM: BOOTS-ON-THE-GROUND CONSERVATION, DEDICATED TO SAFEGUARDING THE BOTANICAL RICHNESS OF THE OSA PENINSULA

## Introduction

The largest remaining tracts of mature Pacific lowland rainforest in Central America are found in the Osa Peninsula of Costa Rica. It has four national protected areas within its 1,800 km<sup>2</sup> area. The small but megadiverse peninsula is home to approximately 454 species of native trees, of which 4.8% are endemic to the Osa Peninsula and the adjacent mainland of Costa Rica (Cornejo *et al.*, 2012). Almost a quarter are likely regionally endemic to Central-Southern Mesoamerica (Costa Rica, Nicaragua and Panama). New tree species are still being described, like the recently named

*Beilschmiedia osacola* Aguilar, D. Santam. & van der Werff (Lauraceae) (Santamaría-Aguilar *et al.*, 2021).

Despite this richness, Osa Peninsula is one of the least developed regions of Costa Rica and has the highest incidence of poverty. The major drivers of the economy are small-scale agriculture by tenant farmers, industrial monoculture palm oil farming, and small-scale ecotourism. Researchers have found that ecotourism in the Osa provides the highest salaries of any local industry (Hunt *et al.*, 2015). Even though part of Costa Rica, a world pioneer in environmental protection policies

including strict, no-cut forest laws and home to one of the world's first payment for ecosystem services schemes, it is not exempt from issues that threaten tropical forests around the world: illegal hunting and timber extraction continue to occur in the national parks and surrounding buffer zones, and primary forest continues to be converted to agricultural systems or otherwise degraded by habitat fragmentation. Tree conservation is of particular concern, principally because so little is known about the location and propagation of threatened tree species in the Osa, and climate change is adding particular urgency to lowland tropical tree conservation.



## Osa Conservation

Osa Conservation is a non-profit organization dedicated to protecting the globally significant biodiversity of the Osa Peninsula, Costa Rica by implementing ecosystem stewardship, enhancing scientific understanding, providing education and training, and creating sustainable economic opportunities. We own and manage nearly 3,000 hectares on the Peninsula. Over the past decade we have planted over 350,000 trees, starting on our properties in the early 2000's, and now focus on creating ecological connectivity throughout community lands on the Peninsula and beyond.

## The Osa Arboretum

A survey showed that the world's botanic gardens contain around 30% of all plant species identified, including 40% of known threatened plant species (Mounce *et al.*, 2017). While tropical plants make up the majority of the world's plant species, they only represent a quarter of the holdings at botanic gardens. Most botanic gardens are located in Europe and North America, yet tropical plants are more difficult to grow in these locations. Furthermore, threatened species make up only a small percentage within these gardens. Thus, there is an urgent need to establish more botanic gardens in the tropics to help represent some of the world's most interesting and threatened plants. Additionally, many of the skills and resources associated with botanic



Pressing plants during a botanical expedition (Lucy Kleiner)

gardens and arboreta, including plant taxonomy, functional ecology, horticulture, and seed management are fundamental to ecological restoration efforts (Gann *et al.*, 2019).

Launched in 2021, the Osa Arboretum provides opportunities for local and international audiences to experience the region's vast botanical diversity and has the potential to become a leading institution through an integrated *in situ* and *ex situ* plant conservation program.

The Osa Arboretum has several components: an extensive trail system mapped with tagged trees and interpretative panels, the first propagation

center of threatened trees in the region, and an agroecological farm. It includes 11 km of trails that cross through various habitats including coastal, wetland and mangrove, riparian, grassland, secondary forest, and old growth forests. The Osa Arboretum, as an *in situ* collection, is composed of the natural forest. We have tagged and georeferenced 1,173 individuals belonging to 301 tree species. Within the arboretum one can observe native pollinators and seed dispersers.

For 270 species, individuals were selected to have an identification plaque and QR code that lead to the Osa Arboretum Website ([osa-arboretum.org](http://osa-arboretum.org)). And as a member of Botanic Garden Conservation International (BGCI), our living plant collection is available on the global PlantSearch dataset. We received first level accreditation from ArbNet, which formalizes our role in contributing to the achievement of the Target 8 of the Global Strategy for Plant Conservation (which calls for the preservation of 75% of threatened plant species in *ex situ* collections, preferable in the country of origin). We are now in the process of attaining level 2 accreditation.

## Saving trees - propagation

The Osa Arboretum also focuses on the propagation of rare and threatened tree species. These efforts go from prioritizing conservation actions according to global assessments, exploration of remote areas, seed collection and seedling propagation, and ecological restoration.



Botanical expedition (Ruthmery Pillco Huarcaya)





*Paramachaerium gruberi* (Ruthmery Pillco Huarcaya)

In order to prioritize conservation actions related to trees, it is essential first to know which species are under greatest threat to direct our focus. We collaborate with the Global Tree Assessment initiative to assess tree species of the Osa according to the IUCN criteria. Between 2019 and 2021 we focused on the conservation of the rare and threatened *Caryocar costaricense* Donn. Sm., *Vachellia allenii* (D.H. Janzen) Seigler & Ebinger, *Magnolia wetter* A. Vázquez, *Anthodiscus chocoensis* Prance, *Couratari scottmorii* Prance, *Aiouea obscura* van der Werff, *Paramachaerium gruberi* Brizicky, *Pleodendron costaricense* N. Zamora, Hammel & Aguilar, and *Inga golfodulcensis* N. Zamora. We have also partnered with NASA Develop to create land-use maps that allow us to assess key areas in need of restoration and enrichment.

Research in remote areas is critical to fill gaps in biodiversity knowledge. Our 9-person botanic team, including local botanists, restoration ecologists, and guides, successfully completed six

expeditions in 2020 and 2021 into remote areas of the Corcovado and Piedras Blancas National Park to collect species information and specimens. These expeditions have tangible outcomes not only lists of species, but also detailed distribution maps of target species and other species present in the area. We contribute botanical samples to the National Herbarium of Costa Rica and orchid specimens to the Lankester Botanical Garden. During the expeditions we found 600 species of trees belonging to 78 botanical families. Of these, 38 species are under some category of threat according to the IUCN red list. We have found species that had never before been registered in the Osa Peninsula, such as the tree *Styphnolobium sporadicum* along with many species of orchids.

The expeditions provide the basis for identifying and implementing appropriate recovery strategies and disqualifying actions that are unsuitable for the target species. For example, the ecological survey information will help to identify appropriate populations for

seed collection or identify appropriate sites for population recovery. The more information that we can gather, the more complete understanding we will obtain of the target species and their survival requirements, and the more successful our species recovery program will be. Conservation will go hand in hand with awareness, and the very important step of identifying existing populations will help us to mitigate the threats towards vulnerable species.

During the botanical expeditions the first steps of species propagation occur. We collect seeds that we germinate at our native tree nursery; the first center for propagation of rare and threatened trees in the region. The nursery has the capacity to hold 38,400 trees. Between 2019 and 2021 we completed germination and propagation trials for the 10 targeted endangered species and propagated over 10,000 tree seedlings.



Nursery assistant holding *Pleodendron costaricense* seedlings (Lucy Kleiner)



Bilingual illustrated interpretive sign about the native endangered *Tachigali versicolor* (Hilary Brumberg)



Osa Arboretum visitor scanning QR code tag on an *Inga alba* (Hilary Brumberg)



*Paramachaerium gruberi* in tree nursery (Hilary Brumberg)





*Copaifera camibar* seedling planted in the Osa Arboretum (Hilary Brumberg)

We meticulously record the process, as for some species this is the first time they have been propagated by humans. For example, we have recorded the first propagation *ex situ* of *Pleodendron costaricense*, a rare and endangered species for which only 3 mature individuals are known in the world; now over 60 seedlings are growing in the surrounding area in the hopes of avoiding the tragic extinction of this rare tree.

All trees propagated in the Osa Arboretum tree nursery are planted in the Osa Peninsula through the Restoration and Rewilding Community Network: an expanding group of people, private and public organizations dedicated to conservation and ecological restoration in the area. Since its start in 2019, where we marked the celebration of Costarrican Tree Day with a river restoration event, we have planted trees to restore abandoned cattle pastures and river banks, enrich young secondary forests, and create more sustainable cattle, oil palm, and agricultural farms. We engaged 396 community members in Restoration & Rewilding workshops and planting events.

In 2020, we planted 18,000 native trees. In 2021, we will plant 30,000 native trees in the Osa Peninsula and over 40,000 throughout southern Costa Rica in the first steps towards creating ecological connectivity from the protected areas of Corcovado National Park to La Amistad International Park, the largest remaining patch of forest in Central America.

### Education for action

One of the most important aspects of the Osa Arboretum, and Osa Conservation's many other conservation programs, is education and awareness. The arboretum



The first *Pleodendron costaricense* seedlings known to be propagated outside its restricted natural environment (Lucy Kleiner)

has already started working towards this goal as many local collaborators, local tourism agencies, and community leaders joined us for the official arboretum launch this past March. We have had national and international tourists visiting the arboretum and learning about the local flora, while helping diminish threats to biodiversity in the region (López-Gutierrez *et al*, 2019). We have held plant identification workshops for volunteer park rangers and kid's environmental groups, and we have designed a booklet on the ecology and conservation of rare, endemic and threatened trees of Osa Peninsula, together with a propagation protocol for key species of the region.

From the start, this arboretum has served as a capacity building center, as the propagation work has been spearheaded by local botanists and horticulturists, like Marvin López and Agustín Mendonza. The arboretum currently employs 15 people, 80% born and raised in Osa.

We thank Fondation Franklinia for their invaluable support in the creation of the Osa Arboretum and in our restoration efforts, and the people of the Osa Peninsula for inspiring and supporting us to do our work.

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Leader of the Alto Laguna indigenous community explores the Osa Arboretum (Hilary Brumberg)



# PRIORITIZATION TO ACTION: HOW RED LIST ASSESSMENTS ARE GUIDING COORDINATED CONSERVATION EFFORTS FOR MAGNOLIAS



*Magnolia gustavii* (Piya Chalermglin)



Global  
Conservation  
Consortium  
**Magnolia**

## Collaboration for conservation

Collaborative efforts to conserve threatened plant species, and in particular trees, have grown in the last several decades and include initiatives such as the Global Trees Campaign. The successes of such programs have come about in part through the recognition that the enormous amount of knowledge and work of the 60,000+ plant scientists and horticulturists based in botanical gardens globally (Smith, 2019) can lead to more effective and efficient conservation action via collaboration and engagement within and outside the botanic garden sector.

The identification of plant groups for which coordinated action can have the greatest impact is key to developing useful long-lasting networks.

For many in the botanic garden world, the charismatic members of the Magnoliaceae quickly come to mind as a group that is a prime candidate for characterisation, collection, conservation and cultivation. Numerous *Magnolia* species have been targets of practical GTC conservation projects in diversity centers in Mexico and China (e.g. *Magnolia jaliscana*, *M. pacifica* and *M. omeiensis* etc.) and over 520 botanic gardens globally report holding *Magnolia* collections. An initiative to scale up the work of these GTC projects and build on the conservation collections of these gardens is taking place through the Global Conservation Consortium for Magnolia (GCCM). The GCCM aims to mobilize a coordinated network of

institutions and experts to collaboratively develop and implement comprehensive conservation strategies for *Magnolia* species. With over 330 species globally, spread in diverse areas of the Neotropics as well as Asia, the first step for the GCCM to develop such strategies is to understand the status of *Magnolia* species in the wild and identify species of greatest conservation concern. This work to identify species of greatest concern has largely been informed by the red list assessments carried out as part of the Global Tree Assessment.

## Red Listing magnolias through time

The first major effort to assess all species within the Magnoliaceae was conducted by Cicuzza *et al.* in 2007. A total of 151 taxa (of the then recognized 245) were assessed at that time. Providing major information on the threat



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status of these species as well as an opportunity to highlight species in need of more research (94 taxa were unable to be evaluated due to lack of distributional data at the time), this publication was a major asset to *Magnolia* conservation. This assessment effort allowed for the subsequent 'Global Survey of Ex situ Magnoliaceae Collections' (BGCI, 2008), an analysis of the presence of highly threatened species in *ex situ* collections around the world and a gap analysis assessment of conservation activities focused on genetic diversity analysis of endangered *Magnolia* taxa (Cires *et al.*, 2013).

In 2016, following the publication of updated information and the description of over 90 new *Magnolia* species, the *Red List of Magnoliaceae - revised and extended*, was published (Rivers *et al.*, 2016). In this publication, 304 Magnoliaceae species were assessed, revealing that at least 48% of species were threatened with extinction. This work also continued to highlight the need for more studies on *Magnolia* species as almost a third of the species (97) were assessed as Data Deficient (DD). Notably, almost 40% of China's *Magnolia* species are assessed at DD. This report shows magnolia hotspots including Mexico and Colombia with over 95% of their described species as threatened with extinction. These results clearly show that this highly threatened group is in need of coordinated conservation action across diverse regions of the world.

Since the publication of the 2016 *Red List of Magnoliaceae*, the GCCM has been working with species experts to complete and submit assessments for an additional twenty-nine *Magnolia* species. These species were either Not Evaluated at the time of publication of the 2016 report due to inaccessibility of information on the species or have been described and published since 2016. These assessments will identify the need for conservation action for these species.

### Using assessments to prioritize action

The wealth of conservation assessments for magnolias, along with growing databases on *ex situ* conservation of threatened species, is allowing for identification and prioritization of species of greatest conservation concern. As part



*Magnolia zenii* (John Evans)

of the GCCM, current data on assessment category, vulnerability and threats in the wild along with an investigation of the *ex situ* status of the 335 currently recognized *Magnolia* species will be used to highlight species of conservation concern. Specifically, with Red List categorization information (along with other metrics of *in situ* and *ex situ* conservation status), the GCCM can use methodologies adapted from Beckman *et al.*, (2019) for use by the Global Conservation Consortia for Oaks to both rank species of greatest concern and also visualize demographic factors leading to the vulnerability of species in the wild. The rankings and visualization of vulnerabilities of species will be grouped at a regional level so that species can be prioritized within regional working groups where impact and coordination can be most effective. For example, threatened species in South America will be ranked against others only in that region to inform priorities for the South American Regional GCCM group. A survey of current and needed conservation actions for threatened *Magnolia* species will help inform a plan for next steps for the global GCCM community.

### Assessments driving field and genetics studies

The assessment of *Magnolia* species as Data Deficient has also led to new field studies and reassessment. This is the case for *M. vargasiana*, a species first assessed as DD in 2015 when it was described. Surveys of the Río Zuñac Reserve and nearby Machay and El Encanto Reserves in Ecuador led to the discovery of further individuals of this species as well as a study of morphology and herbivory on this and other *Magnolia*

species (Kullberg, 2017). The surveys also allowed a more detailed study of magnolia flowering and leaf phenology, which is still to be published. Sufficient data was collected to reassess *M. vargasiana* as Vulnerable and provide recommendations for its future conservation. This reassessment is under review by the IUCN Red List at the time of writing.

*Magnolia zenii*, assessed as Critically Endangered and known from 18 individuals in the Baohua Mountain National Forest Park in Jiangsu, China, has been subject to much conservation attention since its latest Red List assessment was published in 2012. Shanghai Botanical Garden, Jiangsu Institute of Botany, Nanjing Forestry University, Nanjing Normal University, South China Botanical Garden, and Research Institute of Subtropical Forestry, Chinese Academy of Forestry have all carried out *ex situ* conservation at a small scale. The species is also reported in 69 other botanical gardens globally. On-going propagation, *in situ* conservation, *ex situ* conservation, reintroduction, public awareness and conservation technique training are being supported by a Global Trees Campaign project.

Additionally, *M. zenii* is part of an IMLS-funded collaborative project with partners Atlanta Botanical Garden, Chicago Botanic Garden, BGCI, Species Conservation Toolkit Initiative (SCTI), Montgomery Botanical Center and the National Tropical Botanical Garden to develop accessions databases and population management software for the effective and cooperative management of *ex situ* collections of threatened species across botanic garden collections. Contributions of accession data and leaf



samples of *M. zenii* from botanic gardens around the world will help test and refine the tools and ensure they can be useful for the conservation of other threatened species in the future. For more information on this project visit: <https://conservetrees.org/>.

### Practical projects driven by assessments

The global botanic garden community has and continues to use Red List assessments to drive on-the-ground projects for magnolias. Following the assessment of endemic species *M. thailandica* (Vulnerable) and *M. gustavii* (Critically Endangered) and near endemic *M. citrata* (LC), a team from Queen Sirikit Botanic Garden in Chiang Mai, Thailand developed a GTC project with the aim of conducting field surveys to assess the field status of these species, initiate conservation collections via seed collections and further promote and develop tree conservation programs across the Thai botanic garden network. While *M. citrata* was assessed as Least Concern in 2014, the assessment contains notes that more information on threats, population size and trends are needed. Staff of QSBG carried out surveys in 2020 and found fewer than 50 individuals in the field in Thailand. This information along with other population surveys in Vietnam may help inform an update of the assessment of this species, highlighting a more urgent need for conservation. Best practice and field knowledge from this project will help assess and conserve Thailand's fourteen other threatened and Data Deficient *Magnolia* species.

### DD assessments providing information

With over 100 *Magnolia* species (or around one third of all species) assessed as Data Deficient, there is a clear need for more information to fully assess the threat status of many species in this group. Half of these DD species are found in the South & Southeast Asian region and a key activity of the GCCM in this region will be to support work to gather and share data on these species and update assessments. This will create a more complete picture of the status of, and threats to, magnolias in South & Southeast Asia and provide a guide for further steps for conservation. The Global Tree Assessment and other



*Magnolia vargasiana* (Alyssa Kullberg)

Red Listing activities provide a robust body of information to inform the prioritization and conservation of *Magnolia* species globally. Incorporating this information, the GCCM is developing priority species lists, initiating collecting and research projects for those species most in need, and continuing to provide data for updating *Magnolia* species' assessments. Most importantly, the GCCM will facilitate collaboration and knowledge sharing within the global botanic garden community to ensure the work of Red Listing leads to meaningful and effective conservation of the world's magnolias.

Visit the Atlanta Botanical Garden's GCCM website for more information. <https://atlantabg.org/conservation-research/science-and-research/global-efforts/global-conservation-consortium-for-magnolia/>

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# THE PEPPER-BARK TREE: SAVING AN ICONIC AFRICAN TREE SPECIES

## A prized medicinal tree

The Pepper-Bark Tree (*Warburgia salutaris*) is an evergreen tree that grows in the southern African countries of Eswatini, Mozambique, South Africa and Zimbabwe. Its inner bark, which has a distinctive peppery smell, is highly prized for its medicinal properties. Its Latin name “*salutaris*” means health-giving, and it is used to treat a wide range of health conditions from headaches, malaria, stomach ulcers to colds. Although the tree can tolerate a certain degree of harvesting through the production of coppice shoots and regrowth of stripped bark, unsustainable harvesting has resulted in the widespread decline of the species.

In 1998, the species was globally assessed on the IUCN Red List as Endangered. In addition to being threatened by overharvesting for medicinal purposes, other threats to the species include land-use changes, with towns and agricultural land expanding into the forest. The species is also exploited for timber and firewood. At the national level, *W. salutaris* is assessed as

Vulnerable in Mozambique (Izidine and Bandeira, 2002), Endangered in South Africa (Williams *et al.*, 2008), and Eswatini (Dludlu *et al.*, 2016) and Extinct in the Wild in Zimbabwe (Maroyi, 2008). It is formally protected under South African legislation in the revised National Forests Act (2012) and the National Environmental Management Biodiversity Act (2004).

## Conservation programme launched in South Africa

Such was the extent of illegal harvesting in the Kruger National Park (KNP) in South Africa, that a team of armed field rangers were employed with the sole responsibility of undertaking daily patrols of the few surviving trees. Although this did result in a reduction of illegal harvesting, it was not a sustainable solution. To tackle the problem in the long term, a conservation programme was launched in 2008 by SANParks (South African National Parks) to work with local communities surrounding the Park, to make material of socio-economically important species, such as *W. salutaris*, available to broader society.



Old harvesting damage (Michele Hofmeyr)

The programme aimed to propagate a supply of *W. salutaris* saplings which could be distributed initially to the traditional healers and then to local communities, providing them with an alternative to collecting material from the wild.



A big challenge at the beginning of the programme was to grow a sufficient supply for distribution. Most of the fruit of known mature individuals in the park were parasitised by a since identified fruit fly (*Ceratitis cosyra*), and the seeds were not viable. Luckily, mature individuals were found growing on a private farm in KwaZulu-Natal with a bounty of non-parasitised, viable seeds. Experts from the Agricultural Research Council (ARC) and South African National Biodiversity Institute (SANBI) were enlisted to improve the germination of the species and enabled mass propagation of *W. salutaris* saplings at Skukuza Indigenous Nursery in the Kruger National Park.

To distribute the saplings, an engagement network was developed with local communities who selected residents, including traditional healers, to represent them. They were then invited to attend workshops, made possible through sponsorship by Sappi, where saplings were distributed. Importantly, planting and tree maintenance guidance were provided and handouts detailing this advice were available in five South African languages. The use of *W. salutaris* leaves as a sustainable alternative to the bark (and which contain the same medicinal properties) was also encouraged, as they can be harvested much earlier.

Since the beginning of the programme, over 30,000 saplings have been distributed and over 2,500 local community members have been engaged either directly or through their elected representatives. Survival rates of distributed saplings have been found to be high (50-95%) and all participants who were asked, no longer purchase *W. salutaris* material at local markets.

### Replicating success

Building on the success of this methodology at KNP, and with continued financial and technical support from Sappi and ARC, this model has been replicated in other provinces of South Africa and internationally. At Phinda Private Game Reserve in KwaZulu-Natal (South Africa), mature fruiting individuals were discovered during recent survey work. Seed was collected in 2020 and is currently being propagated with the aim of distributing saplings of local genetic origin to communities in the area.



Tall *Warburgia salutaris* trees (Michele Hofmeyr)

In Zimbabwe, it was discovered that a former National Botanic Gardens Harare horticulturist was growing a Pepper-bark tree of Zimbabwean origin in his garden. Remarkably this tree was producing seed (the only known Pepper-bark tree in Zimbabwe to do so) and this seed has been used to propagate saplings. A number of these saplings were distributed to local community members in the Tanganda Halt (the historical range of the species), with training on how to cultivate and sustainably harvest the species provided by experts from South Africa. Planting and maintenance guidance was also provided in the local Shona dialect.

Studies showed that there was no significant genetic difference between Zimbabwean and South African *W. salutaris* subpopulations. As a result, it was decided that South African *W. salutaris* seed (which can be sourced sustainably) should be used to grow a larger supply of *W. salutaris* for future distribution to further community members in the Tanganda Halt. Approximately 5,000 seeds were planted at Vumba Botanical Gardens in November 2018. Further funds are now required to ensure that saplings grown at Vumba Botanical Gardens can continue to be cared for and then distributed to local communities.



## Collaboration is key

In both the initial conservation programme at KNP and its subsequent expansion, a team of multi-disciplinary specialists have been working together to save this species. They have now formed a working group to coordinate and drive the conservation of the species going forward. The members of the working group are Karin Hannweg (ARC, Mpumalanga), Alfred Maroyi (University of Fort Hare), Dave Everard (Sappi), Yvette Harvey-Brown (BGCI) and environmental consultants Willem Froneman (retired SANBI), Michele Hofmeyr and Tim Neary (Sappi).

## Pathway to reassessment

It is recommended that species are reassessed every five-to-ten years to reflect their current conservation status and to ensure conservation decisions are being made with up-to-date information. Reassessments are also vital for using the IUCN Red List as an indicator of biodiversity trends over time (through the Red List Index). With the last global assessment completed over 20 years ago, updating its assessment was identified as a priority.

Since the species was last assessed in 1998, we now have a much better picture of the current population status of the species. Detailed population surveys

have recently taken place across its range in South Africa (Soutpansberg (Limpopo), Ehlanzeni District (Mpumalanga) and Phinda Private Game Reserve (KwaZulu-Natal)). The first comprehensive survey of Eswatini for *W. salutaris* was also completed. During a meeting with members of the *Warburgia salutaris* Working Group and other key stakeholders to discuss the reassessment of the species, an important issue was raised regarding how mature individuals have been recorded. The tree often coppices from roots and from slender stems that fall over naturally, forming characteristic coppice subpopulations. In these coppice subpopulations, a large cluster of plants are found in close proximity to each other. Throughout its range, different methodologies have been employed to determine what constitutes a juvenile and mature individual. In some cases, surveys may have overestimated the true population size due to the high number of genetically identical coppice stems. As a result of this uncertainty, the Working Group is currently developing a population survey methodology that can be shared and used by stakeholders to ensure that the data being collected is consistent and comparable in the future.

Another key aspect that is being considered for the reassessment is the impact of increasing the availability of cultivated material on reducing the threat



*Warburgia salutaris* fruit (Michele Hofmeyr)

of illegal harvesting on wild subpopulations. During population surveys, the majority of bark harvesting observed was historical, however recent harvesting is still taking place. Furthermore, in places such as Mozambique where no conservation measures are currently in place, the situation is still likely to be critical. For example, active bark harvesting has been recorded from the Futi Corridor, a protected area of southern Mozambique (Senkoro *et al.*, 2019).



*Warburgia salutaris* for distribution (Michele Hofmeyr)



Impressive tree (Michele Hofmeyr)



The reassessment of *W. salutaris* is planned to be completed by the end of 2021 and will incorporate both non-genuine change (such as new survey information) and genuine change (such as the impact of conservation actions to reduce threats on wild subpopulations) to the conservation status of the species.

### A brighter future

Although it is clear that this important medicinal tree is not yet out of the woods, concerted conservation action does appear to be making a real difference to the future of this species. The tried and tested methodology will continue to be adapted and expanded to more areas throughout its range and the *Warburgia salutaris* Working Group will continue providing a voice for the species. Lastly, the project highlights the fundamental importance of increasing the accessibility of important socio-economic species to obtain buy-in from local communities to create sustainable nature-based solutions.



Workshop with community members from Mutema Highlands (Michele Hofmeyr)

This, together with teamwork between different organizations in various sectors and the shared learning experiences from this valuable plant conservation work, has ensured the continuity and sustainability of this project.

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*Warburgia salutaris* large individual (Michele Hofmeyr)



# THREATENED TREE ASSESSMENTS AND TROPICAL IMPORTANT PLANT AREAS

*Talbotiella cheekii* Burgt.

## Knowing the location of threatened species is key for identifying important plant areas

### Introduction

In 2015 RBG Kew launched a new science strategy which included the Tropical Important Plant Areas (TIPAs) programme. Based on the Plantlife model of Important Plant Areas (IPAs) already successful in temperate areas, TIPAs identify areas with (i) threatened species (criterion A), (ii) high plant diversity (criterion B) and (iii) threatened habitats (criterion C) in tropical countries where the majority of global plant diversity is held. Phase 1 of the programme focussed initially on seven countries and regions: Cameroon, Guinea, Mozambique, Uganda, Bolivia, Indonesian New Guinea, and the British Virgin Islands (UK Overseas Territories).

Red List assessments of threatened species are a key part of the process to address criterion A in identifying TIPAs (Darbyshire *et al.*, 2017). In order to qualify under criterion A, species are required to have a 'threatened' IUCN Red List assessment or be included on a nationally agreed list of threatened species. In many tropical countries, data on red list status is often unavailable or unconsolidated. There are few Red Data books, Regional or National Red lists for tropical countries, and only c. 13 % of vascular plant species have been assessed for the IUCN Red List (IUCN, 2021). The countries in phase one of the programme were chosen because they have long standing RBG Kew partnerships, meaning that reasonably good data was already available. In order to define TIPAs and ensure that the sites are properly documented, mapping vegetation types, arranging field expeditions, training workshops and meetings are required. This article will

show case two countries where TIPAs and Red List assessments in conjunction with the Global Trees Assessment has led to-increased awareness of threatened species.

### Cameroon - changing a government's mind

The Red Data Book of Flowering Plants of Cameroon published in 2011 (Onana & Cheek, 2011) was the first of its kind for Central Africa. It provides the basis for much of the criterion A analysis for TIPAs in Cameroon. Recently in 2020, one of these TIPAs was put under direct threat from logging by the Cameroonian government. The Ebo Forest is a proposed National Park of c. 2000 km<sup>2</sup>, in the Littoral Region. It is one of the richest and largest surviving intact areas of lowland and submontane forest in tropical Africa. Botanical and zoological richness and significance do not always coincide in the same place,



but Ebo represents a site of great importance for both and is therefore an exceptional opportunity for conservation (Murphy *et al.*, 2020). Communities in the surrounding area are reliant on the forest as sources of medicine, food and wood, it also has cultural and spiritual significance for many people as their ancestors are buried there (Murphy *et al.*, 2020). The Ebo Forest has been studied by RBG Kew and the National Herbarium of Cameroon since 2004 in collaboration with the Ebo Forest Research Programme. These studies have uncovered 15 species new to science and over 75 threatened plant species, including the tree species *Kupeantha ebo* Cheek, a critically endangered (CR) coffee relative and *Talbotiella ebo* Mackinder & Wieringa an endangered (EN) Legume species. The former is a narrow endemic found only at Ebo, whilst the latter is endemic to Cameroon. Further new species from Ebo are awaiting publication (Murphy *et al.*, 2020). Red listing of these threatened species and their subsequent inclusion in the TIPA assessment of the Ebo forest, in combination with other data submitted on primates in the area, provided evidence of the importance of this forest and gained international support from researchers and environmentalists, as well as Leonardo DiCaprio! This led to the decision by President Biya of Cameroon to revoke the logging concessions in August 2020. The case highlights the importance of having the data available and species listed on the IUCN Red List in order to effectively lobby for the protection of areas of global biodiversity importance.

### Threatened trees of Guinea

The Republic of Guinea is one of the most botanically diverse countries in West Africa (Sosef *et al.*, 2017), but it was a botanically under-collected country for many years. The in-country botanical knowledge came mainly from foresters who had little interest in non-woody species and there was little awareness of endemic species or those which might be threatened. Many endemic species had not been re-found for over half a century e.g. *Diospyros felicianae* last collected in 1956 and then only collected again after 60 years in 2016. The influx of interest in mining Guinea's aluminium and iron ore reserves in the early 2000's led to environmental impact assessments and increased botanical exploration and training. These surveys also resulted in species new to



*The Ebo forest seen from an inselberg on Gashaka Hill*

science being documented and brought to light the high level of plant endemism in this west African country.

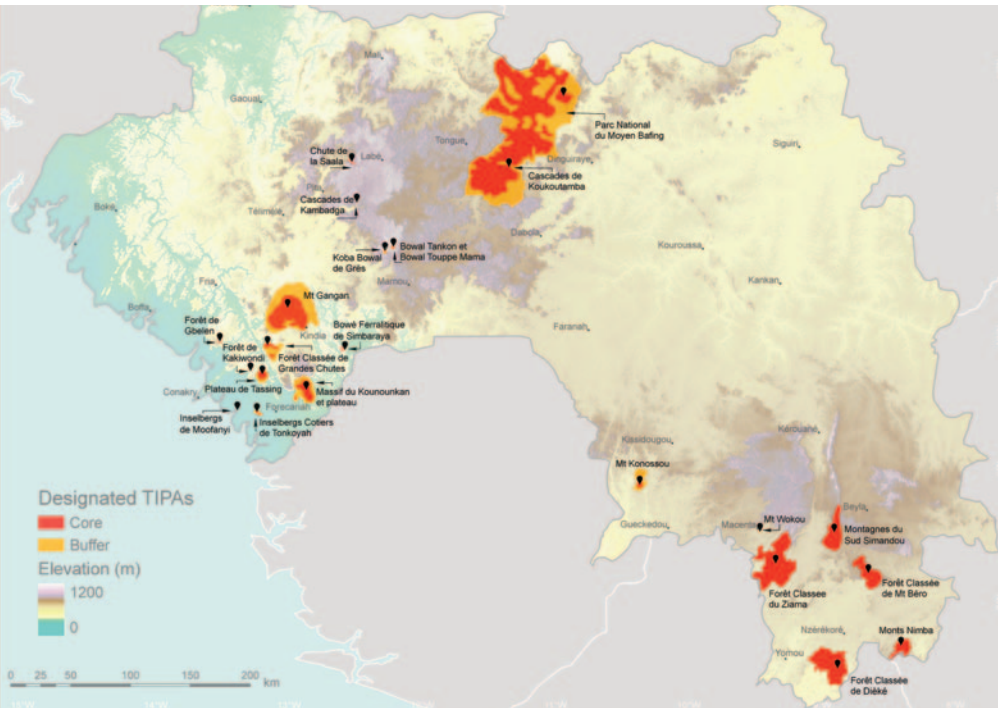
In 2016, RBG Kew received funding from the Darwin Initiative to identify Important Plant Areas of Guinea in collaboration with the National Herbarium of Guinea, Guinée Ecologie (a local NGO) and the Guinea Government. A key part of this was assessing which plant species were

threatened. At the beginning of the project <5% of the Guinea Flora had been assessed according to the IUCN Red List criteria and of these only 1% were in a threatened category (CR, EN or VU), based on Lisowski's species count of c. 3,000 species (Lisowski, 2009). Only 15 of the 34 tree species listed as occurring in Guinea on the IUCN Red List, had been assessed as threatened, many of them being widespread timber species.



*Diospyros felicianae* Ebenaceae





Map showing the 22 designated TIPAs in Guinea

During the project, a provisional list of 273 threatened plant species was compiled (Couch *et al.*, 2019a) and over 200 species assessed with the assistance of the Plant Assessment Unit at RBG Kew. The number of threatened species is still steadily increasing through discoveries of species new to science, which are mostly endemic to Guinea, or species recently discovered in Guinea extending their known distribution from nearby countries. Recent data analysis has also revealed an increase in the overall species count in Guinea to c. 4,000 (G. Gosline, unpublished data) resulting from new discoveries, taxonomic changes and range extensions.

Our research and the work done by the Global Trees Assessment programme has increased the percentage of threatened plant species occurring in Guinea on the IUCN Red List to 6.5% (based on Lisowski's figures) or 5% based on Gosline's figures. The number of threatened tree species assessments has increased to 51 out of 534 listed as occurring in the country (IUCN, 2021). These assessments have been instrumental in identifying 22 TIPAs. Following vegetation mapping and analysis, nine threatened habitats of Guinea were documented and published with the 22 TIPA assessments in 2019 (Couch *et al.*, 2019b). Although TIPAs do not have to be legally designated, the

government of Guinea agreed to put them into the national Protected Areas network. This will increase the total area of land under protection in the country (Sustainable Development Goal 15: Life on land) by 3.4%.

The project also highlighted the threat to forests in Guinea. By the early 1990s, 96% of Guinea's original forest had

already disappeared (Sayer *et al.*, 1992). Apart from the threats from open cast mining, many of the country's habitats, in particular the surviving areas of lowland evergreen forest and submontane forest (including gallery forest) are still greatly threatened by unsustainable slash and burn agricultural practices and the cutting of wood for charcoal.

### Conservation action

To begin reversing the losses to forests and tree species in particular, a proposal to protect threatened trees of Guinea and write a national conservation action plan was conceived by the same project partners and subsequently funded by Fondation Franklinia in 2020. This plan sets out to protect *in situ* and propagate 13 threatened (CR or EN) tree species in three TIPAs in the western Maritime Guinea region, and to restore forest in the buffer zones around these TIPAs with the assistance of the local communities. Endemic threatened tree species such as *Talbotiella cheekii*, *Ternstoemia guineensis* and *Diospyros felciana* will be used in reforestation planting mixes to increase diversity and the size of their overall populations. The project partnership also aims to change attitudes and promote native species for reforestation in Guinea as well as encourage local schools to participate in tree planting activities.



Forest clearance for charcoal production



The national conservation action plan for threatened trees will be coordinated by the Working Group for TIPAs and conservation action plans (CAPs). This group was set up in 2018 to evaluate TIPAs and to write 20 conservation action plans for threatened species as a pilot project. The CAPs included five tree species: two Guinea endemics, one regional endemic and two more widespread across Africa. It became apparent that individual treatment may not be the most effective way to conserve threatened species, time and people resources being limited. This multispecies approach aims to compile data on the 42 non-timber threatened tree species identified and determine the most efficient way to group the species for on-the-ground conservation and monitoring.

In 2021, the partnership received funding from the Critical Ecosystem Partnership Fund (CEPF) to work on five of the TIPAs in the south-eastern Forest Guinea region. This will extend the reach of the threatened trees CAP group and relate it to conservation actions in existing and new management plans for protected areas.

These are ambitious aims, but there is an appetite in Guinea to push plant conservation forwards particularly with the expected increase in the economy from the mining sector which will impact three or more of the designated TIPAs. We are supporting the growing interest in the environment and climate change to inspire Guineans to have pride in their national plant heritage and to change attitudes to the conservation of threatened trees and forest.

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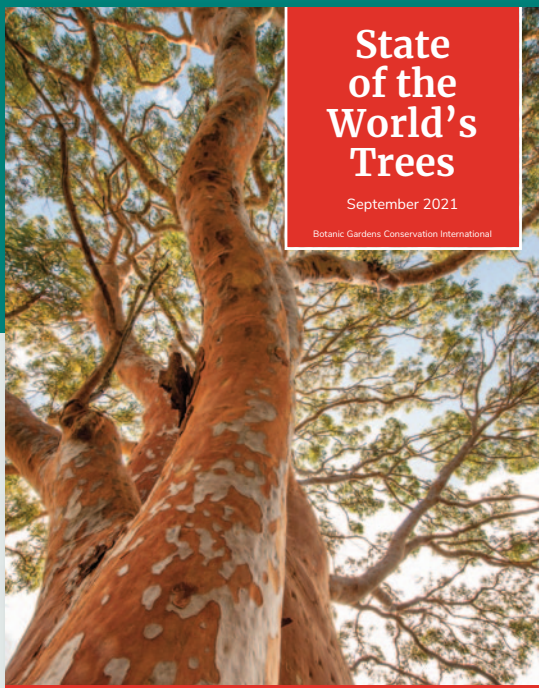


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