Journal of Botanic Gardens Conservation International

BGjournal

Volume 14 • Number 1 • January 2017

Red lists: Plant conservation assessments and the role of botanic gardens

Features in this issue:

- Talking plants: an interview with a plant conservation champion
- Plant hunting tales from Tanzania
- Featured garden: focus on South China

BGCI
Plants for the Planet

Cover Photo: *Echinocereus trichglochidiatus,* T. Heller
Design: Seascape www.seascapedesign.co.uk

BGjournal is published by **Botanic Gardens Conservation International (BGCI)**. It is published twice a year. Membership is open to all interested individuals, institutions and organisations that support the aims of BGCI.

Further details available from:

- Botanic Gardens Conservation International, Descanso House, 199 Kew Road, Richmond, Surrey TW9 3BW UK. Tel: +44 (0)20 8332 5953, Fax: +44 (0)20 8332 5956, E-mail: info@bgci.org, www.bgci.org
- BGCI(US) Inc, The Huntington Library, Art Collections and Botanical Gardens, 1151 Oxford Rd, San Marino, CA 91108, USA. Tel: +1 626-405-2100, E-mail: usa@bgci.org Internet: www.bgci.org/usa
- BGCI-China, South China Botanical Garden, 1190 Tian Yuan Road, Guangzhou, 510520, China. Tel: +86 20 85231992, E-mail: china@bgci.org, Internet: www.bgci.org/china
- BGCI-Southeast Asia, Jean Linsky, BGCI Southeast Asia Botanic Gardens Network Coordinator, Dr. Cecilia Koo Botanic Conservation Center, No. 31, Tongsing Rd., Gaoshu Township, Pingtung County 90646, Taiwan, R.O.C. Tel: +886 8 796 0913, Mobile: +886 966484475, Email: jean.linsky@bgci.org, Internet: www.bgci.org; www.kbcc.org.tw/en
- BGCI-Africa, Kirsty Shaw, BGCI Africa Office, IUCN Eastern and Southern Africa Regional Office (ESARO), P.O. Box 68200 - 00200, Nairobi, Kenya, Tel. +254 (0)725295632 Skype: bgci_kirsty, Email. Kirsty.shaw@bgci.org Internet: www.bgci.org
- BGCI-Russia, c/o Main Botanical Gardens, Botanicheskaya st., 4, Moscow 127276, Russia. Tel: +7 (095) 219 6160 / 5377, Fax: +7 (095) 218 0525, E-mail: seed@aha.ru, www.bgci.ru

BGCI is a worldwide membership organisation established in 1987. Its mission is to mobilise botanic gardens and engage partners in securing plant diversity for the well-being of people and the planet. BGCI is an independent organisation registered in the United Kingdom as a charity (Charity Reg No 1098834) and a company limited by guarantee, No 4673175. BGCI is a tax-exempt 501(c)(3) non-profit organisation in the USA and is a registered non-profit organisation in Russia.

United Nations Decade on Biodiversity

IN THIS ISSUE...


Erythrine zeyheri

EDITORIAL:
RED LISTS: PLANT CONSERVATION ASSESSMENTS AND THE ROLE OF BOTANIC GARDENS

Welcome to BGCI's latest edition of *BGJournal*, the theme of which is red listing and conservation assessments. The publication of this edition coincides (not accidentally) with the launch of BGCI's newest database – ThreatSearch (www.bgci.org/threat_search.php) – the most comprehensive database of plant threat assessments in the world (see page 4). ThreatSearch currently comprises around 242,000 assessments representing over 150,000 taxa. Apart from being the primary source of information on progress towards achieving Target 2 of the Global Strategy for Plant Conservation[1], we hope that this new resource will greatly assist botanic gardens in assessing the value of their collections. I suspect that many gardens will be surprised to find out how many rare and threatened plant species they harbour in their living collections and seed banks. BGCI is grateful to our partners at the Zoological Society of London and the Royal Botanic Gardens, Kew in compiling this database, which will be maintained and added to as new assessments become available.

BGCI has long argued that the loss of plant diversity is the most important challenge for botanic gardens to address. We have unique skills, knowledge and data related to plants right across the taxonomic array. In a recent analysis of BGCI's PlantSearch database, we discovered that the 1100 botanic gardens represented in that database **conserve and manage one third of known plant diversity**. Those 1100 gardens are only about 40% of the total number of gardens out there, so this is a minimum figure. It is quite likely that, collectively, our sector conserves and manages more than half of the world's known plant species. No other professional community comes close to this total, and it is therefore our responsibility to use our skills and resources to prevent extinctions. In this edition of BGJournal, we interview Jennifer Cruse-Sanders, a leading member of our community who passionately believes this, and has put her energies into saving plants from extinction (see pages 6-7).

Given the lack of resources available for plant conservation, prioritisation is essential and threat status is, of course, the top criterion for deciding where we should concentrate our efforts. An example of just such a targeted effort is described in our plant hunting feature (pages 8-9) in which a team of botanists found one of the last two remaining populations of the East African tree, *Karomia gigas*. This species is believed to be down to just 15 trees left in the wild and, with loggers active nearby, it is now critically important that we secure viable seed in order to propagate this species *ex situ*.

Threat assessments come in many different forms but the global standard is IUCN's Red List methodology. On pages 14-15, Malin Rivers and Suzanne Sharrock take us through the Red List categories and methodology. BGCI is a member of IUCN's Red List Partnership, and at the recent World Conservation Congress in Hawai'i we signed a memorandum of Understanding with IUCN committing to support red listing efforts for a further five years. The Global Tree Assessment (pages 16-19) is our flagship red listing project and provides a framework for efforts to assess all the world's known tree species by 2020. BGCI is co-ordinating this effort, and a key tool we have developed for this purpose is GlobalTreeSearch, the first global list of tree species, georeferenced to country level (www.bgci.org/global treesearch). This list will enable us to carry out a gap analysis to see which tree species have not yet been assessed, after which unassessed taxa can be allocated to the relevant national or taxonomic specialists. An example of this process for an important *taxonomic* group is the Global Oak Conservation Partnership (pages 20-23) led by the Morton Arboretum in the United States. An exemplary national red listing initiative led by the South African National Biodiversity Institute is described on pages 24-26, and an example of a smaller scale national effort led by the Royal Botanic Gardens, Kew in the British Virgin Islands is outlined on pages 27-29. Last but far from least, Greg Mueller from Chicago Botanic Garden reminds us that fungi are threatened too (pages 30-33). Greg reminds us of why this matters and reassures us that, through the Global Fungal Red List Initiative, significant efforts are now being made to assess the conservation status of ecologically and economically important, threatened fungi around the world.

One final word. Please make every effort to join us at BGCI's sixth Global Botanic garden Congress, hosted by the Conservatory and Botanical garden of the City of Geneva from June 26th-30th. The theme of the Congress is *Botanic Gardens and Society: visions for the future*. How do we help to solve the big environmental challenges – food security, water scarcity, energy, health, climate change and loss of biodiversity? Be there to find out!

Dr Paul Smith
BGCI Secretary General

[1] An assessment of the conservation status of all known plant species, as far as possible, to guide conservation action by 2020.


Maple collection


Rhododendron milleri

FEATURES

NEWS FROM BGCI

INTERVIEW:
TALKING PLANTS

PLANT HUNTING TALES:
IN SEARCH OF A TREE ON THE EDGE OF EXTINCTION

FEATURED GARDEN:
SOUTH CHINA BOTANICAL GARDEN, THE CHINESE ACADEMY OF SCIENCES


Acer pycnanthum

Montane forest

NEWS FROM BGCI

REGISTER NOW FOR 6GBGC

Registration and abstract submissions are now open for the 6th Global Botanic Gardens Congress. The Congress will be held in Geneva, Switzerland from 26-30 June 2017. Themed on 'Botanic gardens in society: Visions for the future' the Congress will explore the roles and relevance of botanic gardens in today's society. Early bird registration extends until 31 March and the abstract submission deadline is 31 January. Find out more at www.6gbgc.com

BGCI DATABASES

ThreatSearch launched

BGCI is excited to announce the launch of its new database – ThreatSearch. ThreatSearch is the most comprehensive database of conservation assessments of plants. It contains over 242,000 conservation assessments, representing over 150,000 taxa (www.bgci.org/threat_search.php).

The aim is for ThreatSearch to be a one-stop shop to find conservation assessments for plants. Together with our two main collaborators - the National Red List (www.nationalredlist.org) and the Royal Botanic Gardens, Kew (www.kew.org) - we have assembled currently available conservation assessments into a single list of conservation assessments for plants. We are continuing to add new conservation assessments, as well as adding older non-digital sources. Species names have been matched to The Plant List (www.plantlist.org) whenever possible. In all cases, the source of the assessment is indicated, and when available a URL link will take you to the original source of the information.

ThreatSearch can be used to find information about any species of interest, but it can also be filtered on scope, threatened status and year of the assessments. BGCI members will soon have the possibility to carry out more refined searching of the database in the members' only area of the BGCI website.

Look out for our second new database – GlobalTreeSearch – a comprehensive global list of tree species georeferenced to country level. Coming soon.

NEW RESOURCES FROM BGCI

From idea to realisation

Further chapters of BGCI's new Manual on planning, developing and managing botanic gardens are now available for download from the BGCI website. This comprehensive resource provides essential guidance for newly developing institutions, as well supporting established botanic gardens that may be seeking advice or information as part of a re-development or organisational review. Consisting of four main parts, the eight chapters of the Manual are being published in stages, with Chapters 1 to 6 now available online. Recently published chapters 5 and 6 cover Collection Record Management Systems and Horticultural Management. Find out more about the Manual and download the chapters from the BGCI website: www.bgci.org/resources/2016-BGCI-botanic-garden-manual

Seed conservation training modules

BGCI has created a suite of learning modules on seed conservation, essential for those working in seed banks or in botanic gardens with seed collection

programmes. The modules take the learner step-by-step through the process of seed conservation from planning to collection to processing and storage. After every module there is a quick quiz to test knowledge gained. Powerpoint presentations are also available to download for those interested in utilising this resource for training purposes. These resources are also available in Spanish. Find out more at: www.bgci.org/plant-conservation/seed_learning/

NEW STAFF AT BGCI

BGCI would like to extend a warm welcome to Helen Miller, our new Head of Education. Helen joined the BGCI office in January 2017 and brings a wealth of experience in public engagement and vocational training on conservation and broader environmental issues. You will be hearing from her more fully soon in the next edition of Roots.

THE BIG GIVE CHRISTMAS CHALLENGE

The Big Give Christmas Challenge is a yearly fundraising event that sees donations to charities doubled by matched funds. This year the campaign ran from midday Tuesday 29th November to midday Friday 2nd December 2016 and raised a staggering £7.2 million in total. Through participating in the Big Give, BGCI managed to raise a fantastic £16,553.75, beating our target of £15,000. This year, the funds will be used to support the International Plant Sentinel Network (IPSN). The IPSN aims to protect tree (and non-woody) species from attack by invasive damaging pests and diseases. Find out more at www.plantsentinel.org A big thank you to everyone who contributed to the Big Give.

CELEBRATING EXCELLENCE

In November, BGCI was delighted to announce the winners of the 2016 Marsh Awards for International Plant Conservation and for Botanic Garden Education.

For her contribution to International Plant Conservation, the award went to Jenny Cruse Sanders of Atlanta Botanical Garden in the USA.

Jenny is a commendable leader of plant conservation initiatives in the Southeast United States and is guiding the plant conservation field in significant directions at the national level. Jenny has developed conservation programs at the local, state and regional levels for numerous threatened species and habitats of the biodiverse Southeast, including orchids, pitcher plants, and the Torrey pine, one of the most threatened conifers in the world.

For her work in Botanic Garden Education, the Marsh Award goes to Iwa Kołodziejska of the University of Warsaw Botanic Garden in Poland. Iwa has been active at the university and botanic garden for 13 years. During this time the department has gone from strength to strength, with education at the garden becoming increasingly respected. Iwa is also a researcher in ethnobotanical knowledge which supports her ability to develop activities that are innovative and engaging to different audiences. She is keen to see the connection between art and science communication and therefore has the ability to speak to a broad range of often hard-to-reach audiences, including teenagers and refugees.

The awards came with a cash prize of £1,000 and a Certificate for each winner. The Award Ceremony was held at the Linnean Society in London on the evening of December 6th.

NEW INITIATIVES

New IUCN Specialist Group on seed banking to be established

As part of the IUCN World Conservation Congress that took place in Hawai'i, in September, a Knowledge Café session was held that brought together seed banking experts from over 20 institutions. The group was gathered to discuss initiating a new IUCN Species Survival Commission (SSC) Seed Conservation Specialist Group (SCSG).

During the Knowledge Café session, participants nominated Marian Chau, Seed Conservation Laboratory Manager at Harold L. Lyon Arboretum; Dustin Wolkis, Seed Bank & Laboratory Manager at the National Tropical Botanic Garden Hawai'i and Uromi Goodale, Associate Professor at Guangxi University in China as Co-chairs of the SCSG. BGCI will act as Secretariat of the group. The next step will involve submitting a proposal to the SSC Chair on the establishment of the SCSG. The first objective of the group is to create a global directory of resources, facilities and expertise on seed banking.

Sharing and growing - MoU Signed between BGCI and CETAF

On October 18, BGCI and the Consortium of European Taxonomic Facilities signed a Memorandum of Understanding (MoU) marking the start of a new partnership between the two organisations.

The Consortium of European Taxonomic Facilities (CETAF AISBL) was created in 1996, with 33 members representing 57 natural history institutions from 20 European countries. It is a unique platform for collections and taxonomy within Europe. Through the MoU, BGCI and CETAF agree to exchange information and to participate in and contribute to each other's networks. The signatories recognize each other as strategic partners for pursuing their common interests and will strive to work together on issues of common interest.

BGCI US to partner with Montgomery Botanical Center and other member gardens to protect trees

BGCI US and the Montgomery Botanical Center in collaboration with The Morton Arboretum, Chicago Botanic Garden, National Tropical Botanical Garden, and other experts have received a National Leadership Grant from the Institute of Museum and Library Services. The project will optimize the design of *ex situ* tree collections by analyzing genetic variation in a range of important tree groups, from palms to oaks to magnolias, and will help improve the conservation quality of living tree collections by adapting proven methods from zoos.

INTERVIEW
TALKING PLANTS

In this issue of BGjournal, BGCI talks to **Jennifer Cruse-Sanders**, Vice President for science and conservation at the Atlanta Botanical Garden, and recently appointed Director of the State Botanical Garden of Georgia at the University of Georgia, USA. Jennifer was also the 2016 winner of the Marsh Award for International Plant Conservation.

We know you are passionate about plant conservation; what or who originally inspired your love of plants?

My interest in plants grew out of my love for conservation and understanding how people impact native species. After completing my undergraduate degree, I travelled to Belize to study bird populations in roadside tropical dry habitats. During this trip, I discovered how important it is to be able to catalogue plant diversity and share this information with people in-country. The stories about each native plant species offered insights into our connections with the natural world. Another important lesson for me was the realization that in order to have any real impact in the field of conservation, I needed to be able to describe natural habitats and understand botanical diversity better. After this field experience, I began a graduate program in Plant Taxonomy at the University of Georgia. The first plant that I looked at under a dissecting microscope was a weedy little mint (*Lamium amplexicaule*), but under the scope it was the most gorgeous thing that I'd ever seen. From that point on, I've never wanted to study anything other than plants.

You have developed conservation protocols for a wide range of species, which was the most challenging and why?

At the Atlanta Botanical Garden I've had the great privilege to work with one of the most endangered conifers in the world, *Torreya taxifolia*. This species is restricted to forests along a 35 mile stretch of the Apalachicola River in extreme southwest Georgia and the panhandle of Florida. It was once a canopy tree, but in the mid 20th Century there was a catastrophic loss of natural populations, leaving only seedlings and young germinating plants. For 50 years there have been questions surrounding why Florida torreya declined and how best to protect it. This is a flagship species for the Center for Plant Conservation and it was one of the first plants protected under the Endangered Species Act of the U.S. It represents a case study in conservation. Most of the natural distribution for *Torreya taxifolia* is protected by state owned lands within the Florida Park system or within the Nature Conservancy owned properties. The fact is that the fungal disease that impacts this species, and other threats do not stop at park boundaries. Therefore management of this species depends on collaboration between botanical gardens, researchers, and land mangers to pull together a diversity of resources to prevent this species from going to extinction.

You clearly have a very wide ranging job, but is it possible to describe a typical working day?

A typical day for me includes either field work or garden office work. At the botanical garden I combine office work with meetings, reports, laboratory research, student training and administrative work. Although I love the garden collections, my favorite days are in the field working on projects across the southeastern U.S. Each day in the field with co-workers and collaborators is balanced with several days at the garden preparing for the field trip or following up with reports and budgeting. Almost every day at the Garden is accompanied by time spent reading published literature and current media, thinking about how to increase the scientific value of the collections, how to connect with collaborators, and how to budget for the next project.

You have been involved in setting up a series of sciences cafés to bring the public together with scientists. Why did you decide to do this and how do you think we can better engage the public in plant conservation issues?

After I first learned about science cafés eight years ago, I was inspired, and I decided to start a series at the Atlanta Botanical Garden. Science cafés (café scientifiques) were the brain child of Duncan Dallas as a way to open up venues for discussing some of the most important issues in society. It was a brilliant idea that was freely given to the world to adapt and use for multiple purposes.

My objective in bringing science cafés to the garden was to attract new audiences and highlight the behind-the-scenes science and conservation that was an integral part of our programs. I often

chose general or controversial subjects as a series topic (with the goal to address the science underlying the subject rather than the controversy). This has worked for subjects as diverse as climate change, evolution, art and science, and plants and human health. The garden provides a beautiful venue for science discussions and a ready way to connect collections with almost any scientific subject. With a little creativity we made science a sensory experience and helped the general public see how plants touch almost every aspect of their lives.

Early on, when science café was offered during cocktails in the garden (a weekly Thursday night event), we paired each science café with a signature cocktail and then built the cocktail as an opening icebreaker with one of our horticulturists as the lead. The horticultural expert discussed each botanical ingredient, where it was domesticated, or how it is grown or prepared. We would then end the science café with a tour of the collections and an opportunity for people to see the plant ingredients growing at the garden. The first time we tried this our speaker was a physicist from the Georgia Institute of Technology. His talk was titled "Evolution in Darwin's warm little pond," and we paired it with a cocktail called a mudslide, featuring chocolate, coffee and vanilla. This sort of approach was fun and a great way to feature our horticultural expertise and collections.

You have achieved so much already in leading plant conservation activities in the USA. But where do your future ambitions lie? What are the next challenges you will address?

I'm lucky because I do what I love, and I work with people who also love what they do. I've had the wonderful opportunity to work at the Atlanta Botanical Garden and help to build a Center for Southeastern Conservation that brings together the strengths and partnerships that are so much the fabric of Atlanta's garden.

This year I have the opportunity to transition to a new role as the Director of the State Botanical Garden of Georgia at the University of Georgia. These are two very different gardens that work within the same plant conservation networks. Each garden has complementary strengths that are both important for plant conservation in the southeastern U.S.A.

I'm looking forward to growing the collections and programs at the State Botanical Garden of Georgia and working with the University of Georgia to build on the successes and impacts of this garden. In many ways this is a homecoming for me because UGA is where I first learned botany.

I'm also excited to participate in the network of Southeastern Partners for Plant Conservation because I know that

the only way we will be successful in plant conservation is by working within an alliance of governmental agencies (federal, state, local) that includes a network of botanical gardens, academic institutions, non-governmental organizations, citizen scientists and others to prioritize and address the pressing needs for conserving native plants species.

What advice could you give to a new botanic garden just starting to work in plant conservation?

Our strengths and successes are built upon our botanical garden network – however it is defined –statewide, regionally, nationally or globally. I recommend becoming familiar with the BGCI website and the tools it provides, as well as with the Global Strategy for Plant Conservation. These are free resources that allow any botanical garden, large or small, to identify global initiatives for plant conservation and a larger context for their efforts. Once you've taken this step, I recommend that you clearly define your strategic goals, strengths and capacities. Once these areas are defined, you can identify what objectives for plant conservation make sense for your garden, and where you need to invest resources if you'd like to grow in a particular direction. I strongly believe that every garden can contribute to plant conservation. It begins with providing a space that allows people to interact with and learn about plants.

Authors: Emily Beech and Kirsty Shaw

PLANT HUNTING TALES

IN SEARCH OF A TREE ON THE EDGE OF EXTINCTION

A team of botanists from three continents set out in search of *Karomia gigas*, a Critically Endangered tree with fewer than 20 individuals estimated to be surviving in the wild.

In October 2016, BGCI led a survey trip to look for *Karomia gigas*, a tree found only in southeast Tanzania. With an expert team, including representatives from Missouri Botanical Garden, the Tanzania Forest Service, the Tanzania Tree Seed Agency and Tanzania Coastal Forest Botanic Garden, and funding secured from the Mohamed bin Zayed Species Conservation Fund, we set off to look for this Critically Endangered tree.

History of the tree

Karomia gigas was previously known from a single individual tree in Kenya which was cut down in the late 1970's. Another individual was then identified in Tanzania in 1993, but when this specimen could no longer be found, it was feared that the species had become extinct.

However in 2012, the species was rediscovered in Tanzania by botanists from the University of Dar es Salaam, 28 km away from the site of the 1993 collection in Tanzania. Therefore, although not extinct, *Karomia gigas* is still only known from fewer than 20 trees and clearly requires urgent conservation action.

A rocky start

As with many a botanising trip, the expedition got off to a rocky start. The trees are located several kilometres from the main road, along a difficult, dusty,

weaving track through Miombo woodland. The first day was sadly cut short when one of our vehicles got stuck in deep ruts in the track. With rumours that there were leopards in the area, we were pleased to get the vehicle moving again before sunset.

If at first you don't succeed...

The group returned to the forest early the next morning, navigating carefully along the same track, reaching as far as the car could go without getting stuck again. We had enlisted the help of Mr. Salim Jangwa, a member of the nearest village, whose knowledge of the forest was invaluable to help us locate the trees we were looking for. He led us for over an hour on foot winding through dry, hot, coastal forest. After months of drought, the forest was almost silent with few signs of wildlife, birds or insects. The only sound as we walked was the crunch of dry leaves underfoot. The dominant vegetation was small, leafless trees, with the odd flash of colour from bright red native *Hibiscus* and coral red *Erythrina* flowers through the open forest.

Success

And then we spotted our first *Karomia* tree. Towering over the other vegetation in the forest, the tree rose straight upwards from the forest floor with a patchy grey/yellow bark. We found six individual trees of *Karomia gigas*, all with similar impressive trunks. Herbarium specimens collected in the past at the same time of year as our survey, had suggested the trees would have seed available at the time of the trip. Although we did find seed, the seeds were not fresh and therefore unlikely to be viable. There were no signs of natural regeneration. A sample of seeds was however taken to the Tanzania Tree Seed Agency (TTSA) for viability testing.

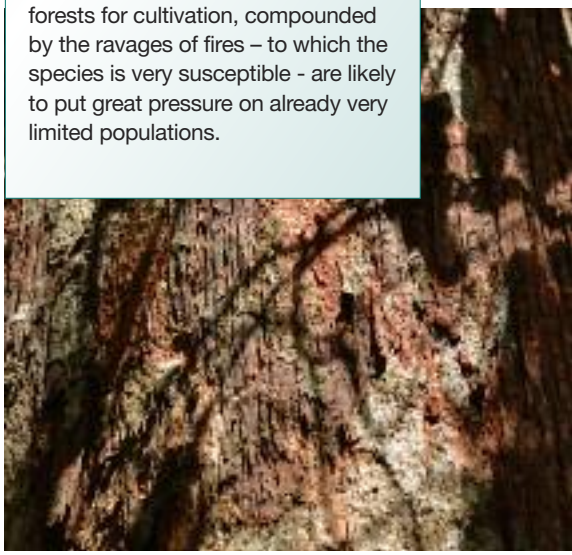
During our mission we appointed Mr. Jangwa as a tree surveyor. He will monitor the trees twice a month to report when flowers and seed are present. The Global Trees Campaign (GTC) has managed to raise further funds for a seed collecting trip, so when we are informed that fresh seed is available, a trained team can go out to collect. Funding has also been secured to survey the only other known population of *Karomia gigas* which is estimated to consist of nine trees. The survey will take place alongside seed collection at the first site in the hope that seed will also be available for collection at the second population.

Karomia gigas

Karomia gigas is a species of plant in the Lamiaceae family. It is only known in Tanzania, where only very small populations survive. The species was previously found in Kenya, where the single known tree was cut for timber.

There is little known about the species and why it has become so extremely rare. Clearly the trees are attractive for use for timber as they are much taller and straighter than other trees growing in its native habitat. During the expedition, signs of timber extraction were noticeable throughout the forest.

Another important factor in its decline is thought to be land use change. The forest where it is found is in an area that is gradually being converted into agricultural land. The clearing of forests for cultivation, compounded by the ravages of fires – to which the species is very susceptible - are likely to put great pressure on already very limited populations.

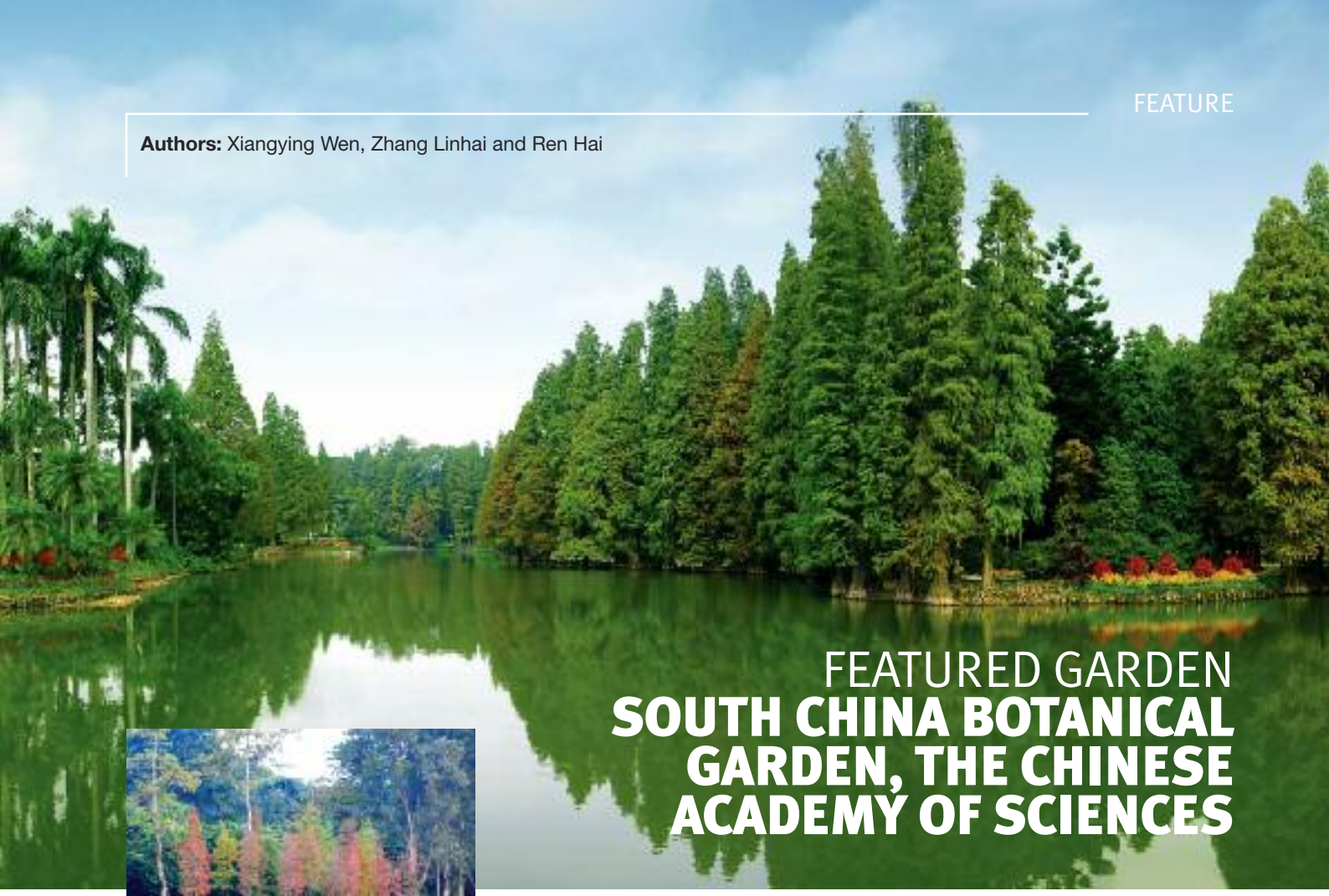


Conservation action

Genetically representative seed collections will be established at TTSA and coastal botanic gardens in Tanzania. A local propagation programme will be initiated to enable restoration. These efforts represent hope for the future of this Critically Endangered tree which, with no current formal protection in place despite high deforestation rates in the region, is at great risk of being lost forever.

The expedition was funded by the Mohamed bin Zayed Species Conservation Fund.

Authors: Xiangying Wen, Zhang Linhai and Ren Hai



FEATURED GARDEN

SOUTH CHINA BOTANICAL GARDEN, THE CHINESE ACADEMY OF SCIENCES

Founded in 1929, South China Botanical Garden (SCBG), Chinese Academy of Sciences (CAS), is one of the top botanical research institutions and botanical gardens in China. Located in Guangzhou City of Guangdong Province, SCBG plays an important role in plant conservation including both *ex situ* and *in situ* conservation, public education and the sustainable utilization of plant resources. In addition, SCBG carries out scientific research, especially in the fields of forest and restoration ecology, systematic and evolutionary botany, plant resources and biotechnology.

So far at SCBG, more than 14,500 plant taxa - of which 456 are threatened plant species (Ren Hai *et al*., 2016) are conserved in 37 special *ex situ* living collections, including magnolias, bamboos, palms, gingers, orchids, cycads, medicinal plants, etc. in an area of 282 ha. About 1,100,000 plant specimens are being kept in the herbarium. Over 2,400 plant species are conserved *in situ* in an area of 1,155ha in the Dinghushan National Nature Reserve which was established in 1956 and was the first national nature reserve in China as well as the only nature reserve affiliated to CAS.

Since the publication of the *Global Strategy for Plant Conservation (GSPC)* in 2002 and *China's Strategy for Plant Conservation (CSPC)* in 2008, SCBG has been implementing and making significant contributions to these Strategies, with a particular focus on Targets 1 (on-line flora), 2 (conservation assessments), 3 (methods and protocols), 7 (*in situ* conservation), 8 (*ex situ* conservation), 10 (invasive species) and 14 (education and public awareness).

Conservation status assessments of plants provide the foundation for practical conservation action. As the only comprehensive botanical garden in South China, SCBG is responsible for the assessment of the conservation status

of plants distributed in cities near to Guangzhou, nature reserves in Guangdong Province or provinces close to Guangdong Province, such as Dongguan City, Nanling National Nature Reserve in Guangdong, as well as the distribution and assessment of rare and endangered plants in Ganshiling Nature Reserve of Hainan Province (Rongjing Zhang *et al*., 2015).

SCBG has carried out the assessments of 90 rare and threatened plant species from Guangdong province according to IUCN Categories and Criteria. These are included in China's red list, The assessment results showed that while no species were listed as Extinct (EX) or Extinct in the Wild (EW), 12 species were considered to be Critically Endangered (CR), 78 species were Endangered (EN), and 12 species were listed as Vulnerable (VU). Meanwhile, SCBG has also evaluated *Plant Species with Extremely Small Population (PSESP)* in Guangdong Province and proposed conservation approaches for these, including *in situ*, *near situ* and *ex situ* conservation, germplasm banks, reintroduction programmes and capacity building activities, based on the evaluation results (Ren Hai *et al*., 2016).

Research on lycophytes and ferns is one of the most important activities at SCBG. To assess the extinction risk of lycophytes and ferns growing in China, experts from SCBG have been involved in the preliminary evaluation of 2,250 taxa (including 146 lycophytes and 2,104 ferns) according to the IUCN Red List Categories and Criteria (version 3.1) at national level. The preliminary results are: 43 species identified as Critically Endangered (CR, including six probably extinct), 68 Endangered (EN), 72 Vulnerable (VU), 66 Near Threatened (NT), 1,125 Least Concern (LC), and 876 Data Deficient (DD). Of the total 183 threatened species (VU, EN, and CR), 79 are species endemic (or nearly so) to China. Conservation priorities have been suggested for 79 threatened, endemic species, especially for the 24 CR species (Shi-Yong Dong *et al*., 2016).

Based on those evaluation results, SCBG has published more than 120 papers in English on rare and endangered plants and taken various practical conservation actions. Reintroduction activities for 28 threatened plant species have been initiated and good progresses made with species such as *Primulina tabacum, Tigridiopalma magnifica, Magnolia longipedunculata, Euryodendron excelsum, Apterosperma oblate, Bretschneidera sinensis, Camellia azalea* etc. (Ren Hai *et al*., 2016).

As the host of two international organizations (BGCI and IABG), SCBG will continue to play an important role in the implementation of the GSPC, especially in plant conservation and botanical garden construction and development.

References

- Ren Hai, Zhang Qianmei, Wang Ruijiang. 2016. *Conservation and Study of Rare and Endangered Plants in Guangdong Province*. China Forestry Publishing House.
- Rongjing Zhang, Zhe Zhao, Wenba Su, Fuwu Xing. 2015. Distribution and assessment of rare and endangered plants in Ganshiling Nature Reserve, Hainan. *Biodiversity Science*, **23**(1): 11-17.
- Shi-Yong Dong, Zheng-Yu Zuo, Jianying Xiang,Haining Qin. 2017. The IUCN Red List of the lycophytes and ferns from China: A preliminary assessment. *Biodiversity Science*, (accepted).

ARTICLES

Rhododendron viallii

Magnolia wilisoni *(Arboretum Wespelaar)*

Acer griseum

Magnolia sp.

Conostegia arborea

Authors: Malin Rivers and Suzanne Sharrock

RED LISTING
AN INTRODUCTION TO THE WHY, WHO AND WHAT OF PLANT CONSERVATION ASSESSMENTS

Rhododendron crassifolium

Red list assessments help to determine which species are at greatest risk of extinction. They are used to prioritise the most threatened species for conservation action, publicise their plight and provide vital information to plan the action needed to save them.

Identifying species at risk

There are over 350,000 known plant species in the world. Each species inhabits its own ecological niche and forms a part of a wider biological network. The loss, or extinction, of an individual species not only means the loss forever of a unique biological entity, but it is likely to also have unforeseen consequences for the other species that are linked to it in the intricate web of life. Recent estimates have suggested that 1 in every 5 plant species is under threat of extinction[1]. However, due to the large numbers of plant species and the lack of relevant information, we do not presently know which plants are under the greatest threat, and where we should focus our conservation efforts.

Conservation assessments allow us to determine the extinction risk for any particular species and therefore prioritise conservation action on species most in need.

There are different systems available for assessing extinction risk, but the most commonly used and most widely recognised system is the IUCN Red List of Threatened Species (www.iucnredlist.org). The IUCN Red List categories and criteria are intended to be an easily and widely understood system for classifying the global risk of extinction for plants, animals and fungi.

What information is needed?

Carrying out a red list conservation assessment involves collecting information on the status of the species in the wild. The best available knowledge is gathered from a range of sources, including published literature, floras, herbarium specimens, survey reports, satellite imagery, consultation with experts etc. and this is used to determine the distribution of the species as well as provide data on the species' population

[1] https://stateoftheworldsplants.com/

Box 1: The IUCN Red List consists of nine different categories:
Extinct (EX), Extinct in the Wild (EW), Critically Endangered (CR), Endangered (EN), Vulnerable (VU), Near Threatened (NT), Least Concern (LC), Data Deficient (DD) and Not Evaluated (NE).

EX means a species has gone extinct, whereas species that are EW are extinct in the wild, but do persist *ex situ* (such as in botanic garden collections). CR, EN and VU are the three threatened categories. Species that do not qualify for a threatened category, but are close to or likely to qualify for a threatened category in the near future, can be assigned to the category NT. LC is used for species that are assessed but are not considered threatened, including widespread species and rare but stable species. The use of the category DD may be assigned to poorly known taxa. Species not yet evaluated are classified as NE.

size and extent. Analysis of the data allows trends and changes in the population to be assessed and threats identified. To assist with this, records from the past and present as well as projections into the future are used. Following the assessment, the species is then assigned a conservation category representing its extinction risk – See Box 1.

Making an assessment

Anyone working in plant conservation can get involved in conservation assessments. It is not necessary to be a specialist, but it is necessary to have relevant knowledge about the species being assessed. More information on how to red list a tree species is available from the Global Trees Campaign website[2]. Completing red list assessments to the standards required by the IUCN Red List relies on prior knowledge and understanding of how to correctly assign the different IUCN Red List categories and criteria. Red list training is available both online and through training workshops[3].

Importance of red list assessments

Completing a red list assessment for even one species is a major achievement and takes much time and effort. However, it must also be recognised that even though a species is listed under a threatened red list category, this does not automatically mean that the species will be conserved. The results from red list assessments need to be proactively used for conservation planning and for monitoring trends over time.

This information gathered in the assessment process is collated and published together with the conservation assessment. Conservation assessments and their associated information therefore become a highly valuable resource to effectively guide, plan for and raise awareness of the need for conservation action on the ground.

Potential uses for red list assessments include:

- Identify and prioritise the species in greatest need of conservation action in a particular region, country or landscape.
- Facilitate education and public awareness of species conservation issues to a wide range of audiences.
- Identify gaps and provide focus for *ex situ* conservation collections.
- Identify gaps in protected area networks and other *in situ* conservation efforts.
- Provide a basis for monitoring the status of plants in the wild.
- Identify knowledge gaps – which species are poorly known (e.g. Data Deficient species) and from which regions.
- Support and provide information for international conservation policy.

Combretum grandidieri

[2] http://globaltrees.org/resources/resource-type/practical-guidance/: Brief No. 10: How to red list a tree species.
[3] http://www.iucnredlist.org/technical-documents/red-list-training

Author: Malin Rivers

THE GLOBAL TREE ASSESSMENT – RED LISTING THE WORLD'S TREES

The Global Tree Assessment (GTA) is an initiative to provide conservation assessments of all the world's trees by the year 2020.

The aim of the Global Tree Assessment (GTA) is to have a red list conservation assessment for every known tree species in order to complete an evaluation of the conservation status of the world's trees by 2020 (Newton *et al*., 2015). The GTA will be an essential data source that will be used to prioritise conservation action for trees. To take this initiative forward, we have completed a list of the world's tree species, we have developed a robust procedure for identifying those that are not threatened according to international criteria and have identified those tree species that are known to be threatened at national, regional and /or international level.

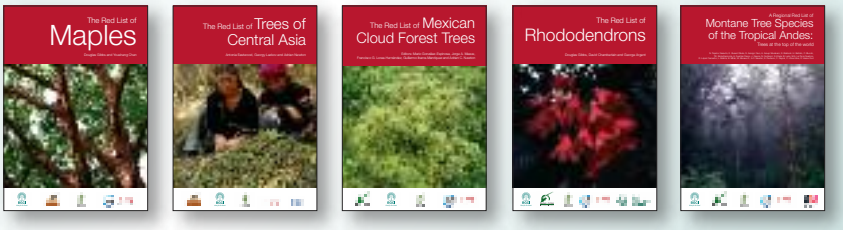
The GTA is led by BGCI and the IUCN Species Survival Commission (SSC) Global Tree Specialist Group (GTSG), who are continuing to develop an extensive global collaborative partnership to safeguard the world's threatened tree species from extinction.

The importance of trees

Trees are essential for life on Earth. They provide us with food in the form of their seeds, fruits, leaves and roots; they also enhance human life further by providing medicines, timber and fuel. Trees are also central to many ecological processes such as climate regulation (including carbon dioxide absorption), soil fertility and the purification of both water and air. Trees provide the physical structure for some of the most biologically diverse ecosystems on earth, including woodlands and forests.

Table 1. Summary of Red Lists produced by the Global Tree Specialist Group, Botanic Gardens Conservation International and Fauna & Flora International

Tree Red List	Year published
The Red list of Endemic Trees & Shrubs of Ethiopia and Eritrea	2005
The Red List of Trees of Guatemala	2006
The Red List of Magnoliaceae	2007, 2016
The Red List of Oaks	2007
The Red List of Maples	2009
The Red List of Trees of Central Asia	2009
The Red List of Mexican Cloud Forest Trees	2011
The Red List of Rhododendrons	2011
A Regional Red List of Montane Tree Species of the Tropical Andes	2014
The Red List of Betulaceae	2014



Moreover individual tree species often play a keystone role in their ecosystems, supporting a multitude of other species from their position at the base of trophic pyramids in ecological networks.

However, increasing numbers of tree species are at risk of extinction by over-exploitation and habitat destruction, as well as by pests, diseases, invasive species and the impacts of climate change. The effects of such threats on trees can lead to the rapid decline of whole ecosystems, their associated wildlife, livelihood values and carbon stocks. Maintaining tree diversity is critical for solving some of this century's major challenges, including food security, water scarcity, human health and mitigation and adaptation to climate change. However, effective forest (and tree) conservation requires species-specific action. It is therefore imperative that we consolidate and analyse information on the world's tree species as a basis for supporting effective conservation of all components of terrestrial biodiversity.

Conservation assessments

The first large-scale assessment of threatened trees was published in 1998 in the book *The World List of Threatened Trees* (Oldfield *et al.*, 1998). From this publication over 7,000 conservation assessments of trees were added to the IUCN Red List. Since then BGCI, working with Fauna & Flora International (FFI) and the Global Tree Specialist Group have continued to produce global conservation assessments of trees both with taxonomic and regional foci (Table 1).

To date, about 10,000 tree species have been assessed globally for their risk of becoming extinct and have been published on the IUCN Red List of Threatened Species (IUCN 2016.3). Another 10,000 species have been assessed on a national or regional level (BGCI, unpublished). However, without knowing which of the remaining unassessed tree species are threatened and what the threats are, we cannot effectively protect and safeguard these trees. The Global Tree Assessment will ensure that no tree species is ignored.

"Conservation of trees, halting deforestation and sustainable management of forests is recognised as playing a major role in addressing climate change"

The Global Tree Assessment will first and foremost give us a complete assessment of the conservation status of the world's trees. However, in addition conservation assessments are an invaluable data source of information for tree conservation action. The assessments are done to the IUCN Red List standard and are published, as far as possible, on the IUCN Red List of Threatened Species website, freely available to all. The GTA will provide data for governments, companies, civil society and forest communities so that tree species can be managed, restored and saved from extinction.

Delonix boiviniana

Above: Red listing workshop in Fiji

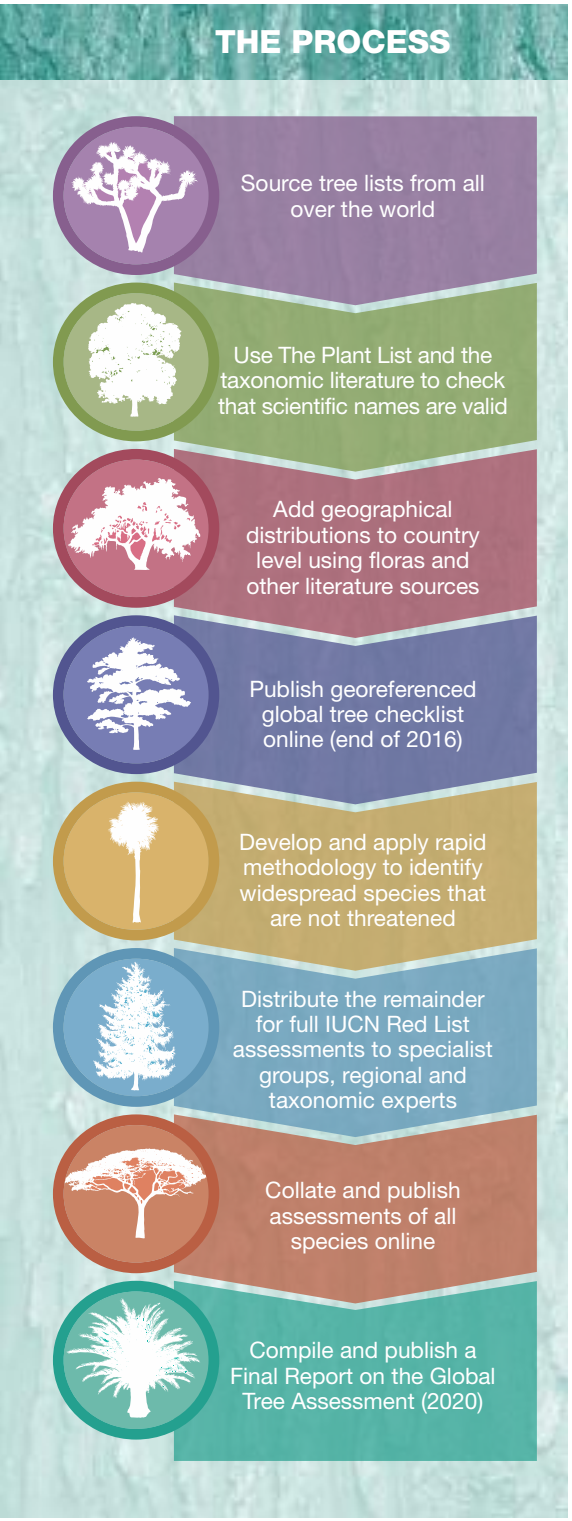


Fig. 1: The process

BGCI
Plants for the Planet

GTSG

Global Tree Assessment: The process

Developing a checklist

The Global Tree Assessment is already in progress and following the process outlined in Fig. 1. A global tree checklist with country distributions has been produced: *GlobalTreeSearch*. This list of approximately 60,000 accepted tree species forms the backbone of the Global Tree Assessment. The *GlobalTreeSearch* database will shortly be freely available on the BGCI website.

Least concern species

The next step in the process – a methodology to identify widespread, not threatened species, has been developed. An initial workshop was conducted in November 2016 with 18 experts to identify data sources, tools and methodologies to identify Least Concern (not threatened) trees. Rapid identification and documentation of Least Concern species will allow us to concentrate on collecting information on the species most at risk.

Threatened species

We are continuing to red list the most threatened trees around the world, and several recent or planned projects are described in the Case Studies. We are also conducting a gap analysis to see in which plant families and in which countries the remaining tree species fall. These species will then be allocated to specialist groups and regional and taxonomic experts for assessment. This allows us to ensure that our resources are focused on the species that are at greatest risk of extinction.

Global Tree Assessment partners – and how to join

The Global Tree Assessment is managed and coordinated by BGCI and IUCN/SSC Global Tree Specialist Group. We are working with the International Union for Conservation of Nature (IUCN) and a wide range of national and local organisations and individuals. The IUCN SSC's Global Tree Specialist Group has over 80 tree experts from countries all around the world who are contributing information and carrying out species assessments.

BGCI is also the pivotal centre of the global network of around 2,500 botanic gardens and arboreta. Our members include many gardens and arboreta already involved in the Global Tree Assessment - Morton Arboretum, Royal Botanic Garden Edinburgh, Westonbirt Arboretum, Missouri Botanical Garden and many others. In addition, we work with and support many smaller botanic gardens situated in the world's plant diversity hotspots. We are also building partnerships with other institutions such as other NGOs, forestry and research institutions.

The role of botanic gardens

Botanical gardens and arboreta play a very important role in the GTA. These institutions support many of the world's botanical experts, including specialists in certain taxonomic groups or geographic regions, many of whom also have detailed knowledge of the distributions and ecology of threatened tree species in the wild. These experts also have access to valuable networks of colleagues with similar interests and skills. Collectively, gardens and arboreta have the knowledge, capacity, and motivation to support the GTA. We urge gardens to contribute in the following ways:

- Coordinate the Red List efforts for a genus, family, or ecological region. Recruit colleagues and other experts to provide the necessary data to compile the assessments.
- Share and provide data and information on taxa from your region of interest.
- Encourage students to complete assessments for the species they are studying. These count as publications and are a great way to get your students familiar with the taxon that they will be studying.
- Review draft species assessments.
- Host a Red List workshop or training day at your institution.
- Publicize the GTA and recruit contributors and experts whenever you can (at conferences and botanical society meetings, on your webpage, in your publications, etc.)

Despite the best efforts of botanic gardens around the world, for too long plant conservation has not received the popular and political support that it deserves.

The Global Tree Assessment with its clear and ambitious goal will provide a major new resource to focus attention and efforts on the conservation of trees and the ecosystems they define. The Global Tree Assessment will provide prioritization information to ensure that conservation efforts are directed at the right species so that no tree species becomes extinct.

References

- IUCN, 2016. The IUCN Red List of Threatened Species v. 2016.3 Available at: www.iucnredlist.org
- Mark, J., Newton, A., Oldfield, S. and Rivers, M. 2014. *The International Timber Trade: A working list of commercial timber tree species.* Botanic Gardens Conservation International, Richmond, UK.
- Newton, A., Oldfield, S., Rivers, M., Mark, J., Schatz, G., Garavito, N.T. *et al.* 2015. Towards a Global Tree Assessment. *Oryx* **49**(3): 410-415.
- Oldfield, S., Lusty, C., and MacKinven, A. 1998. *The World List of Threatened Trees*. World Conservation Press. Cambridge, UK
- Rivers, M., Beech, E., Murphy, L. and Oldfield, S. 2016. *The Red List of Magnoliaceae – revised and extended*. Botanic Gardens Conservation International, Richmond, UK.
- Rivers, M., Shaw, K., Beech, E. and Jones, M. 2015. *Conserving the world's most threatened trees. A global survey of* ex situ *collections*. Botanic Gardens Conservation International, Richmond, UK.

Malin Rivers
Red List Manager
BGCI
Descanso House, 199 Kew Road
Richmond, Surrey, TW9 3BW UK

CASE STUDIES

Threatened trees of Fiji

Fiji is home to around 600 tree species which are only found in Fiji. Many of its natural areas and tree species are under threat from habitat loss or over-exploitation. The extinction risk of individual tree species in Fiji is poorly documented and less than 20% of the Fijian trees are currently included on the IUCN Red List. This is in sharp contrast to the island's animals, with all birds, mammals and amphibians already fully assessed. BGCI is working with Nature Fiji Maquete Viti to build capacity for tree red listing in Fiji and supporting on-the-ground tree conservation action.

Assessing timber species

Part of the Global Tree Assessment is an up-to date assessment of the world's commercial timber species. Timber trees contribute some $468 billion to the global economy every year. They also provide crucial ecosystem services underpinning ecosystem stability, function and biodiversity. A working list of 1,575 commercial timber species has been produced and all species have been mapped by a PhD student at Bournemouth University (Mark *et al*., 2014). BGCI is helping to ensure that complete assessments are included on the IUCN Red List to support sustainable, legal timber harvesting, trade policies and regulations.

European Trees

BGCI and IUCN are working together to assess all the trees in Europe, as well as some larger shrubs. Funded by the EU Life programme, this project that will ensure that all trees in Europe have up-to-date conservation assessments. It has highlighted many trees at risk across Europe from threats such as pests and disease, alteration in management practise and over exploitation. Even in information-rich Europe, some species still lack the necessary data to be able to assign a conservation category. The assessment will be completed in early 2018.

Magnoliaceae

The Red List of Magnoliaceae (Rivers *et al*., 2016) reports that nearly half (48%) of the magnolia species assessed are threatened with extinction in the wild. In the wild, magnolias are principally threatened by logging activity, with habitat loss due to land conversion to agriculture and livestock farming also a significant factor in their global decline. Other threats include collection of wild plant material and impacts of climate change. The Red List of Magnoliaceae has already stimulated conservation action for the magnolia species highlighted as under threat. BGCI is working with our partner botanic gardens in Ecuador, Cuba, China and Colombia to carry out practical conservation projects to protect threatened magnolia species.

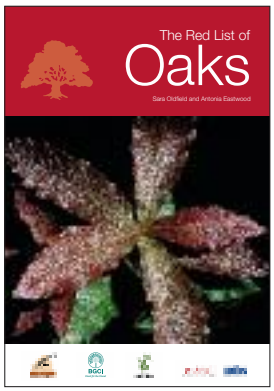
North American Trees

As part of the Global Tree Assessment, a collaborative effort is underway to coordinate North American tree Red Listing. One of the first steps proposed by BGCI, The Morton Arboretum, NatureServe, and the U.S. Forest Service is to create a definitive list of North American tree species. This will provide a foundation to determine which species have been evaluated, and when, by the major conservation status assessment platforms (IUCN Red List, NatureServe G-ranks) as well as the U.S. Forest Service CAPTURE program, the U.S. Endangered Species Act or Canada's Species At Risk Act lists. This comprehensive list of North American tree species together with most recent threat status evaluations will then be used for prioritizing which species need to be assessed and for mobilizing support for achieving the Red List of all North American trees.

Author: Murphy Westwood

A NEW RED LIST OF OAKS: INFORMING CONSERVATION ACTION AND CATALYZING COLLABORATION

Oak species of greatest conservation concern are being identified and prioritised for action as part of the Global Oak Conservation Partnership to inform collaborative conservation action.



Summary of Results	
Conservation Status	**Number of Oak Taxa**
Extinct	0
Critically Endangered	13
Endangered	16
Vulnerable	27
Near Threatened	22
Data Deficient	33
Not Evaluated	c.300
Least Concern	97

Fig 1: The 2007 Red List of Oaks included less than half of the world's oak species and found that one-third of oak species were threatened with extinction.

Introduction

When The Red List of Oaks was first published in 2007 (Oldfield and Eastwood, 2007), it became clear that the oaks of the world, the genus *Quercus*, were in urgent need of research and conservation action. The 2007 report included 175 of the roughly 450 accepted *Quercus* species. Of those 175, one-third fell within a threatened category of Critically Endangered (CR), Endangered (EN) or Vulnerable (VU). Another 19% of the evaluated species were data deficient (Fig. 1). The fact that one-third of the evaluated species were threatened, and well over half of all known species were data deficient or not evaluated, was greatly concerning. The 2007 report marked a major milestone in our knowledge of this ecologically and economically important

*The Morton Arboretum's iconic Millennium Oak (*Quercus alba*)*

tree genus, but there is a still a large information gap to fill. What is the threat status of the 300+ unevaluated species? What are the major threat trends affecting *Quercus* species today, ten years after the publication of the first Red List of Oaks, and do those threats vary by region, habitat, or lineage within the genus? What research and conservation actions are underway to protect threatened oaks? What are the biodiversity hotspots for threatened oaks? Where should conservation efforts focus in the future? These are the questions that The Morton Arboretum, in collaboration with the Global Trees Campaign, set out to answer when they created the Global Oak Conservation Partnership.

Why oaks?

Oaks are keystone species in a wide range of ecosystems around the world, such as in oak-pine forests and cloud forests in Mexico, and subtropical broad-leaved evergreen forests in Southeast Asia. Globally, oaks are ecologically valuable for promoting terrestrial biodiversity, performing critical ecosystem functions, and providing food and habitat for countless species of animals (Miller and Lamb 1985; Menitsky 2005; le Hardÿ de Beaulieu and Lamant 2010). For example, in North America,

native oak species are host to 534 different species of Lepidoptera (moths and butterflies), making *Quercus* the most ecologically valuable plant genus for that insect group (Tallamy and Shropshire, 2009). However, oaks are threatened with extinction worldwide and oak-dominated ecosystems are declining (Oldfield and Eastwood 2007; Fahey *et al*., 2012). Furthermore, oak acorns cannot be seed banked through conventional preservation methods of low temperature and humidity, so effective long term *ex situ* conservation of threatened oak species must be through living collections of genetically diverse, wild-collected trees of known provenance – a challenging undertaking for such large, long-lived trees.

The Global Oak Conservation Partnership

The iconic oak has long been a symbol of The Morton Arboretum, a 1,700 acre public garden in the suburbs of Chicago, IL (USA) and oaks feature prominently in its collections, research projects, educational programs, and outreach events. The logo of the Arboretum, the mighty white oak (*Quercus alba*), is the state tree of Illinois, and the Arboretum hosts the Millennium Oak, Illinois' millennium landmark tree (Fig. 2). Oaks are arguably the dominant and most important tree group in ecosystems of the region – the North American Midwest – such as oak-hickory forests and oak savannas. For these reasons, the genus *Quercus* is a focal point of research and conservation efforts at The Morton Arboretum. In response to the need for more research and conservation efforts for threatened oak species, The Global Oak Conservation Partnership was established by the Arboretum, BGCI, and Fauna & Flora International in 2015 as a formal project of the Global Trees Campaign. The shared vision of these partners is that:

> *"All oak species are secure within healthy ecosystems."*

In recognition of the fact that conservation of threatened oak species will require tailored *in situ* protection and management efforts working in coordination with *ex situ* conservation of living trees, the Partnership has adopted an integrated conservation management approach for oaks (Oldfield and Newton 2012; BGCI 2014).

Oak experts from the International Oak Society learning the IUCN Red List process and reviewing threat assessments.

The goals of the Partnership's activities are:

1) Oak species of greatest conservation concern are identified and prioritised for action.
2) The world's most threatened oak species are secure and their wild populations are recovering through conservation action.
3) *Ex situ* conservation collections of threatened oak species are scientifically informed, efficiently managed, genetically diverse and representative, and climate change resilient.
4) Partners, practitioners and the wider community are empowered to act for oak conservation.

Updating the Red List of Oaks

As a first step towards filling the information gap on threatened oaks, The Morton Arboretum began compiling an updated Red List of Oaks in 2015. As of 2016, 73 new assessments have been published on the IUCN Red List, with another 13 completed and in review (Table 1). Most of these are species from North America, as the Arboretum started with the species closest to home. A complete Red List of US Oaks is nearly finished. The Mexican taxa will be addressed in 2017. A complementary effort by BGCI to assess all of the native European tree species has included several *Quercus* species, helping to push forward this initiative.

Of the North American taxa so far assessed, 21% fall within a threatened category (CR, EN, and VU). This is worrying because the majority of the assessed species are US natives,

	Published and in Review
CR	4
EN	10
VU	4
NT	3
LC	62
DD	3
Total	86
Threatened	18
% Threatened	21%

Table 1: Summary of results of the IUCN Red List of Oaks initiative from 2015-2016. 73 species have been published on the IUCN Red List, with another 13 assessments complete and ready for review.

Quercus brandegeei *in the wild in Baja California Sur.*

which are known to be generally less threatened than species in Mexico and Central America. It is anticipated that the percentage of threatened species will grow considerably as the myriad rare endemics of Mexico begin to be evaluated. Preliminary results suggest that as many as half, possibly more, of Mexican oaks are likely threatened with extinction.

New collaborations

In order to gather the most accurate and up to date information for the Red List assessments, the Arboretum hosted a one-day Red List training and assessment review workshop associated with the International Oak Society conference in October, 2015. In addition to the International Oak Society, the support of the Oak Curatorial Group of the American Public Garden Association has also been key to gathering the necessary information for the assessments. Engaging local experts who know well the species in question has been productive not just for compiling threat assessments, but also for generating collaborations. The Red Listing process has brought together dozens of oak experts from around the world and opened up a productive dialogue on the pressing threats facing oaks.

At the International Oak Society workshop, it was agreed that a meeting was needed to discuss oak conservation in one of the world's oak diversity hotspots: Mexico. Mexico is home to nearly 180 native species of oak, many of which are threatened and/or very poorly known. So, The Morton Arboretum, in collaboration with the Instituto de Investigaciones en Ecosistemas y Sustentabilidad, Universidad Nacional Autónoma de México (UNAM) and the University of Minnesota, hosted the first *"International Workshop on Oak Conservation in Mexico and Central America"* at the UNAM campus in Morelia, Mexico in March, 2016. The objective of the workshop was to facilitate collaborations and catalyze action for oak conservation in Mexico and Central America by identifying critical knowledge gaps, defining conservation objectives, prioritizing next steps, and strengthening the network of oak research and conservation experts. The most significant outcome of the workshop was the establishment of the Oaks of the Americas Conservation Network (OACN), a consortium of experts from universities, botanical gardens, arboreta, industry, conservation NGOs, and government agencies dedicated to protecting threatened oak species. The Network committed to writing a scientific paper outlining the importance of oaks and oak diversity in Mexico and Central America and calling for additional resources and effort towards oak research and conservation. The workshop also identified the urgent need for a conservation gap analysis for oaks in this region (a protocol for which is now being developed) and identified critical training and capacity building needs, especially in the area of oak taxonomy and field identification. Specific conservation opportunities were identified and collaborative projects involving OACN members are now underway. Follow up workshops and oak-focused conference sessions are being planned for the future.

Informed conservation action

In addition to catalyzing global collaborations, the new Red List of Oaks has allowed the Global Oak Conservation Partnership to develop targeted action plans for prioritized threatened oak species, thus maximizing the conservation impact of limited resources. Because the Red List process provides a subjective way to quantify extinction risk, and requires a clear explanation of the specific threats facing each assessed taxon, individual members of the Partnership are able to very strategically identify target species on which they can have the most impact, based on their unique areas of expertise (e.g. plant propagation, community education and outreach, conservation genetics research, etc.). For example, after completing the Red List assessment for *Quercus brandegeei*, an oak endemic to the southern tip of Baja California Sur, it became clear that additional field and greenhouse propagation research was needed to determine what ecological factors were preventing seedling regeneration in this endangered species. This is precisely the sort of work that an arboretum or botanic garden is well positioned to undertake. The Morton Arboretum, in collaboration with researchers at UNAM and Vallarta Botanical Garden, and local partners, have developed a research and conservation action plan for *Q. brandegeei* that is designed to result in a scientifically informed restoration and reintroduction strategy, as well as better *ex situ* representation of this rare species in gardens in Mexico. The project is currently underway.

Global conservation impact for oaks

The establishment of the Global Oak Conservation Partnership and the initiation of the new Red List of Oaks have resulted in many positive and exciting outcomes in the past two years. New partnerships have been fostered that span political borders and cross professional sectors. Scientifically informed conservation strategies are being developed. Collaborative funding proposals have been submitted and awarded, resulting in increased capacity for oak conservation. Dozens of oak experts have been trained in and are now engaged in the IUCN Red List process. The Oaks of the Americas Conservation Network was founded and is growing. New workshops, collecting trips, grant proposals, and publications are in the pipeline. Ultimately, all of these efforts and outcomes will contribute to protecting threatened oak species in the wild and strengthening the conservation value of living *ex situ* collections for this economically and ecologically valuable group of iconic trees. With the threats of climate change, invasive pests and diseases, overharvest and habitat destruction looming large for oaks, this global challenge demands a global solution.

Quercus brandegeei, *an endangered oak endemic to Baja California Sur and the target of a research and conservation project by The Morton Arboretum, UNAM, and Vallarta Botanical Garden (Jose Luis de la Luz)*

The first International Workshop on Oak Conservation in Mexico and Central America, at which was founded the Oaks of the Americas Conservation Network

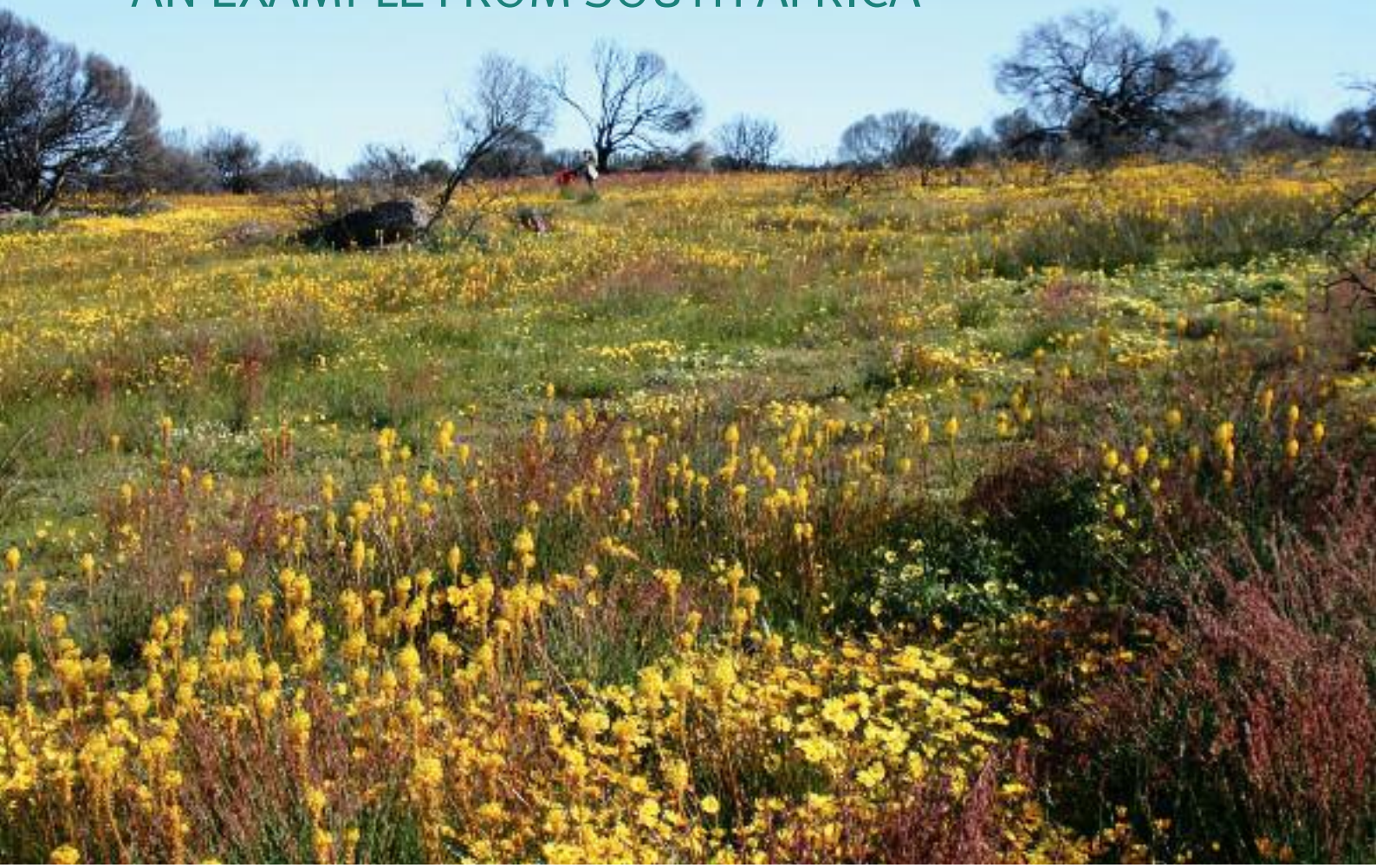
References

- BGCI. 2014. Building living plant collections for conservation: a guide for public gardens. http://www.bgci.org/files/UnitedStates/MBC_Collections_Guide_2014.pdf
- Fahey, R.T., M. Bowles, and J. McBride. 2012. Origins of the Chicago urban forest: composition and structure in relation to pre-settlement vegetation and modern land-use. Arboriculture and Urban Forestry 38(5): 181-193.
- le Hardy de Beaulieu and T. Lamant. 2010. Guide illustré des chênes. Belgium: Edilens
- Menitsky, Yu. L. 2005. Oaks of Asia. Enfield: Science Publishers, Inc.,
- Miller, H. and S. Lamb. 1985. Oaks of North America. Happy Camp: Naturegraph Publishers, Inc.
- Oldfield, S. and A. Eastwood. 2007. The Red List of Oaks. Cambridge: Flora & Fauna International.
- Oldfield, S. and A.C. Newton. 2012. Integrated conservation of tree species by botanic gardens: a reference manual. Richmond: Botanic Gardens Conservation International.
- Tallamy, D. and K. Shropshire. 2009. Ranking Lepidopteran use of native versus introduced plants. *Conservation Biology* **23**: 941–947. doi:10.1111/j.1523-1739.2009.01202.x

Murphy Westwood
The Morton Arboretum
4100 Illinois Route 53
Lisle, Illinois 60532

Author: Domatilla Raimondo

RED LISTS INFORMING *IN SITU* CONSERVATION OF PLANTS IN A MEGADIVERSE COUNTRY
AN EXAMPLE FROM SOUTH AFRICA



Site Avontuur on the Bokkeveld Escarpment in Northern Cape Province of South Africa. Avontuur was bought by WWF in 2008 on request by the botanical community for the conservation of Endangered Bokkeveld Sandstone Fynbos. The site will be officially declared as a protected area in 2016. There are 45 threatened plant species that occur at this site, they are threatened throughout the rest of their range due to the conversion of their habitat for rooibos tea and wheat cultivation (Noel Oettlé)

Introduction

A five step process to guide countries in upscaling *in situ* plant conservation efforts – starting with identifying plant species of conservation concern.

South Africa has the world's richest temperate flora, with 20,456 recorded indigenous vascular plant taxa. With the current estimate of the global flora at 379,881 taxa, 5% of the world's plant diversity is represented within South African borders. Between 2004 and 2008, South African botanists led by the Threatened Species Programme from the South African National Biodiversity Institute (SANBI), completed a comprehensive assessment of the status of the South African flora using the IUCN Red List Categories and Criteria Version 3.1. In so doing becoming the first of the world's megadiverse countries to fully assess the status of its entire flora and to achieve Target 2 of the Global Strategy for Plant Conservation *'An assessment of the conservation status of all known plant species, as far as possible, to guide conservation action.'*

Since the completion of the first comprehensive Red List Assessment, South African conservationists have used the National Plant Red List as an essential resource to guide *in situ* plant conservation work.

South Africa has 4,687 plant taxa of conservation concern (species that are either rare or threatened). With such a high number of species to conserve *in situ,* a species by species approach is not possible. South Africa has developed a number of strategies to effect the conservation of as many species as possible in the most resource efficient way. Reflecting on work done on *in situ* conservation over the past seven years, five critical factors have emerged as essential steps for countries to undertake if they are to effectively conserve plant diversity, these are reflected on below.

Step 1: Conduct comprehensive conservation assessments to identify all plant species of conservation concern.

Most National Red Lists for plants evaluate only a small proportion of the indigenous national floras. In so doing, many species of conservation concern are never identified and do not get included in conservation processes. In South Africa prior to 2003, historic red lists evaluated less than 20% of the flora. As a result of the first comprehensive assessment of all 20,456 taxa, published in 2008, 2,045 plant taxa of conservation concern were added to the Red List for the first time. Of these 942 were taxa threatened with extinction. The majority of these were historically of conservation concern, but were never previously assessed. Many threatened taxa and other taxa of conservation concern are missed when only selective assessments are done.

South Africa uses the IUCN Red List Categories and Criteria Version 3.1 to assess the conservation status for plants as it is globally recognised, and is a scientifically sound means of identifying species threatened with extinction. The IUCN Red List system is in itself however not sufficient for the identification of all plants of conservation priority. For example rare, range restricted species that face no threat qualify under the IUCN system as least concern; these taxa are often either national endemics or near endemics, have very restricted global ranges (less than 500 km^2) and are crucial components of the flora to conserve. In countries with high levels of endemism these rare species can make up a large proportion of the flora, South Africa for example has 1,478 rare plant taxa. Both rare taxa and taxa threatened with extinction need to be included in *in situ* conservation programmes.

Step 2: Invest in mobilising spatial occurrence data for all species that are either listed as threatened or are range-restricted

Over the past 10 years SANBI's Threatened Species Programme (TSP) has mobilised plant occurrence data for taxa of conservation concern. The main source of plant occurrence data comes from herbarium specimens housed in South Africa's six major herbaria which hold samples of more than 95% of South Africa's plant species. Specimens of plants of conservation concern have been digitised through a number of projects supported by small grants from South Africa's National Research Foundation of the Department of Science and Technology. The Threatened Species Programme staff have worked over many years to accurately geo-reference this specimen data. Historic occurrence data from plant specimens have been augmented with recent on-the-ground observations collected by volunteers from the Custodians of Rare and Endangered Wildflowers Programme (CREW). CREW is a citizen science programme jointly funded by South Africa's Botanical Society and SANBI that has been in operation since 2003. CREW volunteers collect accurate data on where populations of plants of conservation concern occur, as well as monitoring the status of these populations, collecting data on population size and documenting threats present.

Step 3: Prioritise areas for protecting plant taxa of conservation concern using systematic conservation planning

South Africa uses accurate spatial data on where species of conservation concern occur to determine how well protected these plants are and to identify which taxa have insufficient levels of protection and need to be included in new protected areas. South Africa's biodiversity sector bases its work on priorities identified through systematic biodiversity plans which identify Critical Biodiversity Areas that represent ecological viable networks of ecosystems and species for conservation. Occurrences for plant taxa of conservation concern are used to set targets in systematic conservation plans conducted for all nine of South Africa's provinces.

Brachystelma modestum, *a Near Threatened Species from the family Apocynaceae (D. Styles)*

Above: Serruria meisneriana, *(Proteaceae) Endangered (C. Paterson-Jones)*
Top: Disa tenella tenella, *(Orchidaceae) Endangered (Rupert Koopman)*

Step 4: Expand protected areas to protect species.

Protected area expansion is based on Critical Biodiversity Areas identified during systematic conservation plans produced by South Africa's nine provincial conservation authorities. Capturing unprotected threatened species which have been identified by systematic conservation planning is a major priority for protected area expansion. Active protected area expansion is taking place acrosss South Africa based on protected area expansion strategies. Sites with high concentrations of unprotected threatened plants are being prioritised in this expansion process. One of the most effective current forms of expanding protected areas is through Biodiversity Stewardship programmes which facilitate the protection of private and communal land through contractual agreements between conservation authorities and landowners. Stewardship programmes have been successfully established in the last decade in most of South Africa's 9 provinces. In addition to Stewardship programmes, outright land acquisition for protection is also conducted by South African National Parks and by World Wildlife Fund's Land Trust.

South Africa is actively working to achieve Target 7 of the Global Strategy for Plant Conservation *'75% of known threatened plant species conserved* in situ*'.* SANBI's Threatened Species Programme is working hand-in-hand with provincial authorities to ensure priority sites with unprotected plants of conservation concern are protected. For example 30 land cadastres (sites) have been identified through systematic conservation planning (von Staden *et al*., in prep) as required to be conserved in order to achieve Target 7. Most of these sites occur in the Western Cape and the Northern Cape and have been incorporated into the Protected Area Expansion strategies for these provinces. Stewardship negotiations are currently underway at more than 50% of these sites. With current progress it is likely that South Africa will achieve Target 7 by 2020.

Step 5: Mainstream considerations for endemic and threatened species into sectors causing loss of biodiversity outside of protected areas.

The above discussed expansion of protected areas to conserve plants caters for plant species that occur in large, intact areas of natural vegetation. Unfortunately, South Africa also has many threatened plant taxa that have lost most of their former habitat and now remain only on remnant small patches of vegetation within urban and agricultural landscapes or along road verges. These taxa are highly vulnerable to extinction as a result of development. South Africa has environmental authorisation legislation under the National Environmental Management Act (NEMA; Act No. 107 of 1998) in terms of the Environmental Impact Assessment (EIA) regulations, which requires an EIA to be undertaken for a wide range of development activities (82 in total). During the EIA process, provincial conservation authorities are requested to comment on development applications. SANBI provides the provincial conservation authorities, on an annual basis, with accurate spatial data of the known occurrences of threatened species. This allows the provincial authorities to oppose development applications in areas where threatened taxa occur. Guidelines for environmental assessment practitioners and botanical specialists working on EIAs have been developed to ensure standardised recommendations for the protection of plants of conservation concern takes place during the EIA process.

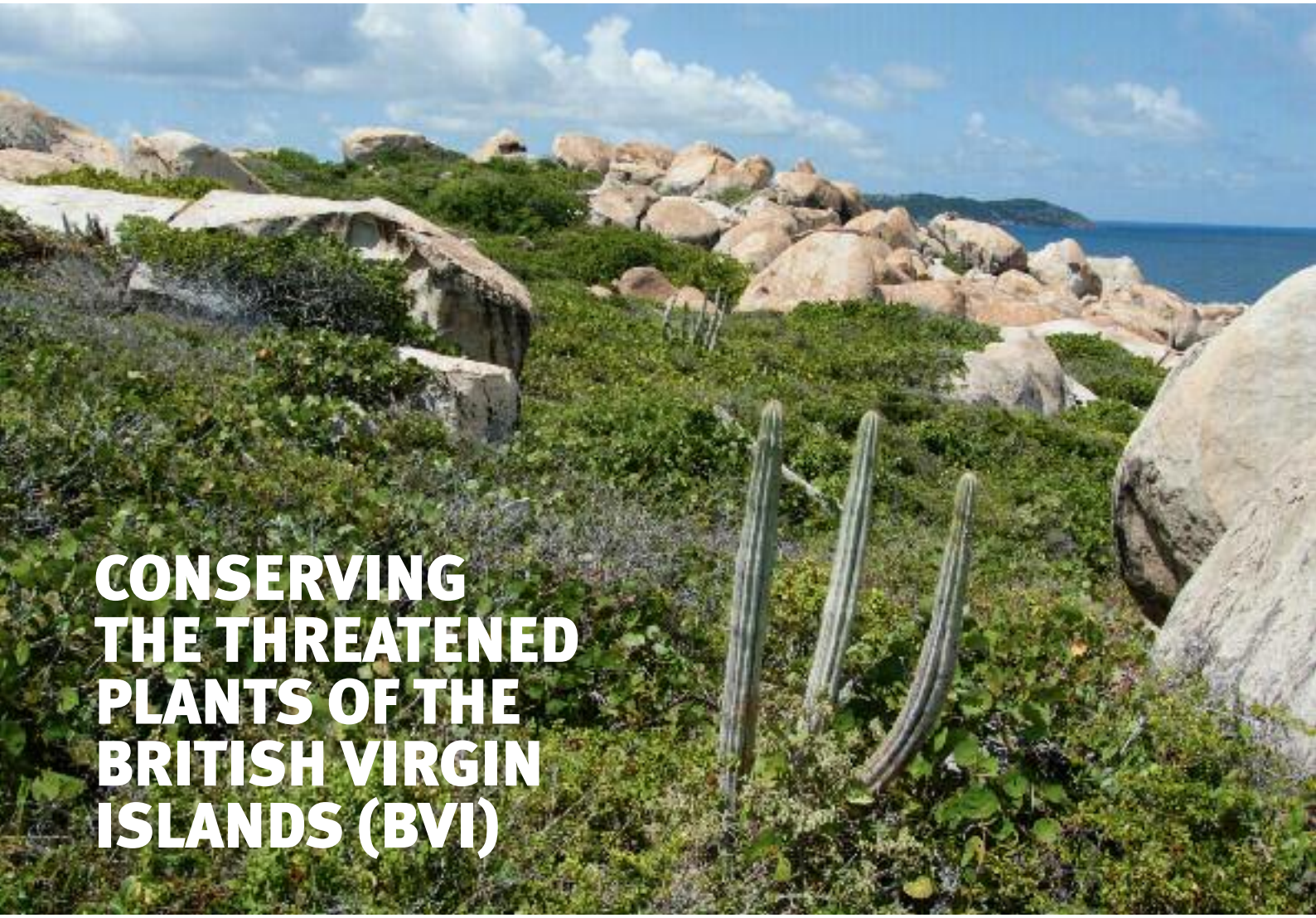
In 2014, South Africa passed an Infrastructure Act which allows large development infrastructure projects to be subject to streamlined environmental authorisation processes. Strategic Environmental Assessments (SEA) are carried out for these large scale infrastructure programmes. During 2015 spatial data for plants of conservation concern fed into the SEA for the Renewal Energy Development, and the SEA for the Electricity Grid Upgrade. Currently the Central Karoo Basin in South Africa has had prospecting licenses for Shale Gas Extraction issued. A Strategic Environmental Assessment under way has spatially mapped ecological sensitive areas not suitable for Shale Gas Extraction. 2,431 plant occurrence records for taxa of conservation concern have influenced areas identified as ecologically sensitive and not suitable for development.

Conclusion

South Africa's experience to date with *in situ* conservation shows the value of not only approaching *in situ* plant conservation work on a species by species basis. Rather we illustrate the value of comprehensively assessing which plants are priorities for conservation, mobilising the spatial data on where these taxa occur and feeding this information into the decision making processes for the country. This is primarily important in determining where protected areas are expanded and influencing the use of land to prevent transformation of remaining habitat occupied by plants of conservation concern. We hope the five step process outlined above may prove to be a useful road map for other countries wishing to upscale their efforts in *in situ* plant conservation.

Domatilla Raimondo
Threatened Species Programme Manager, South African National Biodiversity Institute,
d.raimondo@sanbi.org.za

Authors: Sara Bárrios, Natasha Harrigan, Nancy Pascoe, Keith Grant, Marcella Corcoran, Tom Heller, Rosemary Newton, Michele Sanchez, Colin Clubbe and Martin Hamilton



CONSERVING THE THREATENED PLANTS OF THE BRITISH VIRGIN ISLANDS (BVI)

Intact coastal dry forest, Fallen Jerusalem National Park, British Virgin Islands. (Sara Bárrios)

The Royal Botanic Gardens, Kew has been working with local partners in the British Virgin Islands since 1998 with a focus on assessing the extinction risk for native plant species and mitigating against the main threats.

Introduction

The Caribbean region is home to a highly diverse flora with around 11,000 native species of which nearly 72% are endemic (Acevedo-Rodríguez & Strong, 2008), and is classified as a biodiversity hotspot experiencing significant threats to its biodiversity (Myers *et al*., 2000).

Despite this recognition as a global priority, there has been limited conservation activity across the region. For example, in the British Virgin Islands (BVI) the risk of extinction has been assessed for just 63 plant species (IUCN 2016) using the IUCN Red List of Threatened Species categories and criteria (IUCN 2012). This represents around 11% of the total native flora based on our working list of plant species. To address this conservation deficit we need to close the knowledge gap by assessing all plant species native to the Caribbean and to actively conserve those already recognised as threatened taxa. For more than a decade The UK Overseas Territories (UKOTs) team in the Conservation Science Department at the Royal Botanic Gardens, Kew has been collaborating with local partners to address these conservation issues. In BVI, we are working with the National Parks Trust of the Virgin Islands (NPTVI) to assess the extinction risk of native plants, establish *ex situ* collections and implement *in situ* conservation actions to save this globally threatened flora.

Above: Leptocereus quadricostatus *is an Endangered (EN) plant species endemic to Anegada (BVI) and the island of Puerto Rico (Sara Bárrios)*
Top: Vachellia anegadensis *is an Endangered (EN) plant species endemic to the British Virgin Islands (Sara Bárrios)*

BVI endemic and near endemic plant species

The British Virgin Islands is a UK Overseas Territory (UKOT) located in the Caribbean Sea about 90km east of Puerto Rico. BVI comprises around 240 islands and cays, the majority of which are small and uninhabited. Tortola is the largest and the most densely populated island and home to BVI's capital, Road Town. BVI, the nearby US Virgin Islands (USVI) and the islands of Puerto Rico form the Puerto Rican Bank floristic province (Lugo *et al.*, 2006). Of the 2,221 native plants recorded from the Puerto Rican Bank, 305 are endemic and four are currently thought to occur exclusively on BVI (Acevedo-Rodríguez & Strong 2008).

Under threat

There are very few patches of primary forest left in the British Virgin Islands due to the clearing of land during the 18th century primarily for agricultural uses. The main existing vegetation is secondary seasonal dry forest, which has, to some extent recovered since the plantations ceased. Modern threats to native plants are mainly related to the pressure from development, associated with new tourism, infrastructure and housing developments. Adding to this, the increase of international trade and a lack of biosecurity have led to more introduced (non-native) plants and pests arriving which often spread out of control. Some of these species have become invasive, modifying native ecosystems and competing with native species for available resources. Finally, it is also important to consider the threat posed by climate change. Although this is an area adapted to seasonal tropical storms, more frequent storms of higher intensity are expected as the climate changes. In the future, sea level rise is predicted to affect many coastal areas on the majority of the islands and could eliminate the already fragmented habitats of coastal plant species.

The IUCN Red List as a tool to frame conservation action

Since Kew's UKOTs team and NPTVI started collaborative work in 1998, assessing extinction risk of native plant species and mitigating against the main threats have been key objectives of the partnership. As a result of an initial project funded by the Darwin Initiative, the first report on the status of the threatened plant species of the British Virgin Islands was published in 2003 (Clubbe and Pollard, 2003). This report was particularly important in highlighting the existing knowledge gaps on the distribution of native species. At that time, limited field observations and access to digitised herbarium collections were major restrictions. Since then, we have undertaken several projects that have enabled field work activities, often in previously unexplored areas, which has greatly increased our knowledge. Access to better mapping and visualisation tools such as Google Earth and handheld data recording devices with built-in GPS are now available. This technology accelerates surveys, generates high quality data and enables easier data sharing and interpretation.

To prioritise our efforts to conserve the BVI flora, an initial target list was compiled that included all plant species endemic to the Puerto Rican Bank that occur in BVI. Field surveys were undertaken to look for these species by targeting suitable habitat. Data for all new and confirmed occurrences were digitally recorded and new collections (herbarium vouchers and DNA samples) were made where possible. If the species was found in fruit, seeds were collected for long term storage at Kew's Millennium Seed Bank and for cultivation trials at Kew and at the J.R. O'Neal Botanic Garden in Road Town, Tortola. Currently 125 seed collections representing 94 plant species have been collected from BVI for long term storage. We have also secured 45 plant species in *ex situ* living collections at Kew and the J.R. O'Neal Botanic Garden from either seed or vegetative propagation methods through Darwin Initiative funded projects. Besides the obvious conservation benefits of securing species in *ex situ* conservation collections, there are many other benefits including awareness raising and access to material for research.

Road widening and paving on the island of Anegada (BVI) fragments and degrades the habitat of native plants (Martin Hamilton)

Areas with high concentrations of threatened species are being identified in order to increase *in situ* plant conservation in BVI as part of a new Tropical Important Plant Areas (TIPAs) project. All data from collections and observations made so far are being used to undertake new or updated conservations assessments and identify TIPAs. Our collaborations in BVI are ensuring that the native flora is well documented and providing the necessary information to make informed conservation decisions.

Case study: *Calyptranthes thomasiana*

Calyptranthes thomasiana is a plant species endemic to the British and US Virgin Islands that was previously assessed as Endangered (Clubbe *et al*., 2003). By targeting this species during recent field work, we were able to confirm its occurrence on Virgin Gorda and at a new location in BVI on the island of Tortola within the Sage Mountain National Park. Cuttings were taken and seedlings were rescued from path edges to establish the species in cultivation at Kew. Close monitoring of the species in the wild allowed the team to secure a seed collection of the species and establish it in the *ex situ* collections at the J.R. O'Neal Botanic Garden. An updated conservation assessment is now being completed, taking into account this new location data and updated population status.

Calyptranthes thomasiana, *Endangered (EN) in the wild, flowers for the first time in* ex situ *collection at Kew's Tropical Nursery in June 2016 (Marcella Corcoran)*

Collecting herbarium vouchers and DNA samples, Great Tobago National Park, BVI.(Thomas Heller)

References

- Acevedo-Rodríguez, P. & Strong, M. T. 2008. *Floristic richness and affinities in the West Indies*. The Botanical Review **74**: 5-36.
- Clubbe, C. & Pollard, B. (RBG, Kew), Smith-Abbott, J., Walker, R. & Woodfield, N. (BVI National Parks Trust). 2003. *Calyptranthes thomasiana.* The IUCN Red List of Threatened Species 2003: e.T43895A10830915. http://dx.doi.org/10.2305/IUCN.UK.2003.RLTS.T43895A10830915.en. Downloaded on 21 November 2016.
- Clubbe, C. and Pollard, B. 2003. *Status Report for the British Virgin Islands' Plant Species Red List.* Royal Botanic Gardens Kew.
- IUCN. 2012. IUCN Red List Categories and Criteria: Version 3.1. Second edition. Gland, Switzerland and Cambridge, UK: IUCN. iv + 32pp.
- IUCN. 2016. IUCN Red List of Threatened Species. Version 2016.3. <www.iucnredlist.org>. Downloaded on 8 December 2016.
- Lugo, A.E. *et al*., 2006. Botanical and ecological basis for the resilience of Antillean dry forests. In J. A. Ratter, ed. *Neotropical savannas and seasonally dry forests, plant diversity, biogeography, and conservation*. Boca Raton, FL: CRC Press, pp. 359-381.
- Myers, N. *et al*., 2000. Biodiversity hotspots for conservation priorities. *Nature*, **403**, pp. 853-858. Available at: http://ukpmc.ac.uk/abstract/MED/10706275.

Acknowledgments

The authors would like to thank the UK Government's Darwin Initiative, the Mohamed bin Zayed Species Conservation Fund, the Bentham-Moxon Trust and the Emily Holmes Scholarship for funding to support this work . Our current activities are supported by the Darwin Plus funded project [DPLUS030] *"Building systems and capacity to monitor and conserve BVI's flora"* and the HSBC funded project *"Identifying and conserving Tropical Important Plant Areas (TIPAs) in the British Virgin Islands"*.

Sara Bárrios; Marcella Corcoran, Rosemary Newton, Tom Heller, Michele Sanchez, Colin Clubbe and Martin Hamilton
UK and Islands Programme
Conservation Science Department, Herbarium
Royal Botanic Gardens, Kew
Richmond, TW9 3AE, UK
ukots.dets@kew.org

Natasha Harrigan, Nancy Pascoe and Keith Grant
J.R. O'Neal Botanic Garden
National Parks Trust of the Virgin Islands
Road Town, Tortola, BVI

Author: Gregory M. Mueller

PROGRESS IN CONSERVING FUNGI: ENGAGEMENT AND RED LISTING

Fungal conservation is only now receiving much attention. So it is not surprising fungi have rarely been included in broader conservation discussions, policy decisions, or land management plans. But this is changing, and botanic gardens and their scientists are playing key roles in these advances.

Agaricus pattersoniae *Vulnerable C2a(i)*

Boletopsis nothofagi *Endangered B2ab(ii,iii,v);D*

Bridgeoporus nobilissimus *Critically Endangered A2c; C2a(i)*

Corinarius osloensis *Endangered C2a(i)*

Destuntzia rubra *Critically Endangered C2a(i)*

Hydnellum mirabile *Vulnerable A2c+3c+4c*

Hygrocybe flavifolia *Endangered C2a(i)*

Leptonia carnea *Vulnerable C2a(i)*

Context

Fungi are among the most important organisms in the world, not only because of their vital roles in ecosystem functions, but also because of their influence on humans and human-related activities. Fungi are essential to such crucial activities as decomposition, nutrient cycling, and nutrient transport, and are indispensable for achieving sustainable development (e.g., Palm and Chapela, 1998; Mueller and Bills 2004; Lange 2014). Some species are important plant and animal pathogens; others form obligate mutualistic symbioses with sundry species of plants, algae, cyanobacteria, and animals. Fungi are also of great economic importance, having both positive and negative effects on human activities. They have been domesticated

for use in the brewing, baking, industrial fermentation, pharmaceutical, and biotechnical industries, and other species are cultivated or collected for use as food. At the same time, fungi cause damage worth many millions of dollars each year through food spoilage, destruction or degradation of materials used by humans, and diseases of plants and animals, including humans. Because of the diversity and abundance of fungi, and the vital roles they play in both natural and altered ecosystems as well as human-related activities, fungi need to be included in considerations of biodiversity conservation, land-use planning and management, and related subjects.

Need for action

Species of fungi are not immune to the threats that put animal and plant species at risk, i.e., habitat loss, loss of symbiotic hosts, pollution, over exploitation, and climate change. Yet fungal conservation is not yet commonly discussed, considered, or acted upon by the conservation community, and the conservation status of the vast majority of fungal species has not been assessed. As recently as 2013, only three species of fungi, one mushroom and two lichens, were included on the IUCN Red List. Efforts over the last several years have increased this number to 34 (IUCN Red List of Threatened Species. Version 2016-3 www.iucnredlist.org). But with an estimated 5 million fungal species (Blackwell, 2011), the process of assessing the conservation status of fungal species is just beginning.

The low number of fungi on the Red List is in part due to a perception by some mycologists and other scientists that species of fungi are intractable to rigorous assessment due to their high taxonomic and morphological diversity, predominantly cryptic lifeforms, and paucity of taxonomic, distribution and ecological data (Dahlberg and Mueller, 2011). But significant progress has, and continues to be made in generating the data needed to undertake rigorous conservation assessments.

Fieldwork over the past 50 years, including recent DNA based environmental sampling, together with major advances in our understanding of fungal biology is providing the information needed for making assessments. The mycological and conservation community is increasingly focusing on fungal conservation issues. New computer-based tools and initiatives are making data available, generating new information, and engaging more people in the effort. Botanic gardens, and their scientists, have been key to this work.

The Global Fungal Red List Initiative is a community-based project. The Initiatives web site http://iucn.ekoo.se/ is were species are nominated, data are entered and commented upon. Data on this site form the starting point for assessments made during red list workshops.

Progress

Fungal conservation is a relatively new focus for both the mycological and conservation community. Yet, major strides are being made. The elevation of Fungi to an independent area of focus with five discrete Specialist Groups by the IUCN Species Survival Commission in 2009 was an important advance (botanic garden scientists chair two of these specialist groups and all of the groups include garden scientists). IUCN members passed an important resolution during the World Conservation Congress in 2012 calling for:

> *"... all of the component parts of IUCN ... and the conservation movement more generally, to place much greater emphasis and priority on the conservation of fungi ..."*

(Mueller and Dahlberg, 2013).

There are now national and regional fungal conservation committees throughout most of the world. The International Society for Fungal Conservation was formed in August 2010 (Minter, 2013). Symposia on fungal conservation are becoming regular

Tricholoma acerbum *Critically Vulnerable A2c+3c+4c*

Tricholoma borgsjoense *A2c+3c+4c*

Buellia asterella *Critically Endangered A4c*

Sarcosoma globosum *Near Threatened*

1st Fungal Red List Workshop. The initial global red listing workshop was held in Sweden in Spring 2014. Five additional workshops have been held as part of the Global Fungal Red List Initiative. Over 75 mycologists from the Americas, Europe, and Asia have participated in these events.

events at national and regional mycological conferences and have also been held at broader conservation events. Protocols and assumptions for globally red listing various groups of fungi have been developed (Dahlberg and Mueller, 2011), and there has been a series of red list workshops where the conservation status of a number of fungi were assessed and proposed for inclusion on the IUCN Red List. But much work remains to be done.

Several initiatives spearheaded by botanic gardens are critical to this work.

New and expanded initiatives

Collection digitization

Knowing the distribution of a species is a critical first set of data needed for making an assessment. Botanic gardens house an important component of the world's curated fungal collections. RBG Kew, RBG Edinburgh, New York Botanical Garden, RBG Melbourne, Denver Botanic Garden, Komarov Botanical institute, National Natural History Museum, Paris with the Jardin des Plantes, Kunming Institute of Botany (CAS), Institute of Ecology, Xalapa with the Jardín Botánico Francisco Javier Clavijero, and the Cuban National Botanic Garden are some examples of botanic gardens that house large and critically important mycological collections.

Ongoing efforts to digitize these collections are making the invaluable information contained in these materials broadly available. Digitization initiatives have moved beyond serving information from single institutions to creating portals where data across multiple institutions can be seamlessly searched. One of the newest and most comprehensive of these sites is the Mycological Collections Portal http://mycoportal.org/portal/index.php. The *Mycoportal* serves data on fungal collections housed in US herbaria, and increasingly, from collaborating international herbaria. Importantly *Mycoportal* is more than just a web site - it provides web access technologies to aid taxonomists, field biologists, ecologists, educators, and citizen scientists in the study of fungal diversity. New York Botanical Garden has been a lead institution on the development and coordination of this initiative, which includes a consortium of universities, botanical gardens, museums, and agencies, along with contributions from the citizen science community.

Citizen Science Initiatives

Non-professionally employed mycologists and other citizen scientists are increasingly engaged in documenting the diversity and distribution of fungi. Naturalists have always played an important role in these efforts, but new web based technologies have greatly increased the numbers of people participating, and their ability to have impact.

Collaborative websites like Mushroom Observer http://mushroomobserver.org/ and *iNaturalist* http://www.inaturalist.org/ have dramatically increased the number of georeferenced observations, greatly enhancing our knowledge of fungal distributions. These sites have also engaged a much larger group of people who continue to participate as they receive positive feedback on their postings by having their images identified.

In addition to these sites, several innovative initiatives have been developed to coordinate the enthusiasm and knowledge of the public to systematically obtain data on the distribution and rarity of targeted fungal species.

Fungimap is housed at RBG Melbourne https://fungimap.org.au/ . It is a non-profit, nation-wide, citizen-science organization dedicated to furthering the conservation and knowledge of Australian

The Mycological Collections Portal is an example of the new web-based tools that are available to serve the fungal diversity and conservation community.

Number of species by continent and fungal groups							
Continent	**Chytrid, Zygomycete Downy Mildew and Slime Mould**	**Cup-fungi, Truffles and Allies**	**Lichens**	**Mushrooms, Brackets and Puffballs**	**Rusts and Smuts**	**Species Total**	**Countries Total**
Europe	5	32	48	114	8	**207**	**44**
Asia	2	23	24	59	7	**115**	**42**
Africa	0	8	11	17	5	**41**	**25**
Oceania	1	4	4	12	7	**28**	**4**
North America	4	25	74	101	4	**208**	**20**
South America	0	10	4	33	2	**49**	**11**
Global	**5**	**56**	**122**	**213**	**23**	**419**	**146**

Status of Global Fungal Red List Initiative. Nearly 200 users from 54 countries have contributed data to the Global Fungal Red List Initiative.

fungi. *Fungimap* maintains the National Australian *Fungimap* Database (NAFD) that contains over 100,000 records and 6,500 images of fungi from over 700 contributors nationwide. The major activity of *Fungimap* is a community-based mapping initiative. Through its core of volunteers, *Fungimap* is developing detailed distribution maps of 125 targeted species of Australian fungi.

The Lost and Found Fungi Project is a five-year volunteer/citizen-science based fungal conservation project coordinated at RBG Kew http://fungi.myspecies.info/content/lost-found-fungi-project. The project focuses on fungi that have been rarely recorded from the UK, and is coordinating targeted surveys to establish whether they are still there, and if so whether they are genuinely rare or merely under-reported.

Global Fungal Red List Initiative

The combined data available through these collections digitization and citizen science initiatives coupled with our growing understanding of fungal biology provide the fungal conservation community with a previously unattainable wealth of information to carry out red list assessments.

With the realization that data are now available to enable conservation assessments of fungi, there was a need to coordinate the growing awareness and interest in fungal conservation, and to provide a program for interested mycologists to contribute to conservation efforts. To this end, the five IUCN SSC Fungal Specialist Groups, with the collaboration of the IUCN SSC office and Red List Unit and funding from the Mohamed bin Zayed Species Conservation Fund, developed the *Global Fungal Red List Initiative* http://iucn.ekoo.se/en/iucn/. Additional funding for this initiative has recently been provided through the IUCN –Toyota Motor Company Partnership. The initiative's goal is to assess a global representation of fungi from all major taxonomic groups for publication in the IUCN Red List. Importantly, the results of this initiative will highlight that fungi are in need of conservation, and that they can be, and need to be, part of the broader conservation agenda.

The initiative is working to raise the awareness of fungal conservation among mycologists, the conservation community, policy makers, and the general public. It serves as forum to educate, inspire, and engage the mycological community. In the process, it is identifying knowledge gaps that impede fungal red listing and is working to integrate fungi into general conservation initiatives and open up funding opportunities to address listed fungal species.

Conclusion

Many challenges remain before fungi become fully integrated into conservation initiatives nationally and globally. Gaps in our knowledge of fungal diversity, distribution, phenology, and responses to threats will continue to pose significant challenges to fungal conservation initiatives for the foreseeable future, but we now have sufficient knowledge on an increasing number of species to enable fungi and mycologists to play a larger role in regional, national, and global fungal conservation activities.

References

- Blackwell, M. 2011. The Fungi: 1, 2, 3 … 5.1 million species? *American Journal of Botany* **96**: 426-438.
- Dahlberg A. and G.M. Mueller. 2011. Applying IUCN red-listing criteria for assessing and reporting on the conservation status of fungal species. *Fungal Ecology* **4**: 147-162.
- Lange, L. 2014. The importance of fungi and mycology for addressing major global challenges. IMA 2014 Dec; **5**(2): 463–471.
- Minter, D. 2013. Third international congress on fungal conservation. *Inoculum* 6**4**: 4.
- Mueller, G.M. and G.F. Bills. 2004. Introduction. Pages 1-4 in Mueller, G.M., G.F. Bills, and M.S. Foster, eds. Biodiversity of Fungi: Inventory and Monitoring Methods. Elsevier. 777 pp.
- Mueller, G.M. and A. Dahlberg. 2013. The Global Fungal Red List Initiative. *Inoculum* **64**: 1-3.
- Palm, M.E. and I.H. Chapela. 1997. *Mycology in Sustainable Development: Expanding Concepts, Vanishing Borders*. Parkway Publishers, Boone, NC. 306 pp.

Gregory M. Mueller, Chief Scientist and Negaunee Foundation. Vice President for Science, Chicago Botanic Garden. Chair, IUCN SSC Mushroom, Bracket, and Puffball Specialist Group

RESOURCES

IUCN Red List of Threatened Species

www.iucnredlist.org

Up-to-date conservation assessments are available on the IUCN Red List of Threatened Species website. Searches can be conducted by species, family, region, etc., and full assessments are available providing complete documentation and explanation of conservation status. The IUCN Red List website also contains information about the IUCN Red List Categories and Criteria and training materials for undertaking Red List assessments.
All new assessments and reassessments on the IUCN Red List use the 2001 IUCN Red List Categories and Criteria. Version 3.1. In 2012 the second edition of this publication was released.
The IUCN Red List Categories and Criteria. Version 3.1 is available in English, Français, Español. And can be downloaded at: http://bit.ly/gtc_ref_10

IUCN Specialist Groups

The IUCN Species Survival Commission (SSC) is a science-based network of more than 10,000 volunteer experts from almost every country of the world. Many of these volunteers participate in IUCN's specialist groups, which for plants include the Global Trees Specialist Group, the Palm Specialist Group, the Conifer Specialist Group and the Medicinal Plant Specialist Group. These networks of global experts volunteer their time and expertise to build a scientific and practical foundation for the conservation of specific groups or types of species. More information and contact details for all IUCN SSC Plants and Fungi Groups is available at: https://www.iucn.org/ssc-groups/plants-fungi

National/regional red lists

www.nationalredlist.org

Regional and national Red Lists provide countries with key information about species status within their borders, which can be used directly for national conservation and planning policies supporting effective protection of biodiversity. To date, over 26 regions (encompassing multiple countries), 113 countries and 45 sub-national entities have developed Red Lists. The National Red List project aims to develop an active global network of countries and individuals working on National Red Lists. Through this centralised online hub, Red Listers around the world are able to learn from each other's experiences in both conducting Red Lists and in using them for conservation planning and priority setting. This site contains local, national and regional Red Lists from around the world as well as any resulting conservation Action Plans.

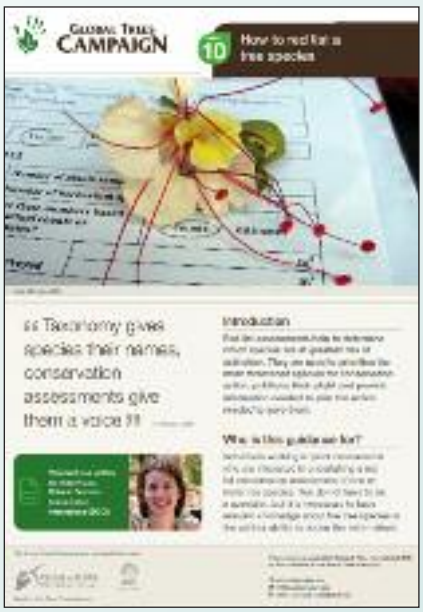
How to red list a tree species

http://globaltrees.org/resources/brief-10-how-to-red-list-a-tree-species

The Global Trees Campaign supports conservation practitioners around the world to develop the skills and techniques needed for threatened tree conservation. To support this aim, the GTC is publishing a series of briefs for non-specialists providing guidance on the basic skills required for tree species conservation.

These briefs are aimed at people who already have some experience in conservation, but who have limited experience or knowledge about botany, forestry or horticulture.

"How to Red List a Tree Species" is a guidance document aimed at individuals working in plant conservation who are interested in undertaking a red list conservation assessment of one or more tree species. As well as providing background information about red listing, it proposes a number of key steps to be followed to ensure the red list assessment is completed correctly.



Red lists produced by BGCI and partners

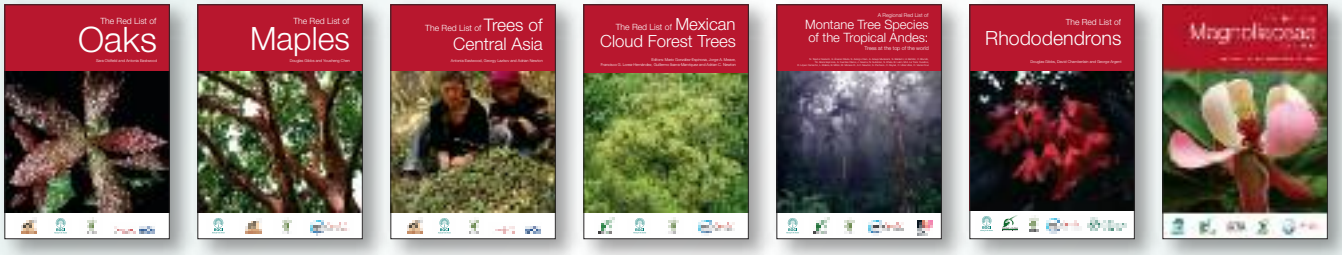
www.bgci.org/plant-conservation/redlisting/

BGCI's Red List programme works with partners to assess the conservation status of the world's plant species. By assembling and disseminating comprehensive information on plant species and their status in the wild, we help to inform and prioritise conservation efforts.

BGCI is a lead provider of plant conservation assessments to the IUCN Red List of Threatened Species. BGCI also hosts the Secretariat of the IUCN/SSC Global Tree Specialist Group (GTSG) and has in the last decade, conducted nearly 4,000 conservation assessments of selected taxonomic and regional groups of trees. BGCI is also coordinating the Global Tree Assessment which aims to provide conservation assessments of all trees by 2020 to support global monitoring of forest biodiversity.

Red lists available to download from BGCI include:

- The Red List of Magnoliaceae – revised and extended (including *ex situ* survey) (2016)
- The Red List of Betulaceae (2014)
- The Red List of Rhododendrons (2011)
- The Red List of Trees of Central Asia (2009): (also available in Russian):
- The Red List of Maples (2009)
- The Red List of Oaks (2007)
- The regional Red List of montane tree species of the tropical Andes (2014)
- The Red List of Mexican Cloud Forest (2011)



BGCI *ex situ* surveys

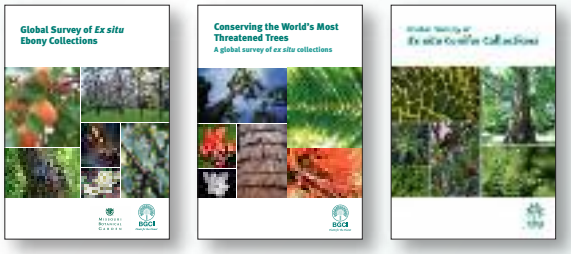
www.bgci.org/plant-conservation/exsitu/

BGCI's *ex situ* survey programme builds on the work of Red Listing to assess whether threatened species are represented in the world's *ex situ* collections. This information allows for prioritisation of conservation action. An *ex situ* survey often follows the publication of a taxonomically focused Red List allowing the identification of those threatened species which are not represented in a collection or appear in few collections. These species then form the basis of prioritised conservation actions.

More extensive *ex situ* surveys are also undertaken by BGCI. For example, the Global Survey of *Ex situ* Conifer Collections gathered information about the quality of the collections to determine their suitability for use in recovery and restoration programmes.

The following ex situ survey reports are available to download from BGCI:

- Global Survey of *Ex situ* Ebony Collections (2016)
- Conserving the World's most threatened trees – a global survey of *ex situ* collections (2015)
- Global *ex situ* survey of Betulaceae collections (2015)
- Global *ex situ* survey of Conifer collections (2014)
- Global *ex situ* survey of Magnoliaceae collections (2010)
- Global *ex situ* survey of Maple collections (2010)
- Global *ex situ* survey of Oak collections (2009)
- Global *ex situ* survey of Rhododendron collections (2012)
- Global *ex situ* survey of Zelkova collections (2010)



BGCI's databases

PlantSearch

BGCI's PlantSearch database is the only global database of plant species in the collections of botanic gardens and similar organizations. In addition to data from hundreds of living plant collections around the world, PlantSearch includes taxon-level data from gene and seed banks, as well as cryopreserved and tissue culture collections. PlantSearch can be searched by scientific name, conservation status, or other criteria such as medicinal plants and crop wild relative species, and connects to other databases such as Tropicos, IPNI, Google Images, CITES Appendices and many more. PlantSearch contains over 1.3 million records, related to over 115,000 plant species.

www.bgci.org/plant_search.php

GardenSearch

BGCI's GardenSearch database is the only global source of information on the world's botanical institutions. In addition to thousands of botanic gardens and arboreta, GardenSearch includes gene and seed banks, network organizations, and zoos. Whether you are looking for collaborators, botanical resources or expertise, or simply want to visit a garden, GardenSearch will connect you to the right garden. GardenSearch can be searched by country or keyword to find relevant institutions. Narrow your search to BGCI members only or ArbNet accredited institutions - or define your search using the GardenSearch Advanced Search to identify gardens with specific facilities, conservation, research, or education programs.

www.bgci.org/garden_search.php

ThreatSearch

ThreatSearch is the most comprehensive database of conservation assessments of plants. It contains over 242,000 conservation assessments, representing over 150,000 taxa. ThreatSearch lists global, regional and national conservation assessments for plants, from a variety of sources. Together with our two main collaborators - the National Red List (www.nationalredlist.org) and the Royal Botanic Gardens, Kew (www.kew.org) - currently available conservation assessments have been assessed into a single list of conservation assessments for plants. New conservation assessments, as well as adding older non-digital sources will continue to be added.

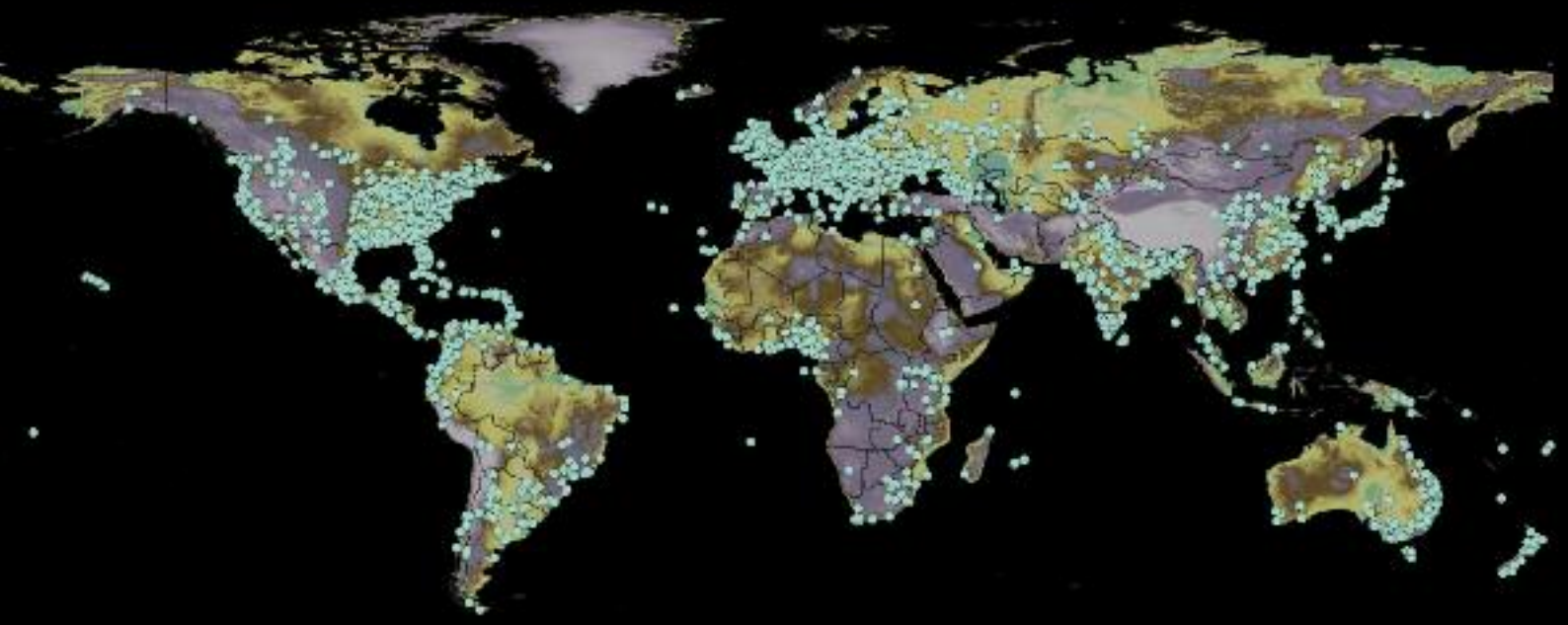
www.bgci.org/threat_search.php

GlobalTreeSearch

BGCI will soon launch the GlobalTreeSearch database, a complete list of the world's tree species (around 60,000 species) and their country level distributions. GlobalTreeSearch will provide a valuable resource to botanic gardens as well as other stakeholders including international and national forestry bodies, land managers and conservation practitioners. This searchable tree list will also provide the backbone for the Global Tree Assessment.

www.bgci.org/globaltreesearch

JOIN THE WORLD'S LARGEST PLANT CONSERVATION NETWORK



For 30 years Botanic Gardens Conservation International has represented the botanic garden and arboretum community.

BGCI's directory of botanic gardens, GardenSearch, lists 2,500 botanic gardens that conserve a third of known plant diversity and attract 500 million visitors a year.

BGCI is a leadership and catalyst organisation that works to promote botanic gardens as a professional community, share knowledge and skills and mobilise funding for plant conservation.

Membership benefits include

- BGCI's publications, including our journals, BGjournal and Roots
- Botanic garden technical support and advisory services
- Major discounts on registration fees for BGCI Congresses
- Access to advanced collections data analysis services
- Eligibility for BGCI project funding
- Eligibility for subsidized BGCI training courses
- Eligibility for BGCI's conservation accreditation scheme
- Eligibility for BGCI twinning/ mentoring scheme
- Eligibility for BGCI prizes and awards
- Use of the BGCI website to promote your events and news
- Use of BGCI's logo and name
- A membership pack, including a Certificate of membership

BGCI
Plants for the Planet

Botanic Gardens Conservation International

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

Tel: +44 (0)20 8332 5953
Fax: +44 (0)20 8332 5956
E-mail: info@bgci.org
Internet: www.bgci.org

Printed on 100% recycled paper

ISSN 1811-8712

Why are we here?
Pourquoi sommes-nous ici ?

find out...

Come to the Global Botanic Gardens Congress in Geneva

on June 26th-30th 2017

Botanic gardens and society: visions for the future

How can we conserve and use plants to meet the big environmental challenges of the 21st Century – food, water, energy, health, climate change & loss of biodiversity?

le découvrir...

Rendez-vous au Congrès Mondial des Jardins Botaniques à Genève

du 26 au 30 juin 2017

Jardins botaniques et société : visions pour le futur

Comment conserver et utiliser les plantes pour répondre aux grandes questions environnementales du 21e siècle – nourriture, eau, énergie, santé, changements climatiques et perte de biodiversité ?

Connecting people • Sharing knowledge

www.6gbgc.org

BGCI 6th Global Botanic Gardens Congress

Conservatoire et Jardin botaniques Genève

BGCI
Plants for the Planet