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Opinion

Using the Global Tree Assessment at Multiple Scales of Planning and Action

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Abstract: The interlinked biodiversity crisis and challenge of global climate change cannot be addressed without the management of tree species. It is crucial that we use the information now available as a result of the Global Tree Assessment to manage, conserve and restore threatened tree species and tree diversity. With over 17,500 tree species now known to be threatened with extinction, well-planned actions need to be urgently identified and implemented that target multiple species. In this review, we highlight approaches that coordinate and mobilise multi-species conservation at the taxonomic, national, regional and global levels. Only through a considerable scaling up of planning and action will we prevent the extinction of both trees and the associated plants, animals and fungi that depend on them, sustain livelihoods and ensure the ecological health of the planet.

Keywords: tree conservation; conservation planning; conservation action; Global Tree Assessment

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1. Introduction

Trees are ecologically, culturally and economically of vital importance [1], and yet there have been surprising gaps in knowledge about the diversity, distribution and conservation status of trees at a global scale. Trees define forest distribution, composition and structure, and forests provide habitat for half the world's known terrestrial plant and animal species [2]. Individual tree species often play a keystone role within their ecosystems. Their loss risks causing a domino effect of extinctions and potential ecosystem collapse. Trees are an important store of carbon, water and nutrients in many ecosystems such as woodlands, grasslands, deserts or urban environments. They also have an intrinsic value to human society through their cultural significance and the invaluable products, such as food, medicine, fuel and timber, that they provide [3].

The Global Tree Assessment is an initiative assessing the conservation status of all the world's known tree species [4–6]. It is a collaborative global initiative linking taxonomic, geographical, ecological and conservation information in support of biodiversity conservation policy and action. The Global Tree Assessment was launched in 2015 in order to address the knowledge gap of the conservation status of the world's tree species, and to ensure that better informed conservation actions be taken towards saving threatened species.

The Global Tree Assessment has developed a strategic approach to data collection on tree species involving an extensive global network of over 60 organisations and over 500 individual experts. The network, coordinated by Botanic Gardens Conservation International (BGCI) and the IUCN Species Survival Commission Global Tree Specialist Group (GTSG), aims to complete IUCN Red List assessments of all tree species by 2023. In 2021, the first global summary report was published, presenting the initial findings of the State of the World's Trees [3]. In addition to this report, the GlobalTree Portal [7] was also launched, which contains information on all the world's tree species as well as summary information on the conservation status (including the IUCN Red List, as well as national, regional and other published sources).

The IUCN Red List Categories and Criteria [8] is the most widely used system to assess the risk of extinction for species. The IUCN Red List uses standardised assessment procedures to assign species to different categories of extinction risk based on five quantitative criteria, including measures of population sizes, restricted geographic distribution and rate of decline. Assessments are also complemented with a map and additional supporting information including specific threats, uses and ecology. Information from the IUCN Red List is extensively used to inform conservation policies and legislation, as a tool for environmental monitoring and reporting, and to prioritize areas for conservation action; it has also been used at the global scale to monitor biodiversity loss.

Through the Global Tree Assessment, intensive research has been undertaken over the past five years to compile extinction risk information on the 58,497 tree species that exist worldwide [6]. We now know that 30% or over 17,500 tree species are threatened with extinction, and at least 142 tree species are recorded as extinct in the wild [6]. The main threats to tree species are forest clearance and other forms of habitat loss, direct exploitation for timber and other products, and the spread of invasive pests and diseases [6]. Climate change is also having a clearly measurable impact [6].

However, conservation assessments are only the first step toward the conservation of a threatened species. Once tree species have been identified as being at risk of extinction, well-planned actions need to be identified and implemented. The GlobalTree Portal, in addition to the information on the conservation status, also contains BGCI's Conservation Action Tracker, which records the known conservation action on the species pages. To ensure that efforts are targeted to where they are most needed and are not duplicated, they need to be tracked and monitored. BGCI's Conservation Action Tracker can be used to fulfil this role by providing real-time information on conservation actions for tree species and allows practitioners to provide information on the species that they are working on. Ensuring that the available information is accessible in usable formats, such as the GlobalTree Portal, will facilitate the engagement of stakeholders beyond just the conservation community, such as restoration practitioners and financiers, helping to ensure a stronger focus on threatened tree species when implementing biodiversity protection, ecological restoration and climate change mitigation. An integrative, multi-stakeholder approach to species conservation planning has been found to be a turning point for threatened species [9]. For over 20 years, the Global Trees Campaign (GTC), which is jointly coordinated by BGCI and Fauna & Flora International (FFI), has taken a targeted approach to the in situ conservation of individual tree species [10]. Whilst the majority of conservation programmes take a broader, landscape-level approach, the GTC recognises the unique challenges that individual species face and that targeted, proactive management is needed to guarantee their survival. The GTC has used this approach to support conservation initiatives benefiting more than 400 threatened tree species in over 50 countries worldwide. However, with so many tree species at risk of extinction, there is a desperate need to scale up conservation action, whilst also ensuring that actions are still tailored as much as possible to the requirements of individual species. To avoid the duplication of effort and to maximise impact, approaches that coordinate and mobilise multi-species conservation at the taxonomic, national, regional and global levels are explored below.

2. Taxonomic Level

Species within the same taxonomic group often share similar traits (e.g., life history) and may be impacted by the same or closely related threats. For example, 80% of threatened species in the genus *Tovomita* are declining due to deforestation from agricultural expansion [11]. As a consequence, related species are likely to benefit from similar conservation actions. Planning and coordinated action at a taxonomic level can therefore be a useful approach, especially for groups with a high number of threatened species. It also provides an opportunity to bring together those with a shared taxonomic interest to exchange expertise and facilitate collaboration. For example, germination requirements are often shared across species of the same genus or in genera within the same family.

An excellent example of planning and action implemented at the taxonomic level is Project *Zelkova*, launched in 2010 by an international group of experts. The initiative has developed a global action plan for the six species that make up this small relict tree genus [12]. In this process, existing information was reviewed, and new data was gathered to recommend priority actions for each species. Additionally, coordinated global field surveys were completed alongside genetic analyses to provide an overview of the complete distributional range and genetic diversity present within the genus. For example, *Z. abelicea* (Endangered), which is endemic to Crete, was found to have a distinct genetic diversity in each of its four main locations of occurrence. Preserving the entire range of genetic diversity both in situ and ex situ was therefore an important priority for the species. The global action plan has been used to catalyse conservation action on the ground for two species, *Zelkova abelicea* and *Zelkova sicula* (Critically Endangered), and to update their conservation assessments [13].

A taxonomic approach at the national level has been used to develop a conservation action plan for Dominican Republic's threatened *Magnolias*: *Magnolia domingensis* (Critically Endangered), *M. hamorii* (Endangered) and *M. pallescens* (Endangered) [14]. For the action plan, information was gathered on the species' distribution range, population size and key threats. Additionally, priority actions were also identified for their conservation. Through the process of developing the action plan, vital momentum has been generated with the key national stakeholders, including the government, which is now being utilised to implement the recommended actions.

Using a taxonomic approach, the Global Conservation Consortia (GCC) [15] are mobilising a coordinated network of partners to collaboratively develop and implement conservation strategies for priority threatened plant groups. Target genera include those which are technically difficult to conserve, those which have been overlooked by other sectors, and groups that provide opportunities for conservation in biodiversity hotspots. Currently, Global Conservation Consortia have been launched for six tree groups (magnolias, maples, southern beeches, oaks, dipterocarps and rhododendrons), and they focus on highly threatened taxonomic groups identified by the Global Tree Assessment.

The Global Conservation Consortium for Oak (GCCO), led by The Morton Arboretum, has been established to address the conservation needs of wild oak species. In 2017, The Red List of US Oaks was published, assessing the extinction risk of 91 native US *Quercus* species and providing a baseline on the state of the country's oak species [16]. Building upon the red list, a Conservation Gap Analysis of Native U.S. Oaks used spatial analyses, information on current conservation efforts, and the vulnerability of wild populations to provide species-specific conservation recommendations for 28 species of conservation concern [17]. A key action identified in the report is the need to address the challenge that acorns cannot be banked for long-term conservation. Instead, genetic diversity can be preserved in coordinated living ex situ collections (meta collections). Guidelines for establishing and managing an oak meta collection site in the US region have been published in response to this recommendation [18]. Over 15 oak species of concern have now been targeted for collection in order to propagate and grow out in conservation meta collections; the material has been shared and distributed to multiple GCCO affiliate institutions [19].

3. National and Regional Levels

Coordinating tree conservation at the national level can be an effective method for identifying priority sites, engaging key stakeholders, building capacity and leveraging governmental support. It may also be possible to align national-level recommendations with national-level policies to harness legal protection for multiple species. In assessing whether countries should develop national programmes, it is essential to take into account government policy, technical capacity and, of course, the biodiversity context. In addition to the number and proportion of threatened and endemic trees, possible criteria to take into consideration include: a country's restoration pledges, governmental support, the presence of Key Biodiversity Areas (KBA) and Alliance for Zero Extinction (AZE) sites, the

capacity of in-country partners, appetite for a national-level programme, and if there is an opportunity to make an impact on a national scale.

A national-level approach is being used to plan and deliver action for the threatened trees of Kenya. All tree species endemic to Kenya have been assessed on the IUCN Red List, as a result of efforts led by BGCI and the IUCN Eastern African Plant Red List Authority. The Assess to Plan (A2P) methodology developed by the IUCN Conservation Planning Specialist Group (CPSG) was subsequently used to facilitate multi-species conservation planning. In this process, data from the IUCN Red List is used to group species with overlapping characteristics (e.g., distribution, ecology and/or major threats) that can be planned for and acted on together. For example, species affected by the same invasive species will likely require a similar suite of actions to mitigate the threat. During a series of conservation planning workshops, co-led with CPSG and the Kenya Forest Service and involving more than 30 conservation organisations, a national-level vision and goals were developed and actions for two key priority areas with a high concentration of threatened tree species (the coastal forest and the Taita Hills) were identified [20]. Additionally, the responsibility for delivering these actions was assigned to key stakeholders. The planning process led to the engagement and establishment of a Kenya Threatened Trees Consortium, which is acting upon identified actions to protect and recover Kenya's threatened trees. Since the workshop, funding has been secured to scale up the delivery of well-planned and coordinated action, and so far 50 threatened tree species are covered by the collective action of the group [21].

In Indonesia, FFI has been working at the national level to address the challenge of conserving the country's almost 700 threatened tree species. The majority of conservation initiatives in Indonesia are focused on flagship animal species or large areas of high-carbon forest, rather than specific actions for individual threatened tree species. An Indonesian Forum for Threatened Trees (a group of more than 70 members from at least 30 different institutions with the mandate to advise and influence the conservation of threatened trees) has been established to address this. The Forum is working to get more threatened tree species to be included on the Ministry of Environment and Forestry priority species list, and a ten-year national conservation strategy has been published for 12 priority threatened tree species [21].

The Royal Botanic Gardens Kew have used the Tropical Important Plant Areas (TIPAs) approach, which identifies concentrations of threatened species to prioritise sites within a country in need of urgent protection. Through this process, 22 TIPA sites have been identified in Guinea, West Africa [22]. The Royal Botanic Gardens Kew are now working with the Guinean government to integrate the TIPA sites into the National Protected Area network and to develop a Conservation Action Plan for threatened tree species in the country.

On a country level, the distribution of threatened tree species is not evenly spread throughout the world. The large megadiverse countries (e.g., Brazil, China, Colombia, Indonesia, etc.) also have a large number of threatened tree species [6]. Additionally, islands have a high percentage of threatened species compared to their total tree diversity [6]. For these countries with a high density of threatened tree species, planning and action at a national scale will be a particularly useful approach to ensure that a country's resources can be coordinated to effectively conserve as many species as possible.

Additionally, using a regional rather than national approach may be more effective in certain cases, encouraging cross-country collaboration and reducing the duplication of effort. The island of Borneo, for example, is politically divided into three countries: Indonesia, Malaysia and Brunei-Darussalam, but it is a biodiversity hotspot with many single island endemic tree species that are found nowhere else. The Red List of Bornean Endemic Dipterocarps uses the island as a geographic delimitation to present the conservation status of all 162 species of dipterocarp endemic to Borneo and provides regional recommendations [23].

4. Global Level

However, with nearly 60,000 tree species in the world, and about 30% of these being threatened with extinction, a larger-scale prioritisation approach is needed. As Global Tree Assessment data is now available on a global level, the prioritisation of taxonomic groups, geographic regions or other thematic groups (such as timber trees, medicinal plants, etc.) can be made. With the global dataset, we can now for the first time conduct a comprehensive analysis of species being covered by in situ and ex situ efforts. ex situ collections can be used in addition to in situ conservation, to provide an insurance policy for wild populations against extinction. Initial studies show that one third of trees are found in ex situ collections (however, the extent to which the genetic diversity is conserved is not known), and nearly two thirds occur in at least one protected area [6]. Although more analysis is needed to see how effective these conservation efforts are on a global scale, they can be used as an indication of where to target conservation efforts. Therefore, more effort is being currently focused on populating the Conservation Action Tracker on the GlobalTree Portal [7] for the most threatened trees, in order to track conservation progress.

The now available tree species distribution and mapping data have opened up new opportunities for plant conservation. New work is being carried out at BGCI together with international partners to identify KBA and AZE sites. These sites will help to locate the key areas of tree diversity that need protecting to ensure the survival of the largest and most important populations and habitats of tree species.

By focussing on AZE sites, we will identify the sites most important for preventing global extinctions. This will include identifying where trees can be used as "trigger species" for existing KBAs and AZEs, as well as highlighting areas where trees can be used to identify new sites. Through the designation of these sites, we are ensuring that these areas containing critical species populations are not overlooked and that in situ action is focussed on where it is needed most.

BGCI is the largest global plant conservation network in the world, with >700 member plant conservation organisations in >100 countries. As GTA data becomes available, BGCI will systematically contact national CBD focal points, policymakers, NGOs and its government member/partner organisations, alerting them to the tree conservation data for their respective countries on the GlobalTree Portal and Conservation Action Tracker. We will ask them to help us gather information on which species are being actively conserved and which are not, and then together we will address gaps in effort through the provision of technical and financial support to ensure that no tree species becomes extinct. Tree species conservation costs vary depending on the species, the threats and the location. For some of the most threatened species, we estimate costs of $62,500–$250,000 to save species from extinction [24].

5. Conclusions

Through the Global Tree Assessment, we now have a better understanding of the tree species that are most at risk of extinction—not only which species are at risk, but also where they are found and why they are threatened. In addition, ensuring that this detailed tree species information is available in usable formats (e.g., the GlobalTree Portal [7]) will facilitate the incorporation of threatened tree species within forestry, tree planting, biodiversity conservation and climate change mitigation. Identifying which tree species are at risk of extinction is only the beginning, and conservation actions with appropriate partners (botanic gardens, local communities and governments) need to be identified, planned, funded and implemented. Without the urgent scaling up of conservation planning and action while utilising approaches on multiple scales (species-specific, taxonomic, national, regional and global levels), there is a very high risk of many more tree species becoming extinct.

In addition, by conserving the world's tree species, we are also supporting a range of other organisms, such as a large proportion of threatened birds, mammals, amphibians and reptiles that are found in forest habitats [25], as well as supporting key ecosystem

functions such as soil stabilization, carbon capture and water regulation. Therefore, effective conservation planning and action for the world's trees will have far-reaching and profound benefits.

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