

Royal Botanic Gardens  
**Kew**

**Review of the Year**

2020–21



# A future for all life on Earth

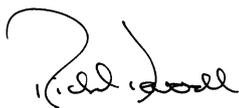
**At a critical juncture for humanity and the future of our natural world, I write to you with a great sense of optimism from here at Royal Botanic Gardens, Kew. Across the board, our world-class horticulturists, scientists and staff have spent the last 12 months redoubling our energies to harness RBG Kew's extraordinary assets and prove that botany really can be the science to save humanity.**

In this most challenging of years, our world-leading research has continued at pace. Many major multi-year science and horticulture research projects have been brought over the line, and our experts have continued to yield critical new discoveries in the laboratory and in the field.

Building on this, we have high hopes for the future, and, this spring, we launched an ambitious strategy, *Our manifesto for change 2021-2030*, to make that commitment public: RBG Kew will do all we can to end the extinction crisis and to intensify efforts to understand and protect plants and fungi, for the wellbeing of people and the future of all life on Earth.

With RBG Kew's unique combination of invaluable collections, cutting-edge science and conservation work, and with our trusted voice backed by over 260 years of history, we are perfectly placed to lead global efforts to curb biodiversity loss and the devastating effects of climate change, and that, with your support, is what we will do.

I end with a heartfelt thank you. In a year where repeated lockdowns have had a major impact on RBG Kew's income streams, we've managed not only to weather the storm but to flourish. Without your championship and support, that simply wouldn't have been possible. Thank you.



Richard Deverell  
Director, Royal Botanic Gardens, Kew




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**RBG Kew will do all we can  
to end the extinction crisis**

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# Financials 2020–21

## Royal Botanic Gardens, Kew income

**44%**

### DEFRA grant

Funding as part of our status as a non-departmental government body

**6%**

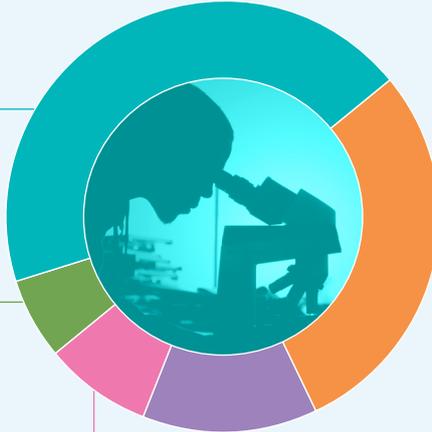
### Other grants

From research councils and other funding streams

**8%**

### Membership

All membership categories including gift memberships and Wakehurst memberships



**29%**

### Visitor and commercial income

From day visitor ticket sales, shops and catering, big ticket events, partnerships, sponsorship

**13%**

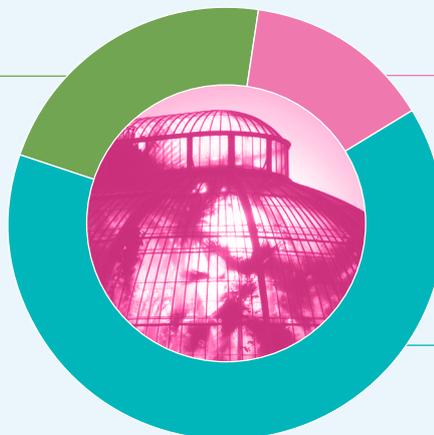
### Foundation grants and donations

Philanthropic support from individuals, trusts and foundations, and corporate partnerships

## Royal Botanic Gardens, Kew spending

**22%**

### Visitor activities



**14%**

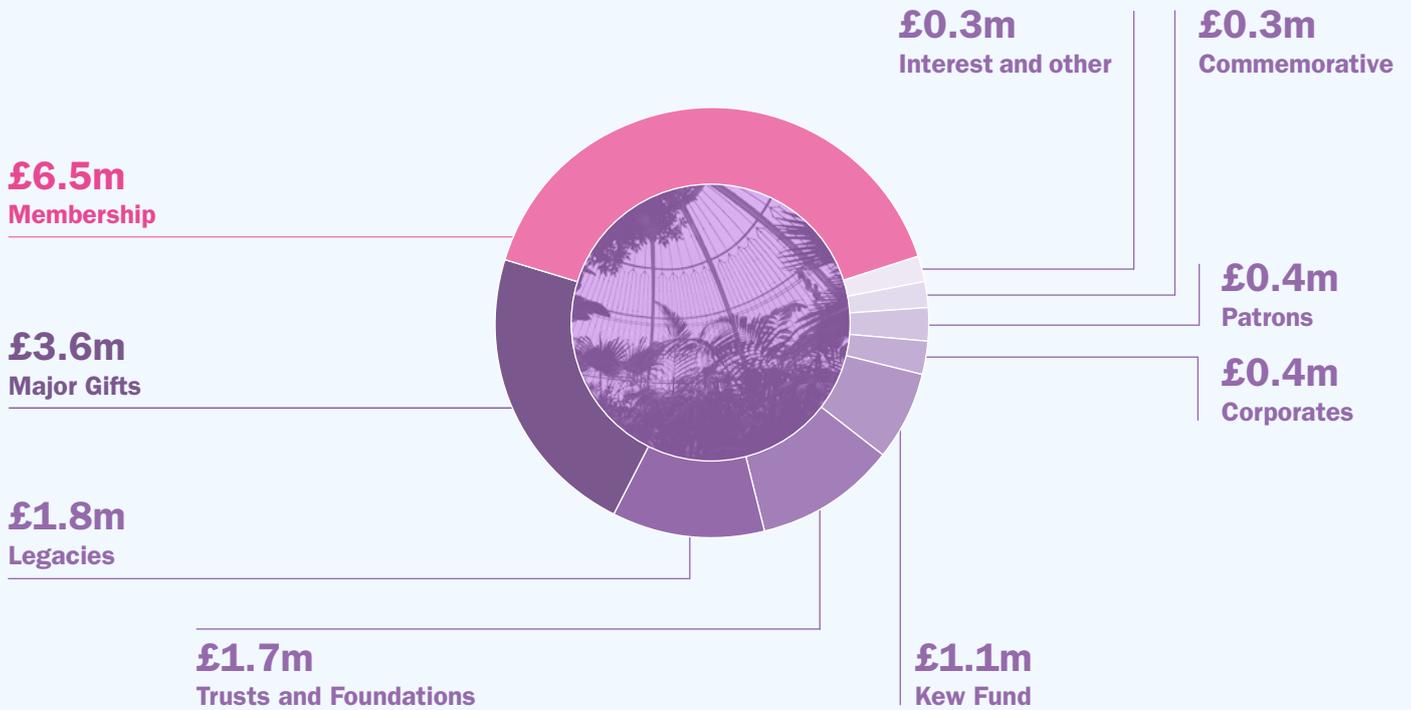
### Costs of generating funds

**64%**

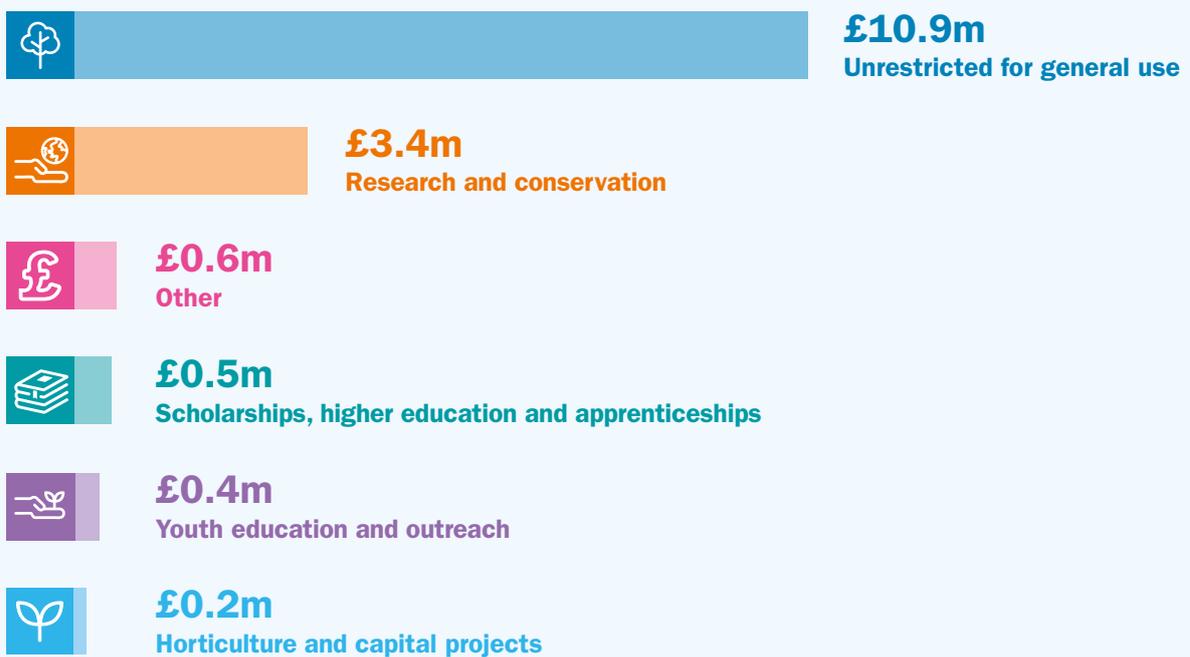
### Research and conservation

Kew Foundation is a directorate of Royal Botanic Gardens, Kew, responsible for generating funds through philanthropy and membership. Legacy gifts are made through the Foundation and Friends of Royal Botanic Gardens, Kew, which is a separate legal entity to Royal Botanic Gardens, Kew.

## Kew Foundation income by area



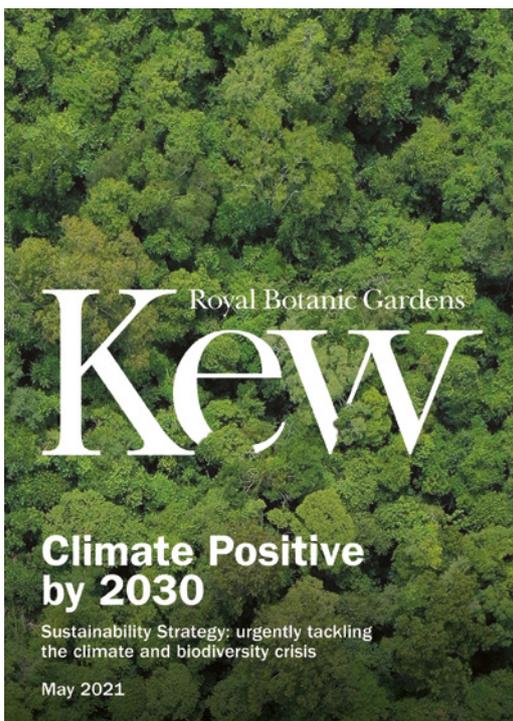
## Kew Foundation income by purpose of gift



# Setting the agenda in a critical decade

## Our next ten years

In spring 2021, RBG Kew launched a bold new strategy to meet the planet's most pressing challenges. *Our manifesto for change 2021–30*, a major project many months in the making, is RBG Kew's public commitment to do everything in our power to reverse the environmental devastation of biodiversity loss and climate change, and, ultimately, help end the extinction crisis. As the world's leading plant science organisation, we are perfectly placed to make a distinctive and substantial contribution to solving the planet's biggest challenges, leading global efforts in creating a world where nature is protected, for the benefit of all. The manifesto, available to read at [kew.org](http://kew.org), maps out this mission, detailing our five key priorities and how we seek to leverage our unique and invaluable assets in the critical decade ahead.



## A new commitment to sustainability

In spring 2021 we set out a new sustainability strategy and joined the UN Race to Zero. The culmination of years of work, our aims are ambitious: to go beyond 'net zero' and to achieve 'climate positive' status by 2030. We're using a science-based target to reduce emissions as rapidly as possible and more than offset any unavoidable emissions by investing in nature-based carbon sinks. Central to our sustainability strategy will be engaging with everyone in the Kew community and across the horticulture and science sectors, from partners and supporters to visitors, and the many millions we reach each year via our online resources and outreach programmes.

## Leading the way to restore the world's forests

With a paper published in leading journal *Global Change Biology* in January 2021, 'Ten golden rules for reforestation', and, in February, a major international virtual conference co-convened with Botanic Gardens Conservation International and with support from Sky Zero and Fondation Franklinia, RBG Kew is setting the agenda for genuinely sustainable global reforestation. 'Tree planting now dominates political and popular agendas and is often presented as an easy answer to the climate crisis but sadly, it isn't as simple as that,' said Dr Kate Hardwick, RBG Kew Conservation Partnership Coordinator. 'When people plant the wrong trees in the wrong place, it can cause considerably more damage than benefits.' That's why our experts have established 'a framework for people, businesses and policymakers to use for future reforestation projects that can aid both people and the environment'. With such published work and a suite of conferences attended by researchers worldwide, RBG Kew is questioning assumptions, showcasing success stories, identifying challenges and encouraging new, integrative and collaborative approaches, all of which better secures workable, evidence-based solutions.



Human activities are accelerating biodiversity loss

# In the gardens

## Work begins on the Edible Science Garden

We're proud to have obtained support from an anonymous donor this year towards the creation of a brand-new garden at Kew Gardens. The Edible Science Garden, once complete, will be a dedicated educational space engaging visitors with our critical research into global food security, sustainability and the critical role of pollinators to our food. It will also be the centerpiece of our major 2022 summer festival centred on food, a space where we'll showcase Kew's groundbreaking research into future foods and possible solutions to the global crop crises exacerbated by the impacts of climate change.



Rainbow carrots from the Kitchen Garden



The American Prairie at Wakehurst

## Engaging diverse audiences worldwide

*Kew Gardens: A Year in Bloom*, a four-part television series, was filmed at Kew throughout 2020, and has now been broadcast to great acclaim on Channel 5. An opportunity for households across the nation to engage with RBG Kew, the show told stories across the four seasons. Viewers followed the day-to-day trials and joys of our world-famous horticulturists and saw behind the scenes to the work of our 350-strong plant science team. As a result of its success, another series has been commissioned and will commence filming shortly.

In 2020–21 we also devised and delivered a major festival, *Secret World of Plants*, inviting tens of thousands of visitors to reconnect with the incredible nature surrounding us all. *Secret World of Plants* encouraged visitors to embrace the wonderful world of plant biodiversity through newly commissioned interactive art installations using music, sound and colour.

## A prairie's progress

Spanning six acres, the American Prairie now sits centre stage at RBG Kew's wild botanic garden, Wakehurst. Only one per cent of North America's iconic sweeping prairies are intact today, making these habitats some of the world's most endangered. That's the reason behind the creation of this exciting new space, a pioneering conservation landscape and living collection that offers us the unique opportunity to share resources and knowledge.

In 2019, we wild-collected tens of thousands of viable seeds of fifteen species on a specialist trip to Illinois, USA, helping us build a volume of genetically diverse, resilient seed. After being stored at the Millennium Seed Bank, in September 2020 our experts sowed 60 wild species directly into the ground, followed, in spring this year, by 50,000 plug plants we raised in our nurseries, many from the wild-collected seeds. In the months to come, we'll be following a complex programme of plant community creation, sowing layers of new plants and managing their growth by mimicking wild stresses and disturbances. Visitors continue to enjoy this space as it evolves, immersing them in waves of gentle movement and colour.

## A new home for the Arboretum team

In summer 2021, our state-of-the-art new building, the Arboretum Headquarters, at Kew Gardens, was opened by Dame Judi Dench. The Arboretum Headquarters is the result of a major, multi-year fundraising project supported by members of the Arboretum Circle among others and led by Tony Kirkham, who retired from his position as Head of Arboretum, Gardens and Horticulture Services this summer after a distinguished 43 years. The structure is a vital space for collaboration, providing our experts with the facilities they need to continue their work at the forefront of tree care and conservation.



The Arboretum Headquarters



The 'Tree Gang' with Tony Kirkham in the Arboretum

# Major milestones

## 1 Leading the fight against extinction

Assessing the level of risk plant species face, and raising awareness of those most threatened, is a critical part of Kew's global conservation work. Our Plant Assessment Unit (PAU), a team of dedicated RBG Kew staff, was set up as part of a five-year collaboration, concluding this year, between Toyota Motor Corporation and the International Union for Conservation of Nature's Red List of Threatened Species (IUCN Red List).

Since 2016, the team have been leveraging unique taxonomic expertise and data acquired over decades to increase the number of high-quality plant assessments on the IUCN Red List, both conducting these assessments and providing high-quality training worldwide to build capacity.

## 2 A 'bumper' list of newly described species

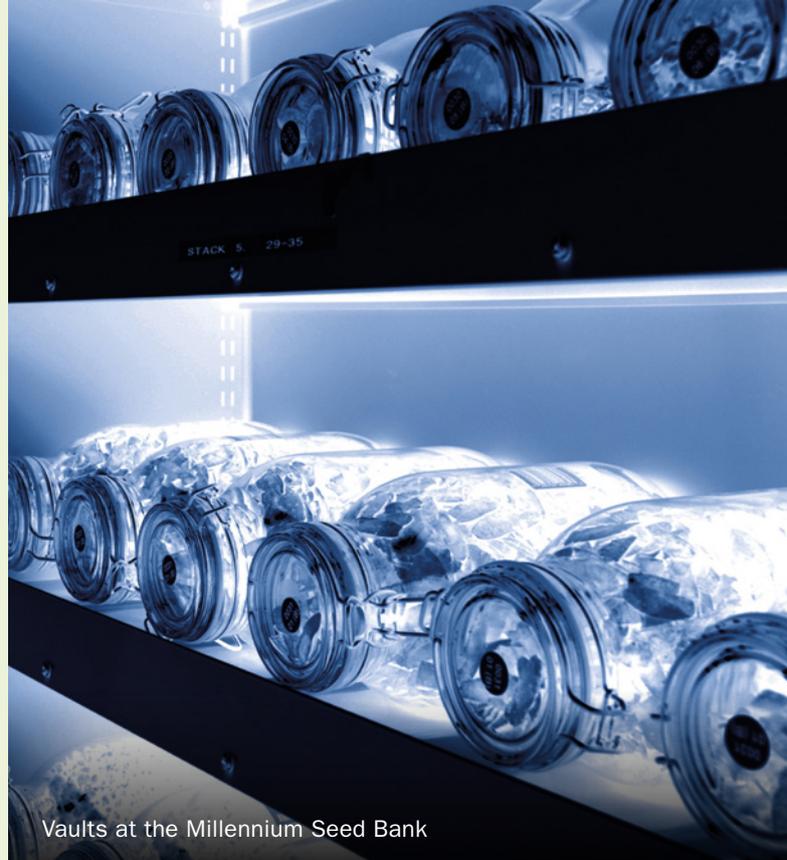
With partners, RBG Kew described approximately 156 plants and fungi worldwide in 2020, from a toadstool mushroom found at Heathrow Airport, to what has been deemed 'the ugliest orchid in the world'.

'In a challenging year, it's so thrilling to see botanical and mycological science continue, with a bumper list of incredible newly named species being documented,' noted Dr Martin Cheek, Senior Research Leader in RBG Kew's Accelerated Taxonomy department. 'Among this list are some amazing new finds for science, each with their own unique qualities and potential for humanity. We hope our annual lists inspire people to realise the beauty and vital importance of plants and fungi and support us to find, document and understand these species so they can be protected.'

## 3 The MSB at 20: 2.4 billion seeds banked

In November 2020, the Millennium Seed Bank (MSB) turned 20. To mark the anniversary, RBG Kew published data revealing the MSB, located at Wakehurst in Sussex, now holds 2.4 billion seeds from 39,681 species, sourced from 190 countries and territories.

The MSB represents a global network for biodiversity conservation, with over 260 partnerships with institutions from 97 countries and territories across Africa, the Americas, Australia, Europe and the Middle East. Partners range from universities and botanic gardens to government institutions, NGOs, landowners and community groups. Since 2013, RBG Kew staff have helped with the development of seven new international seed banks, and have delivered seed-collecting and conservation training programmes for more than 2000 people from 61 different countries and territories, many of who have gone on to manage seed banks that conserve their national and regional floras.



Vaults at the Millennium Seed Bank

**When counting the collections held across the global partnership, the MSB and its partners have helped protect 46,664 species.**

# 4

## Plant and Fungal Trees of Life

In February 2021, the twenty dedicated RBG Kew scientists behind our flagship Plant and Fungal Trees of Life (PAFTOL) project, currently supported by the Calleva Foundation and the Evolution Education Trust, achieved a major milestone with colleagues and partners worldwide. Together, we have now sequenced the DNA of one sixth of all flowering plant genera. Understanding these evolutionary trees of life is the ultimate endeavour in biology, equivalent to constructing the periodic table in chemistry. They enable researchers to understand how different species are related to each other, and are vital for helping future species discovery, monitoring and conservation.

This year, the team made data publicly available for 404 families, 2,333 genera and 2,956 species of flowering plants – that's one sixth of the total – in an online resource: the Kew Tree of Life Explorer. It's an unprecedented dataset that will be used by researchers worldwide and provides a knowledge base for the conservation, protection and restoration of biodiversity.



Brightly coloured bracket fungi  
on a tree in Madagascar

## MAJOR MILESTONES

# 5 Successes at the forefront of alpine conservation

**2020 saw the conclusion of the Harding Alpine Plant Conservation & Research Programme. Supported by the David and Claudia Harding Foundation, this multi-strand, five-year project aimed to address the rapid deterioration of natural habitats and crucial knowledge gaps in key alpine species. The European Alps cover 200,000 square kilometres and are home to over 4,400 wild plant species, many of which are endemic and endangered. Yet the region's flora is under critical threat by human development and climate change, requiring urgent protection. High mountain and alpine ecosystems are now the most threatened habitats in Europe.**

## Over the course of this project we:

- Created the European Alpine Seed Conservation and Research Network, bringing RBG Kew together with partners from five plant science institutions in Austria, France, Italy and Switzerland. We've held symposia and a series of schools programmes to improve ecological and taxonomic knowledge, with 687 joint seed collections representing 597 different species.
- Investigated the evolutionary relationships across alpine species of the aster family (Asteraceae) to determine the role different genetic traits play in enhancing a flower's attractiveness. Automated monitoring technology – a type of fixed webcam on these flowers – let us examine pollinator behaviour in unprecedented detail, laying the foundation for the continued production of high-quality data on pollinators in the face of global decline in insect numbers.
- Conducted a comprehensive study of saxifrages to gain novel insights into the way mountain biodiversity originates and to unlock the potential of our significant living collection of this genus at Kew Gardens. Many wild saxifrage species are restricted to small areas in habitats sensitive to environmental change. We investigated how and why they respond to the climatic gradients of alpine environments, providing a scientific baseline for understanding their sensitivity to future climatic disturbances.



→ Established key insights into the diversity of fungi that associate to plants above the tree line in alpine ecosystems and the factors that affect their diversity and distribution across the Alps. We discovered that drier, warmer summers will negatively impact the underground fungal communities plants rely on to survive in snow-bed habitats, helping to finesse and prioritise conservation efforts in the face of climate change.

Alpine rhododendrons on the mountain fields of Chamonix, France

## MAJOR MILESTONES



After the Cudlee Creek bushfires, January 2020

### 6 Restoring Australia's devastated Cudlee Creek

Cudlee Creek, in the Mount Lofty Ranges near Adelaide, is an area home to several rare and threatened plant species, and in 2020 was left devastated by bushfires – 23,200 hectares burned, including several conservation parks and private reserves.

The South Australian Seed Conservation Centre has been a partner of RBG Kew's Millennium Seed Bank Partnership since 2003 and through them we're helping to restore the area.

In 2007, we collected over a thousand seeds of clover glycine (*Glycine latrobeana*) from the area, a rare, nationally vulnerable pea that's endemic to south-eastern Australia. We kept these in long-term storage at the Millennium Seed Bank at Wakehurst, allowing us in the wake of the fires to send a collection of seeds back to Cudlee Creek for propagation of new plants and further seeds for restoration.

Our partners at the South Australian Seed Conservation Centre continue to work with local ecologists to conserve this pea, among other threatened species – including the Mt Lofty leafy greenhood (*Pterostylis cucullata* subsp. *sylvicola*), a plant in the orchid family whose vulnerable population is made up of fewer than 50 plants restricted to an area around 15m<sup>2</sup>.



### 7 A new flagship programme at Wakehurst

In April 2020, we began work on a major new flagship programme for Wakehurst, the Landscape Ecology Programme. Decades of careful stewardship have made Kew's wild botanic garden in Sussex especially productive and biodiverse, and a vital resource for policymakers worldwide.

With the UK government driving significant changes to environmental land management policy, evidence for the values of biodiversity is urgently needed to ensure the best possible investments are made. The Landscape Ecology Programme will research, engage with and share the benefits of UK biodiversity. To achieve this, we're partnering with institutions such as the University of Sussex, Royal Holloway University of London, Sussex Local Nature Partnership and the National Trust, with initial support from Sky Zero, Ground Control and a £2.3 million government grant. In the coming years, we will transform Wakehurst into a 'living laboratory' to scientifically measure nature's benefits for people and the environment, focusing on pollination, carbon, hydrology, and nature connectedness. We will also engage the public with nature and why it matters and share research with policymakers, conservation bodies and landowners to inform how to best manage land and use nature to solve environmental and social challenges in the UK and internationally.



Bloomers Valley at Wakehurst

## 8

## Botanical data helps save Cameroonian forest from logging

In August 2020, thanks to lobbying by RBG Kew scientists, other experts and the actor Leonardo DiCaprio, the President of Cameroon revoked an earlier decision to allow extensive logging in the Ebo Forest.

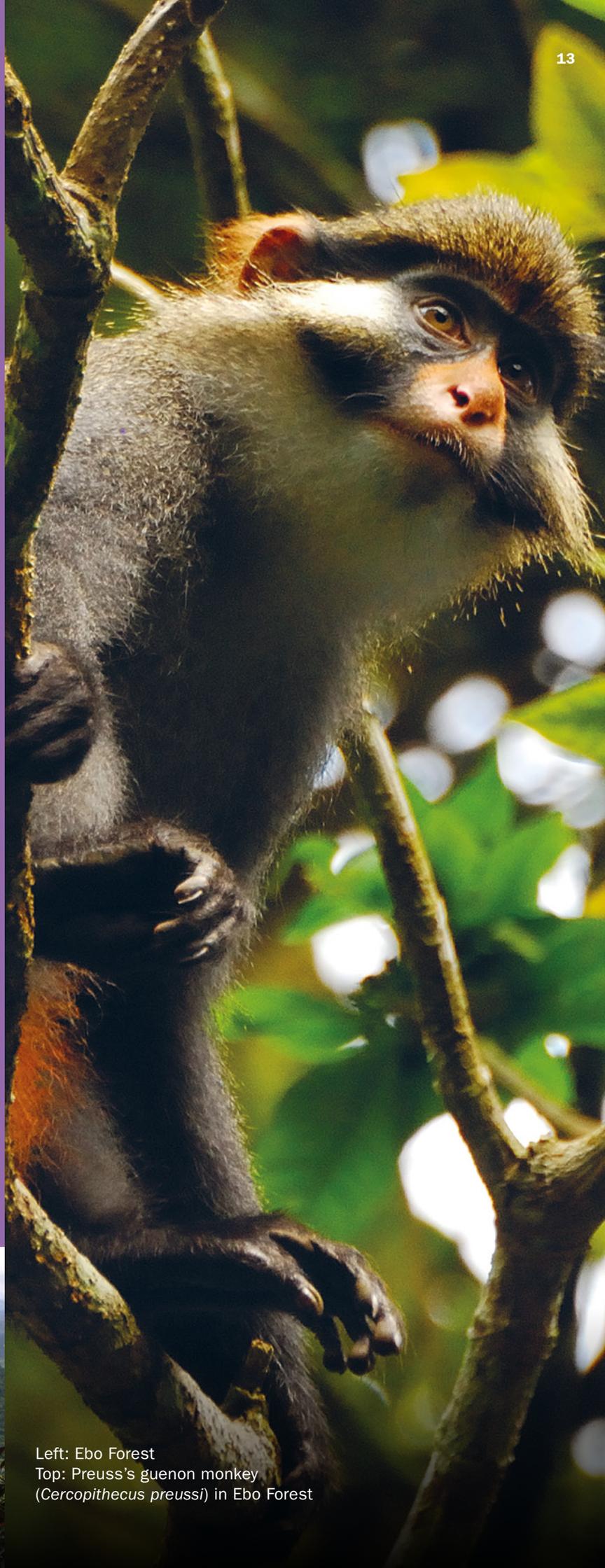
Covering about 2,000km<sup>2</sup>, the Ebo Forest is one of the largest intact rainforests in Cameroon and is home to an incredible diversity of plant and animal life.

Since 2004, botanists from RBG Kew and the National Herbarium in Cameroon have been exploring the previously little-studied area. So far, 14 plant species new to science and over 75 threatened species of plants have been discovered there. Ebo is also home to some globally important animal populations, including the only known population of chimpanzees to crack nuts and fish for termites, and one of only two remaining populations of Preuss's red colobus monkeys.

RBG Kew's expertise, along with our preserved herbarium specimens, which underpinned the plant identification work, helped demonstrate Ebo's exceptional botanical richness, meriting its designation as a Tropical Important Plant Area.

This finding, coupled with those of primatologists, was crucial in prompting President Paul Biya to reverse the logging concession, and we are continuing to collaborate with local partners to secure the future of Ebo in perpetuity.

This work in Cameroon is made possible with support from players of People's Postcode Lottery, and is just one strand of our major Tropical Important Plant Areas (TIPAs) programme, generously supported by a variety of donors and funders. Kew's TIPAs experts work with partners across seven countries to identify tropical areas where threatened species are concentrated, providing vital botanical data that aids important lobbying efforts and helps enable national authorities to prioritise the protection of these areas.



Left: Ebo Forest  
Top: Preuss's guenon monkey  
(*Cercopithecus preussi*) in Ebo Forest

# Equipping future leaders in plant and fungal science



Kew scientist extracting eucalyptus in funnel

## Celebrating a decade of early-career scholarships

Over the last ten years, the Emily Holmes Memorial Scholarships, funded by The Amar-Franses & Foster-Jenkins Trust, have been supporting early-career students at Kew and internationally to conduct high-quality postgraduate botanical research. The scholarship grants of up to £3,000 support work that aligns with RBG Kew's scientific priorities, with dozens of important research projects – and budding members of the new generation of plant and fungi scientists – benefitting from the scheme.

The Emily Holmes Memorial Scholarships are just one part of RBG Kew's varied and world-renowned science training and education programme. We are committed to sharing our knowledge, skills and expertise with future leaders and the next generation of plant and fungal scientists, with over 50 PhD students currently calling Kew home. Our popular MSc programme, delivered in conjunction with Queen Mary, University of London, equips students with the cross-disciplinary skills they require to develop careers in academia, government, industry, consultancy, public engagement and non-governmental organisations. We also run placements and internships for undergraduate students and short courses for working professionals.

## Supporting local communities during the pandemic

In 2020, RBG Kew launched a range of free downloadable educational resources to support parents home-schooling their children. The newly developed family-friendly, seasonal activity sheets, spotter sheets and nature-inspired songs proved very popular with several thousand downloads, and were accompanied by the launch of a series of new resources on Endeavour, a free online learning platform for use with children at all school Key Stages.

During the first lockdown in 2020, RBG Kew's national outreach programme, Grow Wild, distributed 10,000 wildflower seed kits for key workers. The Grow Wild team rounded off 2020 with some new live online events on

wildflowers, fungi and digital storytelling. The events proved very popular, with 169 attendees across the three events and lots of engagement in the 'ask an expert' Q&As. The event recordings received thousands of views on YouTube.

And, throughout 2020, RBG Kew's Community Horticultural Learning team donated food parcels of Kew produce harvested from the on-site community allotment – together with gardening essentials – to local people in need. From December 2020, participants from community groups across Greater London took part in a range of online learning activities involving poetry, creative writing, music, wellbeing and knitting.



### Toral Shah PhD student

'In my research, I analyse genetic data from plants belonging to the genus *Ochna*, a plant group predominantly found in dry forest and coastal habitats of East Africa. I recently travelled to Tanzania to collect fresh plant material of rare species and species we knew very little about, using the historic specimens from the Kew Herbarium to inform and identify the scientific gaps for my fieldwork. With my Emily Holmes Memorial Scholarship, I used the leaves of species collected during the trip, and from Kew's Herbarium, to extract and isolate their DNA and subsequently perform genetic analysis. This allowed me to create a phylogenetic tree of life to help us better understand the evolutionary relationships of all *Ochna* species. This important work is allowing me to ask key questions that could help with future conservation of the group. For example, I am investigating why certain *Ochna* species have different anther shapes, and how this relates to flowering and rainfall patterns, as well as why species occur in different habitats and environments and the future implications of this. My data has also revealed some species new to science, and lays the groundwork for conservation assessments, which will help establish good protection for the future of this plant group.'



### Nanty Herizo Rakotomalala MSc student

'As an MSc student at the University of Antananarivo, Madagascar, working with the Kew Madagascar Conservation Centre (KMCC), I was working to produce a checklist of grasses in protected grassland areas in the south of Madagascar (Isalo National Park), to understand the diversity and origins of these habitats. With my Emily Holmes grant, I spent a fortnight at the Herbarium at Kew and the Museum National d'Histoire Naturelle in Paris, a vital trip to meet my Kew supervisor, Dr Maria Vorontsova, develop my skills, immerse myself in the Kew research community and more accurately identify some of my grass samples. I'm now a KMCC employee, and grass identification – using the skills I developed on the trip – is one of my main tasks. With my accurate data, I have produced a publication that aids our understanding of Madagascar's grass biodiversity to help with its future sustainable use and conservation.'



### Leif Bersweden PhD student

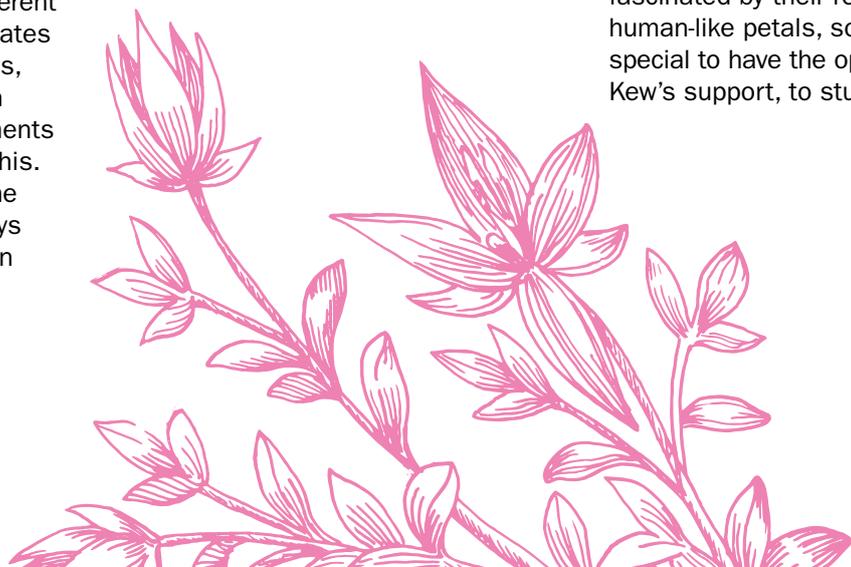
'I work on a group of British and European orchids whose petals resemble little human figures called lady, military, man and monkey orchids.'

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**'With my Emily Holmes scholarship, I've been using next-generation DNA sequencing technology to better understand what happens when these orchids grow together and hybridise.'**

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'I'm also investigating how hybridisation affects their genetic make-up, and what processes allow them to retain their integrity as distinct species, rather than just merging together. I first came across these orchids growing wild in the Oxfordshire countryside when I was 14 years old and was utterly fascinated by their remarkable human-like petals, so it's very special to have the opportunity, with Kew's support, to study them now.'



# The 'forgotten' coffee plant that could save your morning brew



Heralded as 'the holy grail' and a 'once-in-a-lifetime' event by Dr Aaron Davis, Senior Research Leader at RBG Kew, the rediscovery of and results of in-depth research into stenophylla coffee (*Coffea stenophylla*), a rare wild species from Upper West Africa, hit headlines worldwide in the spring of 2021.

Along with scientists from the University of Greenwich, CIRAD (the French Agricultural Research Centre for International Development) and Sierra Leone, Davis and his RBG Kew colleagues published a paper in *Nature Plants* revealing stenophylla has a superior taste to the arabica brews most coffee drinkers worldwide rely on, and is more resilient to high temperatures. This much-sought-after combination offers a lifeline to the multibillion dollar coffee industry, which is vulnerable to climate change.

## What's next?

*Coffea stenophylla* is classified on the IUCN Red List of Threatened Species as 'Vulnerable', so efforts are urgently required to safeguard the future of the species in the wild. In the year to come, the four institutes involved in the paper plan to plant *stenophylla* seedlings in Sierra Leone and Reunion Island (CIRAD), in order to start assessing its agronomic potential under a range of environmental conditions.



**'If you'd have asked me a few years ago, "Can we find a coffee that is climate-resilient and have a great taste?" I would have said no,' said Davis (left). 'That was the holy grail.'**

## A remarkable rediscovery

Once widely farmed in Upper West Africa but now non-existent as a crop species and not seen in the wild since 1954, when Dr Davis and the team came across *Coffea stenophylla* in late 2018 it seemed too good to be true.

With only a selection of 125-year-old *stenophylla* bean specimens from the Kew Herbarium and the scattered habitat reports of those who had searched before, in late 2018 Davis travelled to the lowland forests of Sierra Leone with fellow paper author Professor Haggard and development specialist Daniel Sarmu. With support of NGO Welthungerhilfe and the Sierra Leone Forestry Department, and after several hours of trekking through dense forest, they finally located a healthy population.

## Coffee farmers in crisis

The discovery comes at a crucial time, as up until this point, experts had not identified any robust means of protecting coffee farming from the climate crisis.

Despite its global success, the coffee supply chain is plagued with challenges, above all accelerated climate change. There are 124 species of coffee, but we rely on just two for 99 per cent of our coffee consumption: arabica and robusta. Arabica is a cool-tropical plant that is vulnerable to increasing global temperatures and coffee leaf rust, a fungal disease that has severely impacted coffee plantations in Central and South America. Robusta fares slightly better – the species grows at low elevations across much of wet-tropical Africa. However, it falls short in flavour, with the majority of its production used for instant coffee.

## The taste test

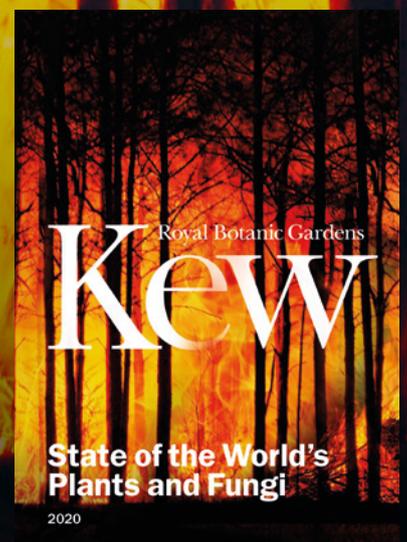
Until now, finding a coffee that can tolerate rising global temperatures, whilst also satisfying consumer preferences for flavour, has been a major challenge. *Coffea stenophylla* could well change all that, and it certainly meets the taste test.

Results from independent, professional tasting sessions with panellists from Union Hand-Roasted Coffee in London and, among others, Nespresso and Jacobs Douwe Egbert (JDE) in Montpellier, show that the flavour of *stenophylla* is like high-end arabica. The evaluation revealed it has a complex flavour profile, with judges noting its natural sweetness, medium-high acidity, fruitiness, and good body. Desirable tasting notes included peach, blackcurrant, mandarin and honey. In a tasting, when asked if the *stenophylla* sample was an arabica, 81 per cent of the judges said yes.

# Essential findings from our landmark report

September 2020 saw the release of Kew's fourth *State of the World's Plants and Fungi* report. Funded by the Sfumato Foundation, it's our renowned annual assessment of the state of the world's plant and fungal kingdoms globally.

The new data, the result of a huge and unprecedented international collaboration bringing together 210 scientists from 42 countries, shows how we are currently using plants and fungi, what useful properties we are missing, and what we risk losing. Here we share our key headlines and expert recommendations, which we hope to leverage to make change at the highest levels.





## Two in five plants now estimated to be threatened

Kew's 2016 *State of the World's Plants* report estimated one in five plants were at risk but new analyses this year show that extinction risk may be much higher than previously thought, with 39.4 per cent of plants estimated to be threatened with extinction. This jump in proportion is due to more sophisticated conservation assessments and new analytical approaches to correct biases in current data.

In the face of this crisis, our experts suggest the best course of action is to fast-track risk assessments so key areas can be protected, and species can be conserved without delay – and new advances in artificial intelligence (AI) could be the key.



*Brugmansia sanguinea*  
has vanished from the wild

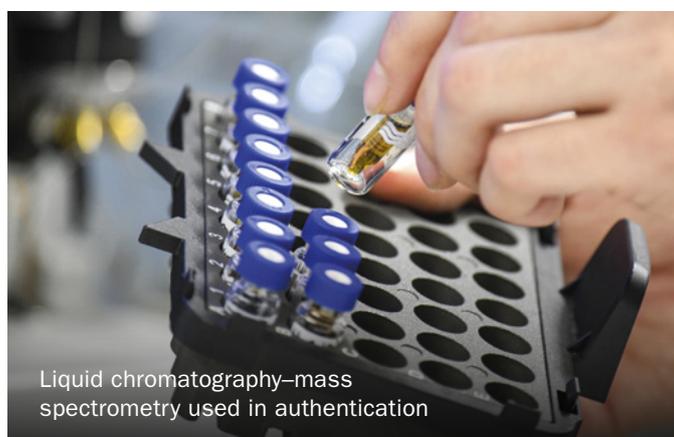
## ESSENTIAL FINDINGS FROM OUR LANDMARK REPORT



Rice paddy field in  
Muong La District, Vietnam

### There are at least 7,039 edible plant species

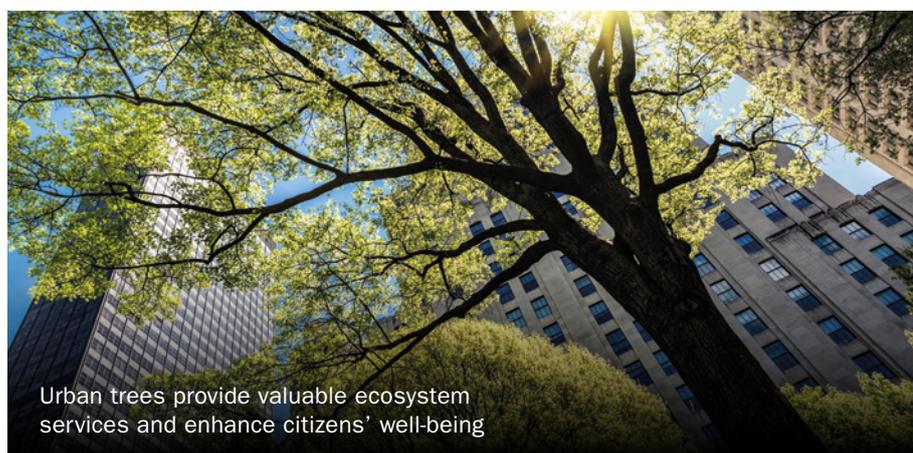
New data in this year's report show there are 7,039 edible plants which hold potential as future foods, yet just 15 plants provide 90 per cent of humanity's food energy intake. With the global population anticipated to increase from 7.8 billion to 10 billion by 2050, RBG Kew scientists and collaborators researched which overlooked and underutilised plants could hold the key to future-proofing our food production systems. They identified 7,039 plants listed as 'human food' from a Kew dataset of useful plants, of which only 417 (5.9 per cent) are considered as major food crops.



Liquid chromatography–mass  
spectrometry used in authentication

### Only 6.2 per cent of plants are associated with patents

The commercialisation of products derived from plants and fungi via patents has the potential to generate wealth, reduce poverty, improve human wellbeing and raise awareness of biodiversity to incentivise its conservation. However, new data in this year's report show that a very small percentage of species are associated with patents. An improved patenting infrastructure is needed, including more research into each country's own natural resources, and strong benefit-sharing agreements put in place globally to increase the development of nature-based products.



Urban trees provide valuable ecosystem  
services and enhance citizens' well-being

### We need greater urban tree diversity

City trees provide valuable ecosystem services, from reducing pollution to flood protection, and can help boost the wellbeing of inhabitants. In the face of climate change, and future pests and diseases, we must make sure the urban trees we plant can withstand these challenges and support the insects and fungi they interact with. Taxonomic and genetic diversity are essential for ensuring this – at present, there is a low diversity of tree species in our cities, leaving them vulnerable. To ensure we gain the greatest benefit from the ecosystem services that trees provide, we need to plan future cityscapes wisely; the report's authors suggested that city planting schemes assess the ecosystem services required and choose diverse species to deliver those services and ensure trees are genetically diverse, which could mean planting rare and untraditional tree species.

### Naming species is still too slow

It is a race against time to find, identify, name and conserve plant species before they go extinct. Yet the rate at which this vital work takes place is still too slow. We cannot protect a species if we do not know it exists, but currently we are losing species before they are known about.

Conservation projects and outcomes rely on detailed knowledge of a nation's biodiversity. Our report authors are calling for more research and funding across the world to urgently address the lag between taxonomy and conservation.



Rapeseed crop grown for biofuel near Lake Ontario, Canada

## 2,500 plants provide clean energy worldwide

There are 2,500 identified plants that could be used for fuel or bioenergy, but only six crops – maize, sugarcane, soybean, palm oil, rapeseed and wheat – generate 80 per cent of global industrial biofuel. With 840 million people (mainly in sub-Saharan Africa, Asia and Oceania) having no access to electricity and three billion without access to non-polluting cooking fuels and technology, new bioenergy crops are urgently needed.

Until now, research has focused on a few crop species grown for industrial energy supply chains. In an attempt to address this knowledge gap, RBG Kew and its collaborators carried out an in-depth evaluation of the plants and fungi that could be used as a source of energy, assessing the species with the potential to be scaled-up with innovative technologies.

As renewable sources of bioenergy, plants and fungi have a huge contribution to make in reducing both carbon emissions and energy poverty. Fungi, in particular, have much unexplored potential within the bioenergy sector and are abundant and renewable as a resource. However, rather than helping to reduce greenhouse gases and alleviate energy poverty, some of the methods currently used to produce bioenergy are harming the environment and people. For example, in 2019, a ban on sugarcane cultivation in the Amazon was lifted, which could amplify rates of deforestation, releasing carbon dioxide into the atmosphere and threatening species.

The team found various bioenergy initiatives that could be implemented at a local level as a solution to energy poverty.

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**Dr Olwen Grace, botanist at RBG Kew and lead author of the energy chapter in the report, says: ‘I think that energy poverty can be addressed sustainably within a decade if there is political will, given that we have a diverse pool of plants and fungi to explore and a vast array of suitable emerging technologies. There is real potential to harness the advances in engineering to support diverse, sustainable and resilient landscapes supporting the most essential human needs – food, water and energy.’**

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# Looking ahead

**The extraordinary events of 2020–21 have inspired a renewed connection with nature, local community and scientific evidence across the planet.**

**As the world's leading plant science organisation, RBG Kew is committed to deepening and broadening that connection, developing cutting-edge botanical research and conservation, and leveraging our invaluable collections, expertise and history to help implement effective action against biodiversity loss and the devastating effects of climate change.**

**In 2022 and beyond, we'll be delivering across the priority areas outlined in RBG Kew's major new ten-year strategy, *Our manifesto for change 2021–2030*, including training the next generation of experts, providing science-based knowledge and solutions to protect biodiversity and use natural resources sustainably, and influencing national and international opinion and policy.**



**The manifesto is available to read at [kew.org](https://www.kew.org), with news also forthcoming of some exciting new infrastructure projects, including:**

- A major transformation of the current Herbarium buildings at Kew Gardens, providing new and improved research facilities and public engagement spaces.
- A series of major capital and landscape developments at our wild botanic garden, Wakehurst – including a new conservation research nursery – which will transform the Sussex site into RBG Kew’s new national centre of excellence in conservation practice, seed research and landscape ecology.
- Restoration of the Palm House at Kew Gardens, a major capital project which will turn one of the globe’s most iconic buildings into a world-leading ‘net zero’ tropical hub, home to RBG Kew’s important collection of tropical plants from some of the most threatened environments in the world.

Thank you for your support. Together, we will end the extinction crisis and help create a world where nature is protected, valued by all and managed sustainably.

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