



Royal Botanic Gardens

Kew

**Kew and the
Global Strategy for
Plant Conservation**



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Introduction

Plants and fungi are essential for life on Earth and provide natural resources such as food, medicine and clean water. They sustain life through oxygen, carbon and nutrient cycling, and support human well-being. Kew is working with partners in more than 100 countries, through a dedicated team of over 300 science staff, to help address three of the greatest global challenges facing humanity today: biodiversity loss, sustainable development and climate change.

Kew's scientific vision is to document and understand global plant and fungal diversity and its uses, bringing authoritative expertise to bear on the critical challenges facing humanity today. Drawing on over 250 years of botanical and mycological data from our collections, Kew's scientific research is at the forefront of furthering knowledge of plant and fungal diversity.

Our primary stakeholders include UK and global scientific institutions, governments, research councils, industry, international conservation and development agencies, and the public. We are an Executive Non-Departmental Public Body part-funded by the UK Department for Environment, Food and Rural Affairs (Defra) and play an active role in delivering their policy objectives. Kew's research informs policy at both national and global levels.

The Global Strategy for Plant Conservation (GSPC) was adopted by the Convention on Biological Diversity (CBD) in 2002. It provides a framework for the policies and actions required to prevent the loss of plant diversity and promote plant conservation.

The first phase of the GSPC included 16 outcome-orientated targets to be addressed by 2010. Achievements included the formation of a Global Partnership for Plant Conservation (GPPC) and the uptake of plant conservation in National Biodiversity Strategy Action Plans.

To continue the momentum for plant conservation, the second phase of the GSPC was implemented for the period 2011–2020. The GSPC has five objectives with 16 updated targets to monitor progress and halt the loss of plant diversity, contributing to the wider CBD Strategic Plan for Biodiversity 2011–2020.

In the international policy arena, the United Nations implemented the Millennium Development Goals in 2000, which evolved into the 17 Sustainable Development Goals in 2015. The targets in the GSPC are essential to achieving the economic, social and environmental goals guiding the Sustainable Development Agenda.



Scientific and botanical institutes worldwide have played a vital role in implementing the GSPC. This document provides examples of how Kew and its partners have been contributing to and achieving the GSPC targets in the 2011–2020 period. It also highlights the role of plant conservation in achieving the Sustainable Development Goals. We have shown this by including one or more of the Sustainable Development Goal logos under each GSPC target.





GSPC objectives and targets

GSPC Objective I: Plant diversity is well understood, documented and recognised

- Target 1: An online flora of all known plants.
- Target 2: An assessment of the conservation status of all known plant species, as far as possible, to guide conservation action.
- Target 3: Information, research and associated outputs, and methods necessary to implement the Strategy developed and shared.

GSPC Objective II: Plant diversity is urgently and effectively conserved

- Target 4: At least 15 per cent of each ecological region or vegetation type secured through effective management and/or restoration.
- Target 5: At least 75 per cent of the most important areas for plant diversity of each ecological region protected with effective management in place for conserving plants and their genetic diversity.
- Target 6: At least 75 per cent of production lands in each sector managed sustainably, consistent with the conservation of plant diversity.
- Target 7: At least 75 per cent of known threatened plant species conserved *in situ*.
- Target 8: At least 75 per cent of threatened plant species in *ex situ* collections, preferably in the country of origin, and at least 20 per cent available for recovery and restoration programmes.
- Target 9: 70 per cent of the genetic diversity of crops including their wild relatives and other socio-economically valuable plant species conserved, while respecting, preserving and maintaining associated indigenous and local knowledge.
- Target 10: Effective management plans in place to prevent new biological invasions and to manage important areas for plant diversity that are invaded.



GSPC Objective III: Plant diversity is used in a sustainable and equitable manner

- Target 11: No species of wild flora endangered by international trade.
- Target 12: All wild harvested plant-based products sourced sustainably.
- Target 13: Indigenous and local knowledge innovations and practices associated with plant resources maintained or increased, as appropriate, to support customary use, sustainable livelihoods, local food security and health care.

GSPC Objective IV: Education and awareness about plant diversity, its role in sustainable livelihoods and importance to all life on Earth is promoted

- Target 14: The importance of plant diversity and the need for its conservation incorporated into communication, education and public awareness programmes.

GSPC Objective V: The capacities and public engagement necessary to implement the Strategy have been developed

- Target 15: The number of trained people working with appropriate facilities sufficient according to national needs, to achieve the targets of this Strategy.
- Target 16: Institutions, networks and partnerships for plant conservation established or strengthened at national, regional and international levels to achieve the targets of this Strategy.



GSPC Objective I: Plant diversity is well understood, documented and recognised



Target 1: An online flora of all known plants

Kew has been at the forefront of several initiatives contributing to a widely accessible and online World Flora of all known plant species. Digitisation is Kew's way of turning over 250 years of botanical and mycological knowledge into an open and accessible online global resource, which contributes to Target 1. Kew has digitised around 13 per cent of its collections, close to 1 million specimens, since the digitisation of herbarium specimens began at Kew in 2004. Kew's Fungarium has an estimated 1.25 million specimens and is prioritising digitisation of fungi which pose the greatest threat to plant health in the UK. There are currently over 130 fungal diseases on the UK Plant Health Risk Register.

Our Plants of the World Online portal contains digitised information from three tropical African Floras: *Flora of Tropical East Africa*, *Flora of West Tropical Africa* and *Flora Zambesiaca*. Over 54,600 taxa have been digitised, including descriptions, images, distribution maps and uses. Information on over 20,000 taxa with descriptions from the African Floras has been shared with the international consortium that coordinates the World Flora Online.

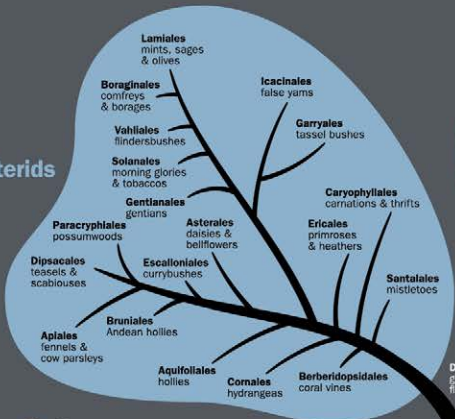
CASE STUDY 1

The Reflora partnership

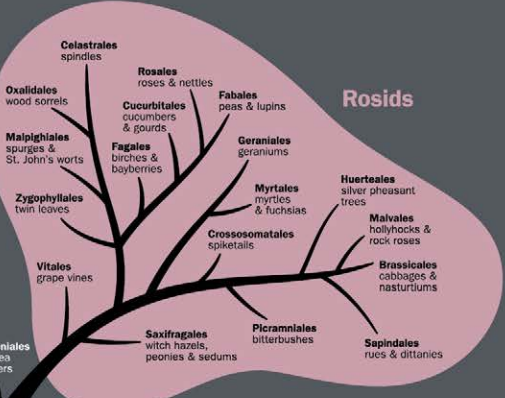
Collaborating with Jardim Botânico do Rio de Janeiro and Muséum National d'Histoire Naturelle, Paris (MNHN) as well as a network of herbaria, this project aimed to develop a high-quality digital resource to consolidate and share images and data from Brazilian plant specimens deposited in herbaria worldwide. The outputs help Brazil meet its commitments to Target 1 by completing a Flora treatment for Brazilian plant species. Images and label data were captured for more than 206,500 Brazilian specimens deposited in the Kew Herbarium, contributing to the description of more than 100 species new to science by over 110 Brazil-based students and researchers who made study visits to Kew within the framework of Reflora. The specimens digitised at Kew are available through the Brazilian Virtual Herbarium.

**Kew has digitised around
1 million specimens**

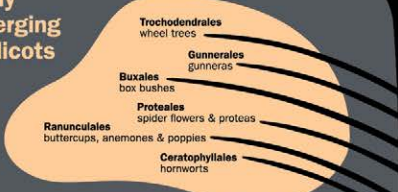
Asterids



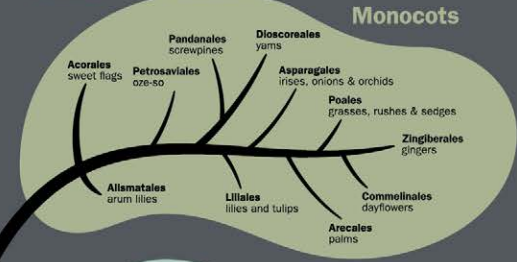
Rosids



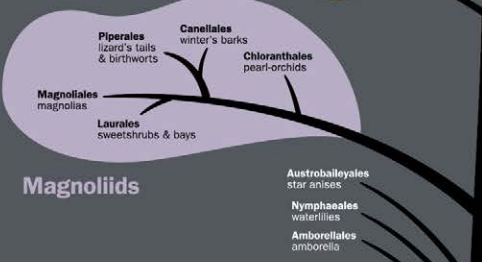
Early diverging eudicots



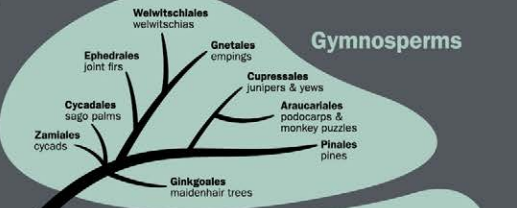
Monocots



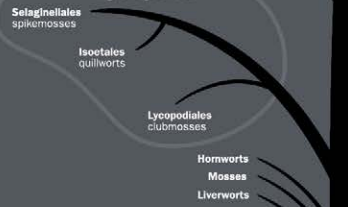
Magnoliids



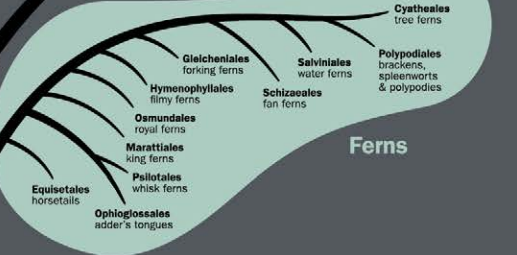
Gymnosperms



Lycopods



Ferns



Hornworts
Mosses
Liverworts

Algae

Animals
Fungi
Bacteria
Archaea

CASE STUDY 2

Medicinal Plant Names Services

Kew's Medicinal Plant Names Services (MPNS) has catalogued half a million scientific, pharmaceutical and common names cited in health regulations or medicinal literature and mapped these to 28,000 plant species. Through collaboration with the World Health Organisation and 10 national centres, MPNS continues to identify medicinal plants and to improve the data integrity and interoperability of these centres' information resources. MPNS also facilitates communication among medicinal and food regulators and supplies terminological controls used in an ISO drug standard, enabling health professionals to talk with one another reliably and to access information about Target 1 species.

CASE STUDY 3

Plant and Fungal Trees of Life (PAFTOL) project

All living things are connected by their evolutionary history in the tree of life. The tree is a roadmap to life on Earth – it helps us to discover, understand, utilise and conserve biodiversity. Revealing all the branches of this tree of life is one of the most fundamental challenges in science today. Kew has played a leading role in DNA-based research into the plant tree of life, resulting in discoveries of flowering plant relationships, their origins, and a radical new classification, which for the first time illustrates their evolutionary history. Our current PAFTOL project aims to produce genomic-scale data for at least one species of each genus of flowering plants (14,000 genera) and fungi (8,200 genera), drawing on our unrivalled collections and innovations in high-throughput DNA sequencing. The tree of life is fundamental to an online Flora of all known plants, because it is essential for accurate classification and provides a comparative framework through which the Flora can be understood and utilised.





Logo of the organization, featuring a globe and the text "ORGANIZACIÓN MUNDIAL DE LA SALUD" and "WORLD HEALTH ORGANIZATION".

Logo of the organization, featuring a globe and the text "ORGANIZACIÓN MUNDIAL DE LA SALUD" and "WORLD HEALTH ORGANIZATION".

No seed sample available



Target 2: An assessment of the conservation status of all known plant species, as far as possible, to guide conservation action

The task to complete an assessment for all plant species by 2020 is ambitious. In response, Kew scientists have developed strategies to predict the conservation status of species based on climatic and ecological variables, as well as threats such as land-use change. In collaboration with Botanic Gardens Conservation International, a new **ThreatSearch** database has been established that aims to collate all digitally available extinction risk assessments and can be used to monitor progress against Target 2. This synthesis determined that only around a quarter of plant species have received a global conservation status assessment and around 30,000 of these are categorised as globally threatened. Additionally, conservation assessments feed into the wider initiative of the Kew-led Tropical Important Plant Areas (TIPA) programme, identifying sites that contribute significantly to the global persistence of biodiversity in all ecosystems.





CASE STUDY

Kew and the IUCN Red List

Kew coordinated an initiative to complete International Union for Conservation of Nature (IUCN) Red List assessments for randomly selected sets of species from five plant groups. The results were combined to obtain a robust estimate of global extinction risk to plants, with most of these assessments published between 2011 and 2014. The project determined that one in five plants are threatened with extinction.

Web-based conservation tools and algorithms developed by Kew have enabled the online GeoCAT tool to facilitate calculations which underpin thousands of Red List (extinction risk) assessments, thus contributing to GSPC targets 2 and 3. In 2018 alone, there were over 6,000 unique users of GeoCAT from around the world. These tools enable others to implement the GSPC within their own countries.

In 2016, Kew's Plant Assessment Unit was created to accelerate the assessment of species in tropical regions. The team support the preparation and publication of extinction risk assessments on the IUCN Red List. At the end of 2018, 29 per cent of all plant assessments on the Red List had been assessed or reviewed by a Kew scientist. The Plant Assessment Unit has facilitated the completion of Red List assessments of wild relatives of crops including bananas, coffees and yams, as well as assessments of orchids, tree ferns and ecologically important rainforest trees. The Plant Assessment Unit will add 4,750 new global assessments to the IUCN Red List by June 2021. This contribution to the IUCN Red List has raised awareness of plant extinctions, influenced policy and helped to change business practice.

Following research on the Critically Endangered lady's slipper orchid (*Cypripedium calceolus*) in the UK, Kew was asked to conduct a global Red List assessment of all 180 slipper orchid species. We found that approximately 90 per cent of these species are threatened.







Target 3: Information, research and associated outputs, and methods necessary to implement the Strategy developed and shared

Kew has played a leading role in DNA-based plant research into the plant tree of life. We have already sequenced more than 25 per cent of all flowering plant genera, using a novel genomic toolkit created with our collaborators from Chicago Botanic Garden, Texas Tech University and the 1000 Plants project. This toolkit (known as Angiosperms-353) is now openly available to the scientific community and has the potential to develop as a community-wide standard for plant tree of life research.

CASE STUDY 1

Knowledge transfer across the Millennium Seed Bank Partnership

The Millennium Seed Bank Partnership (MSBP) safeguards wild plant diversity and enables its sustainable utilisation through global partnerships. Seed conservation is underpinned by science, and Kew shares new science and best practices globally through multiple channels: technical training programmes in-country and at the Millennium Seed Bank (MSB); the MSBP Seed Conservation Standards and associated review process; the MSBP Data Warehouse website; and the MSBP network newsletter, *Samara*. Kew's knowledge and experience in conservation seed banking enable us to promote technology transfer and capacity building and advise on:

- species prioritisation and targeting
- the design of seed banks and collection programmes
- data management for conservation seed banking
- viability testing and seed longevity
- environmental and taxonomic diversity in seed desiccation tolerance
- seed-collecting guides.

Our knowledge of seed storage behaviour led to the development of an online tool (soon to be available externally) that identifies taxa likely to be recalcitrant – that is, having seeds which do not survive conventional drying and freezing. These species can then be prioritised for the identification of alternative *ex situ* conservation methods such as cryopreservation.



Target 3 continued:

CASE STUDY 2

Lost and Found Fungi project

Kew's Lost and Found Fungi project uses a citizen science approach to harness the support of volunteers and amateur mycologists across the UK to search for a target list of 100 species of current or potential conservation concern. The project aims to help develop UK fungal conservation by trying to find out which species are genuinely rare or extinct and which are simply 'lost' or under-recorded due to a lack of survey work. Around 15,000 species of fungi have been recorded in the UK over the last century, and several thousand species are known only from a few collections or sites. By gathering this information, Kew aims to improve the baseline data for the target species, produce enough evidence to formally Red-List genuinely rare species, and to provide their populations and habitats with some measure of protection. Red-Listing fungi directly contributes to Target 2, which is essential as only around 145 fungi species have been globally assessed on the 2019 IUCN Red List. Citizen science has helped mobilise individuals and organisations to contribute to data gathering and recording, which is vital to achieving the GSPC targets.





GSPC Objective II: Plant diversity is urgently and effectively conserved



Target 4: At least 15 per cent of each ecological region or vegetation type secured through effective management and/or restoration

Habitat degradation includes both the loss of habitat and decline in habitat quality due to inappropriate land use and management, alien species invasion, or the loss of key biodiversity elements of ecosystem processes. In some instances, it is possible to reverse the effects of habitat degradation via ecological rehabilitation. However, a 'true' restoration process aimed at reconstructing a prior ecosystem and re-establishing former functions, communities and structure can be difficult to achieve, particularly at the landscape level and with a changing climate. Attempts to provide specific services, to reintroduce certain functions, or to re-vegetate damaged lands align with the aims of Target 4.

Kew's UK Seed Conservation Programme contributes to these efforts by coordinating collaborative, multi-disciplinary activities with more than 50 partner organisations to enable the conservation and restoration of threatened species and priority habitats across the UK. Between 2015 and 2019, 1,455 seed samples from the UK collections were dispatched within the UK via the Millennium Seed Bank seed list. Of these, 1,062 were for research, 200 to develop the living collections at Kew and other botanic gardens, and 193 for environmental purposes including regeneration.

CASE STUDY

Lady's slipper orchid reintroduction

Widely distributed across Europe, the lady's slipper orchid, *Cypripedium calceolus*, is Critically Endangered in the UK. Through Kew's work, successful reintroduction has taken place at 12 sites in northern England. Further to this, knowledge generated by Kew's research into propagation methods, mycorrhizal associations and genetics has led to the production of seedlings, which are currently grown by a network of growers managed by Natural England before planting out. Our network of collaborators has expanded across the range of the species, and genetic data are now being incorporated into conservation plans for this species in Denmark, Estonia, Finland, Italy, Romania and Russia.







Target 5: At least 75 per cent of the most important areas for plant diversity of each ecological region protected with effective management in place for conserving plants and their genetic diversity

Kew's Tropical Important Plant Areas (TIPA) programme is enabling tropical countries to make significant progress towards Target 5 by mobilising information on critical sites for plants and habitats and contributing information for effective protected area management. We have worked closely with Plantlife International, their existing Important Plant Area (IPA) partners and a range of Kew's partner institutions in the tropics to revise the IPA criteria to extend their application worldwide to address global conservation issues and priorities.

Together with our in-country partners, we are now in the process of identifying and documenting areas in seven countries that support globally threatened plant species, and habitats and concentrations of important species, including those of socio-economic value. The identified TIPAs, including data and recommendations, enable national authorities to effectively prioritise the protection and sustainable management of their natural resources. The timelines for consultation on the revised IPA criteria overlapped with IUCN's work on Key Biodiversity Areas (KBA), enabling exchange of information and identification of synergies between the two schemes. Kew scientists contributed to workshops and threshold testing for the KBA criteria and worked with members of the KBA partnership to ensure that IPA and KBA thresholds were aligned wherever feasible and appropriate. The TIPA programme will be a major contributor of plant data to future KBA identification.

CASE STUDY 1

The British Virgin Islands

Working with the National Parks Trust of the Virgin Islands and the Ministry of Natural Resources, Labour and Immigration, we have identified a network of 18 TIPAs across the archipelago. During this process, 25 globally threatened species were identified, as well as 35 plant species of national high conservation importance and five nationally threatened habitats. Regular engagement with the British Virgin Islands Government has facilitated the inclusion of TIPAs and their critical species and habitats as conservation priorities within the new British Virgin Islands Environment and Climate Change Bill, currently being drafted.



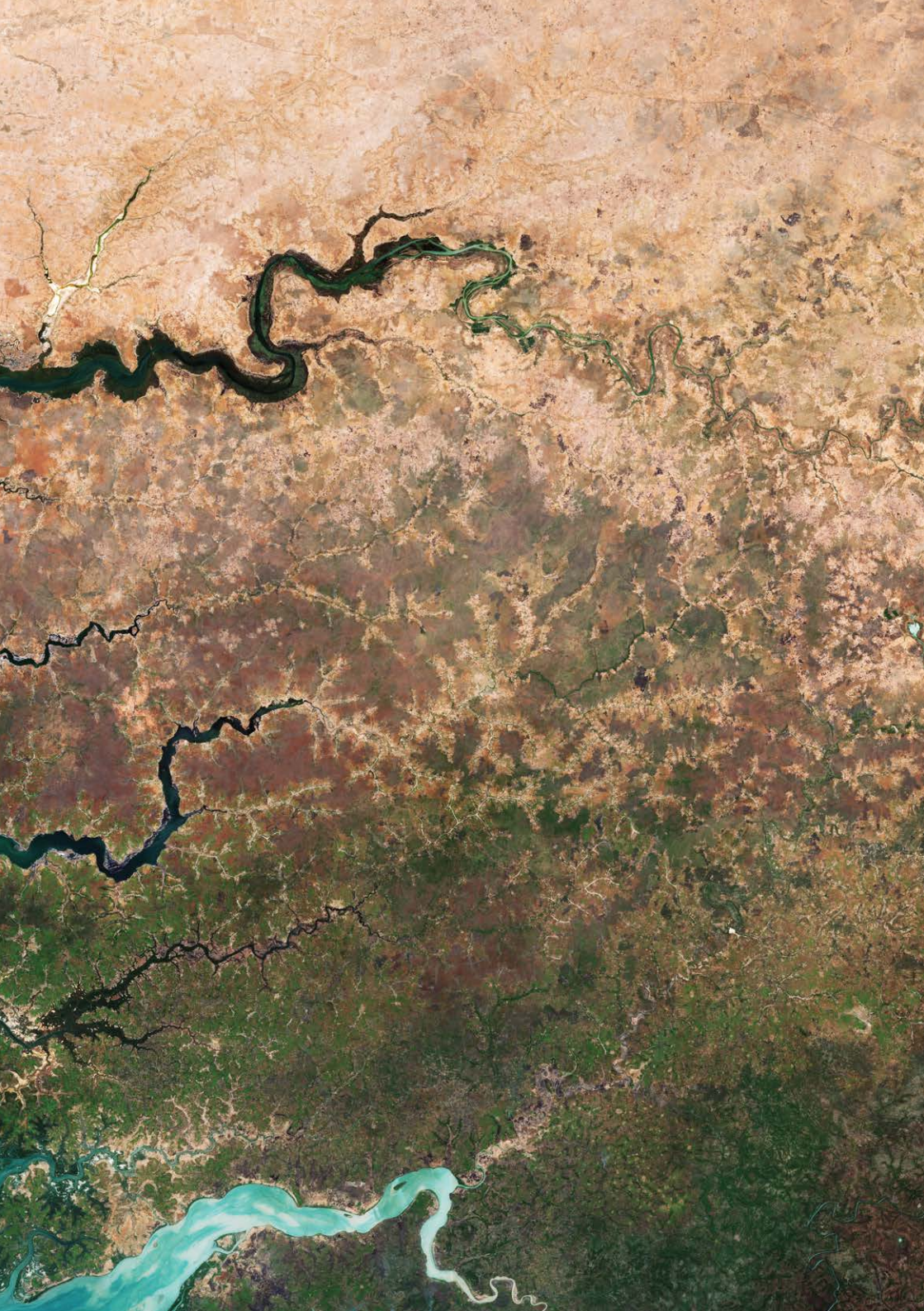
Target 5 continued:

CASE STUDY 2

Guinea

In Guinea, Kew is part of a working group on 22 TIPAs and Conservation Action Plans, providing input into the management of these sites. At the proposed Moyen Bafing National Park in Guinea, managed by the Wild Chimpanzee Foundation, we are providing much-needed plant data to support the new management plan for this site. This will help to conserve a range of rare and threatened plant species, including the Critically Endangered *Barleria asterotricha* and Endangered *Dissotis linearis* (syn. *Argyrella linearis*), both endemic to Guinea. Overall, these TIPAs cover 3.5 per cent of Guinea's surface area and include more than 60 per cent of the country's 273 threatened plant species.







Target 6: At least 75 per cent of production lands in each sector managed sustainably, consistent with the conservation of plant diversity

A major contribution to Target 6 has come from our research and knowledge on seed storage and plant traits, which have significantly influenced policy development internationally in the agriculture and forestry sectors. Kew was influential in *The State of the World's Forest Genetic Resources*, a review published by the Food and Agriculture Organization (FAO) in 2014. As a result of this work, strategic priorities were adopted and formed the basis of the FAO's *Global Plan of Action for Conservation, Sustainable Use and Development of Forest Genetic Resources*.

CASE STUDY 1

Kew's Great Green Wall project

This project, working with communities in sub-Saharan Africa to build a 'Green Wall' that will contribute to their sustainable future, began as a restoration model but has evolved and is delivering environmental and socio-economic benefits. These include food security and improved livelihoods, through the selection of well-adapted species and the prevention of desertification and biodiversity loss. The model has also been used for FAO's Action Against Desertification programme.

Our participatory approach working with local communities, national collaborators and the FAO in the transboundary area between Mali, Burkina Faso and Niger, has informed the wider Great Green Wall initiative for the Sahara and the Sahel.





Target 6 continued:

CASE STUDY 2

Seed functional traits for sustainable agriculture, food security and forest genetic resources conservation

Kew has contributed to an improved understanding of seed germination performance and vigour within the agricultural sector. We have tested over 200 species from numerous habitats for germination temperature and time requirements. This provides us with an understanding of the needs of important crop species in a changing climate. Kew has been influential in the formation of the European Native Seed Producers Association and the formation of the Spanish Semillas Conservation Working Group, where we have supported:

- multiplication of native grasses providing ground cover in olive groves and almond crops
- the use of selected plants for biological control in agroecosystems and landscaping in collaboration with farmers' associations
- forest seed production practices, seed testing methods and woodland sowings preventing wasted effort through sowing seeds in inappropriate conditions.







Target 7: At least 75 per cent of known threatened plant species conserved *in situ*

Kew works with partners worldwide to identify risks, share technical expertise, and provide assessments and data to global partners in order to conserve threatened species *in situ*. A key criterion for identifying Tropical Important Plant Areas (TIPAs) is the presence of threatened species. Our work in identifying TIPAs is providing scientifically robust data to enable targeted *in situ* conservation of threatened species.

CASE STUDY 1

St Helena

St Helena has a third of the total endemic biodiversity recorded across the UK and its Overseas Territories. The cloud forest of the Peaks National Park is home to 17 per cent of this endemic biodiversity total. There are four key cloud forest tree species, *Nesohedyotis arborea*, *Pladaroxylon leucadendron*, *Petrobium arboreum* and *Commidendrum spurium*, and wild populations of all these species are in decline. These species are on the edge of extinction as they are under continual pressure from invasive species. Kew has contributed to the development of a proposed management plan for the Peaks National Park for the period 2019–2024. Twenty-five endemic plants will be conserved *in situ* with this management plan. It provides a framework for actions to conserve native habitats and their communities of threatened endemic species, for actions to control invasive species in conjunction with restoration of self-sustaining habitat, and for guiding research priorities and training needs.

CASE STUDY 2

Caribbean pine

The Caicos or Caribbean pine, *Pinus caribaea* var. *bahamensis*, is the only native pine in the Lucayan Archipelago. It is a keystone species in the pine forests of this region and an important timber tree. This endemic and threatened pine has undergone significant decline in the Turks and Caicos Islands in the past decades due to a non-native invasive pest. The Caicos Pine Recovery Project, a collaborative effort between Kew and the Turks and Caicos Islands' Department of Environment and Coastal Resources, developed a restoration strategy for the species based on scientific data on the species' biology, range, genetic diversity and ecological associations. This enabled the ongoing *in situ* conservation, monitoring and reintroduction of the Caicos pine in the Turks and Caicos Islands. The conservation and restoration of the Caicos pine forests are vitally important for biodiversity and for maintaining the associated ecosystem services.



Target 7 continued:

CASE STUDY 3

The Itremo Protected Area in Madagascar

In 2015, Kew established the 250 km² Itremo Massif Protected Area through a decree by the Government of Madagascar. It is managed by Kew Madagascar with local communities and authorities. The Itremo Massif is a marble and quartzite plateau that is famous for beautiful landscapes, semi-precious crystals, charismatic plants (including numerous succulent species) and its silk, produced by a locally endemic silk moth that builds cocoons on a locally endemic tree species (tapia, *Uapaca bojeri*). It is dominated by grassland, but it is equally important for the biodiversity of its humid gallery forests, rocky outcrops and savanna (tapia) woodlands. The Itremo Massif Protected Area is a Key Biodiversity Area and an Alliance of Zero Extinction site, as it is the only known location of *Podocarpus capuronii*. Over 700 plant species have been recorded, including 178 that are Endangered or Critically Endangered under the IUCN Red List criteria. It is considered a 'micro-hotspot' as it is home to more than 80 species and subspecies of orchid and many local endemics, such as the grasses *Eragrostis betsileensis* and *Tristachya betsileensis* and the palm *Dypsis ambositrae*.

Kew's contribution to the management of this protected area and significant research include the following:

- Intensive plant surveys, doubling the number of species known, mapping important populations and undertaking IUCN Red List assessments of threatened species.
- Ecological and phylogenetic research of the savanna grasses, which established that the grasslands are ancient in origin and not anthropogenic.
- Long-term fire studies that will inform effective management regimes to preserve grassland biodiversity and protect savanna woodlands and humid gallery forests.
- Research on fungal symbionts that support germination of orchids *in situ*. This has led to protocols for cryopreservation of orchid protocorms with their co-dependent fungi at Kew (e.g. for the orchid species *Angraecum sesquipedale* and *Cynorkis cinnabarina*).







Target 8: At least 75 per cent of threatened plant species in *ex situ* collections, preferably in the country of origin, and at least 20 per cent available for recovery and restoration programmes

In a time of ever-increasing environmental challenges, with species loss at an unnaturally high level and with climate change threatening many ecosystems, the role of botanic gardens in *ex situ* conservation is vital. Kew has the knowledge and expertise to make a positive difference to biodiversity conservation around the world through the conservation of genetic diversity in living collections and seed banks. Through field collection trips, collaboration with partners and provision of training, Kew has made significant progress to achieving Target 8.

Our living plant collections play a significant role in global conservation. Comprising 68,490 collections from 319 plant families, they represent 27,267 taxa and 18,834 species. There are large numbers of collections from China, the USA, Japan, Turkey, South Africa and Australia.

Our Living Collections:

- 39 per cent are of wild origin
- 87 per cent are identified to species level
- 872 taxa are categorised as threatened with extinction, of which 334 are Vulnerable, 334 are Endangered, 191 are Critically Endangered, and 13 are considered to be Extinct in the Wild.

CASE STUDY 1

St Helena boxwood, *Withania begoniifolia* (syn. *Melissia begoniifolia*)

- This species is only found on the island of St Helena and was thought to have been extinct since the 1870s, declining mainly due to poor soils, overgrazing and insect pests.
- Rediscovered in the 1990s, it again faced extinction in 2010 when a single ailing plant died. However, a few seeds then germinated in the wild from the seed bank in the soil (a natural seed bank).
- Since 2012, plants grown at Kew from the original seeds have been pollinated by hand, and over 13,000 seeds have been collected from these cultivated plants. Batches of seed were sent back to St Helena, germinated and were returned to their natural habitat as small plants.



STACK 5. 29-35



Target 8 **continued:**

CASE STUDY 2

Millennium Seed Bank Partnership

Kew's Millennium Seed Bank Partnership (MSBP), based at Wakehurst in West Sussex, has a significant impact on plant conservation, currently conserving samples of 16 per cent of global plant species (for orthodox, seed-bearing, wild vascular plants). It is the largest *ex situ* plant conservation initiative in the world, involving a global network of partners. The Millennium Seed Bank (MSB) currently stores more than 95,000 collections representing 40,936 species. These have been sourced from 190 countries and undergo regular curation to align with taxonomic revisions.

MSBP collections contain substantial taxonomic diversity, representing 365 plant families and over 5,800 genera. Some recent key achievements of the MSBP are listed below:

- Seven international seed banks have received technical help with their facilities – in Colombia, Dominican Republic, Georgia, Indonesia, Singapore, Thailand and the United Arab Emirates.
- Seed-banking kits sent to partners have enabled over 1,800 additional seed collections to be made.
- More than 60,000 seed collections are stored in 35 of our partner seed banks around the world.
- 3,283 crop wild relative seed collections have been sent to nine international gene banks for crop research.
- 78 per cent of the collections represent endangered, endemic or economically important taxa.
- Kew has undertaken taxonomic verifications for 7,569 seed collections, with the results sent to MSB partners.
- The Kew-led European Native Seed Conservation Network has banked over 50 per cent of Europe's threatened plants.
- The UK National Tree Seed Project has banked 1,303 seed collections from 74 native species.
- Kew has begun working on the development of cryopreservation techniques, enabling seeds unsuitable for normal freezing processes to be stored at temperatures of -196°C .







Target 9: 70 per cent of the genetic diversity of crops including their wild relatives and other socio-economically valuable plant species conserved, while respecting, preserving and maintaining associated indigenous and local knowledge

Kew works in partnership to help safeguard crop diversity around the world. Through collections of unique and valuable species, we give priority to crops important to global food security and agroforestry as they play a major role in sustainable livelihoods. Focusing on this important subset of useful plants, Kew is contributing to Target 9 as described below.

CASE STUDY 1

Ethiopian coffee

While studying the climate resilience of indigenous Arabica coffee, Kew and its Ethiopian partners discovered a strong negative impact of climate change on farmed and wild Arabica stocks. Following the publication of *The Coffee Atlas of Ethiopia*, information from this research has been incorporated into Ethiopian government policy. Work on coffee processing and improving the coffee value chain has increased household income by 20–30 per cent, bringing \pm US\$1.3 million extra revenue to a community of more than 5,000 people. Our Coffee Extinction Risk Assessment project provided Red List assessments for all 124 coffee (*Coffea*) species. It concluded that:

- 60 per cent of all coffee species are threatened with extinction
- 45 per cent are not held in any seed or DNA collections
- 28 per cent are not known to occur in any protected area
- wild coffee species are extinction-sensitive, especially at a time of accelerated climatic change.





Target 9 continued:

CASE STUDY 2

Crop and tree seed conservation

The Millennium Seed Bank holds 3,800 collections of 237 taxa representing 25 of the most important crops for global food security. These collections, totalling over 12 million individual seeds, are central to Kew's Adapting Agriculture to Climate Change project, a ten-year global initiative spanning 24 countries that focuses on the wild relatives of some of the world's most important food crops. The Global Tree Seed Bank project focuses on conserving the seeds of rare, threatened and useful tree species and conducts research on key areas of tree conservation, including seed biology and behaviour, cryopreservation protocols and reforestation. Since 2015, we have conserved the seed of 3,435 tree and shrub species from 34 countries.

CASE STUDY 3

Enhancing rural Caucasian livelihoods through fruit and nut conservation

The Caucasus region is one of the most biodiverse hotspots in the world. It is home to around 6,400 plant species, with more than a quarter found nowhere else on Earth. Within this region, 2,000 species have been linked to direct economic value, with uses ranging from timber and firewood to food, medicines and dyes. Wild berries alone account for over 50 per cent of the total value of cash forest products. Threats to the 260 wild fruit- and nut-producing species include illegal logging, fuel-wood harvesting, overgrazing and pollution. Kew is collaborating with partners in Georgia and Armenia to collect the seeds of over 120 wild fruit and nut species to ensure their conservation. We are working alongside rural communities to alleviate threats from overharvesting through educational workshops and introducing wild-harvested species into cultivation.







Target 10: Effective management plans in place to prevent new biological invasions and to manage important areas for plant diversity that are invaded

Kew works with various partners to identify, monitor and address the threat of invasive alien species. Our longstanding work in UK Overseas Territories has focused on producing field guides to help identify invasive species and initiate management control mechanisms.

CASE STUDY 1

Ash dieback

In 2012, ash dieback, a disease caused by the fungus *Hymenoscyphus fraxineus*, was first found in native woodlands in Britain, prompting an immediate ban on the movement of ash (*Fraxinus excelsior*) trees. Since then, research by Kew's Plant Health team has provided information and evidence that has helped the Department for Environment, Food and Rural Affairs (Defra) and other stakeholders to develop strategies for the management of ash dieback. Research has investigated the viability of a breeding programme to increase ash dieback resistance and the potential effectiveness of natural selection in driving increased ash dieback resistance. Research has also provided information about the proportion and rate of ash tree death that can be expected in the UK. The full economic cost of ash dieback in the UK has been estimated at £15 billion.

CASE STUDY 2

Botanical insecticides

Kew has been researching pesticidal properties of plants as an alternative to commercial pesticides. Our work has been focused in sub-Saharan Africa to help farmers on smallholdings control insect pests more effectively and safely. Typically, pesticidal plants are inexpensive, less harmful to beneficial insects and can generate new income, as farmers can trade the pesticidal plants or provide pest management services. One of our training activities in Kenya and Tanzania led to 40,000 pesticidal shrubs being propagated for home use and sale. When grown in field margins, pesticidal plants can also support pollinators and natural enemies of pests by providing nectar and pollen. We worked with over 600 farmers in Tanzania and Malawi to promote the value of multipurpose field margin plants. During this project, their incomes increased by 13 per cent. Over a decade, this research built a pan-African collaboration that became an international consortium of researchers promoting the research and benefits of pesticidal plants.





GSPC Objective III: Plant diversity is used in a sustainable and equitable manner



Target 11: No species of wild flora endangered by international trade

The UK was one of the original signatories of the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES) and became a Party to the Convention in 1976. Kew is the designated UK Scientific Authority for plants, and we have provided training in trade-related issues on artificial propagation, sustainable use, taxonomy and nomenclature, horticulture, wood anatomy and DNA techniques. We provide scientific advice on over 4,000 CITES permit applications to the UK annually. We are a part of the EU Scientific Review Group and the UK delegation to the CITES Conference of the Parties, where we provide comprehensive briefs and analyses for the UK government.

Kew has played a major role in the development of non-detriment findings assessments for CITES. We collaborated with the German Scientific Authority, TRAFFIC International and WWF Germany to develop the current *CITES Non-detriment Findings Guidance for Perennial Plants*. This has been used in training workshops in Vietnam, Peru, Georgia and China, promoting international cooperation and improvement of CITES implementation. Kew participated in the 2018 Illegal Wildlife Trade Conference to showcase CITES-listed plants – the first time plants were featured, raising the awareness of illegal trade in plants internationally.

Kew Gardens' quarantine house keeps seized plant materials, and we are regularly required to identify such material and testify when offenders are prosecuted. Our experts are regularly consulted by enforcement authorities regarding the illegal trafficking of plant specimens.

Kew's timber anatomy laboratory receives specimens of timber products from all corners of the globe for identification. Our plant collections help with species identification, which is essential for law enforcement. Our wood reference material includes 36,000 wood anatomy slides and over 42,000 wood collections.







Target 12: All wild-harvested plant-based products sourced sustainably

The sustainable use of biological resources must ensure that extraction does not lead to the long-term decline of a species or the disruption of the ecological integrity of the ecosystem in which the species occurs. Kew continues, through ongoing research and adaptive management principles, to refine the levels of sustainable harvesting of biological resources despite the challenges associated with the development of often complex harvesting systems.

CASE STUDY 1

Conservation of yam diversity in Madagascar, enhancing food security and income

Kew, in partnership with local authorities and international organisations, has developed a national strategy for wild yams to guide resilient utilisation of yams (*Dioscorea* spp.) in Madagascar. Kew has completed over a decade of research in Madagascar on yam diversity. During this time, nine wild-exploited edible species were found to have a narrow distribution and to be threatened by habitat loss and overexploitation.

Our work has included:

- cultivation of the Asian-origin crop species *Dioscorea alata* (winged yam) piloted successfully by communities in south-eastern Madagascar
- providing seed tubers of *D. alata* to 93 communities, who in return cultivated threatened species and monitored their populations
- cultivating seed tubers to provide rapid income and nutritional improvements in northern and south-eastern Madagascar, which later expanded to north-western and western Madagascar
- training 3,209 community technicians (47 per cent female) in yam propagation, cultivation, harvesting and wild population surveying.

Our latest project is looking at sustainable yam markets to support conservation and food security in Madagascar. This aim will be achieved by providing business models at multiple scales, sustainable value chains, markets for processed tubers, and nutritional information to guide policy in the form of annexes to the national strategy. The aim is that increased income from yam cultivation will underpin long-term, sustainable conservation gains without further international funding. This also contributes to Target 9.



Target 12 continued:

CASE STUDY 2

Authentication of plants entering trade and used in crime

Overall, the research undertaken by Kew on the authentication of plant and fungal extracts entering trade has increased supplier and producer awareness of issues associated with the quality of materials. Our results have provided information on the ways products can be compromised by adulterants and substitutes. In undertaking this research, Kew has investigated the chemistry and biological activity of around 24,000 species. These projects utilise our taxonomically curated collections as well as the expertise of our scientific staff in systematics, chemistry, anatomy and taxonomy in the development of analytical methods.





Target 13: Indigenous and local knowledge innovations and practices associated with plant resources maintained or increased, as appropriate, to support customary use, sustainable livelihoods, local food security and health care

This target recognises the need for the relationship between plant diversity and local and indigenous knowledge to be strengthened. It is an ambitious cross-cutting target, and implementation needs to be reflected across the *Global Strategy for Plant Conservation*.

CASE STUDY 1

Brazilian Amazon

Kew worked with Hutukara, the Yanomami indigenous association in the northern Brazilian Amazon, to publish a book on their traditional medicines, in their language, for the first time. The primary aim of the publication was to provide a resource for the community itself, with the project helping to increase intergenerational dialogue and improve communication between genders on the uses of plants, as this was traditionally 'female knowledge'. This publication will also help protect this knowledge by documenting its source.

The data, including information on 101 species of plants, 6 fungi and 14 insects, were collected by indigenous researchers in the village of Watoriki. This publication builds on a legacy of research spanning two decades. Part of the success of this project can be attributed to the Yanomami association representing the group's needs and concerns about publishing this information for the first time. In addition, a Yanomami community leader saw it as an opportunity to capture disappearing knowledge for the future while strengthening the capacity for autonomous research among communities. Kew's role was to support the project by developing a methodology, helping with data collection, and supporting the design and publication of the book.





Target 13 **continued:**

CASE STUDY 2

Papua New Guinea

On the island of New Britain, to the east of Papua New Guinea, Kew is working with indigenous communities to research and document plants used as medicine. Research has focused on the clinical effectiveness of plants traditionally used to treat tropical ulcers. This is a common bacterial skin infection in this part of the world, as people walk barefoot, and children are particularly vulnerable. Although it starts as a minor scratch that could be treated simply with antibacterial cream, such remedies are not available in these isolated villages, so work has been underway to look at the antibacterial qualities of plants used locally to treat ulcers. Clinical trials will be carried out to ascertain whether populations of people who have lived in the rainforest for 30,000 years may have successfully unlocked the medicinal properties of these plants through years of trial and error. The end goal is to find a clinically effective, readily available, antibacterial plant sap that can reduce the likelihood of infected scratches developing into tropical ulcers.





GSPC Objective IV: Education and awareness about plant diversity, its role in sustainable livelihoods and importance to all life on Earth is promoted



Target 14: The importance of plant diversity and the need for its conservation incorporated into communication, education and public awareness programmes

With over 1.5 million people visiting Kew Gardens in London and 366,000 visiting Wakehurst every year, our gardens offer an ideal platform to reach a wide audience. Each year, the wonder and importance of plants are shared with over 15,000 members of the public during their visit to Kew through guided tours. In parallel, our Discovery Programme, aimed at people with additional needs including physical, sensory and mental health, includes British Sign Language tours, dementia-friendly health walks, tours for people with visual impairment and well-being sessions. Kew also communicates the importance of plant diversity online through its website and various social media platforms to reach different audiences. The @kewgardens Instagram account has 306,000 followers and the @kewgardens twitter account has over 125,000 followers.

CASE STUDY 1

Science Festival

Our annual, family-friendly Kew Science Festival provides visitors with an understanding of why plants and fungi matter. In 2019, over 24,000 people visited our gardens over the two science festival weekends and engaged with over 350 members of staff and volunteers through a range of talks, tours, interactive activities, games and shows. With the help of Kew's scientists, visitors had the opportunity to extract DNA from a strawberry, carry out a fungi quest, go on a virtual plant expedition, X-ray seeds, make a herbarium specimen and measure the height of a tree.





CASE STUDY 2

Grow Wild

Kew's national outreach programme is connecting people with wildflowers, fungi and each other throughout England, Scotland, Wales and Northern Ireland. Grow Wild was publicly voted the UK's Best Environment Project in 2016.

Through Grow Wild, Kew has:

- shared enough seeds for 2.2 million people to cover 1,000 football pitches with wildflowers
- shared enough fungi for 50,000 people to grow their own mushrooms
- inspired 3.2 million digital interactions and attracted 60,000 social media followers
- reached 30 per cent of the most deprived areas in the UK with 28 per cent of the seed kits and 48 per cent of community project grants.

CASE STUDY 3

Education and learning at Kew

Over 100,000 school pupils visit Kew each year, with more than 65,000 engaging in a teaching session linked to the National Curriculum, focusing on the importance of plants and the need to protect them. Kew also provides regular Continuing Professional Development training and teacher training, reaching over 4,000 teachers since 2010. Since 2016, Kew has featured in the London Curriculum for schools, providing opportunities for pupils to learn about the role of Kew in biodiversity and the importance of this issue on a global scale. It promotes Kew as a prime location for studying ecosystems, rainforests, field studies, microclimates and biodiversity.





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CASE STUDY 4

Higher education at Kew

Kew offers postgraduate training through our one-year MSc in Plant and Fungal Taxonomy, Diversity and Conservation, delivered in partnership with Queen Mary University of London. This course is helping to train the next generation of plant and fungal scientists and is addressing the UK skills shortage in taxonomy, systematics and fieldwork. Kew scientists also currently co-supervise over 60 PhD students, conduct four Continual Professional Development training courses in plant science for academic and professional audiences each year, welcome over 200 students from other universities for essential undergraduate training in plant science, and provide paid one-year and summer internships in plant and fungal science. Training in plant taxonomy and identification is also offered through Kew's three-year Diploma in Horticulture. Additionally, our scientists teach on several external postgraduate courses hosted at Kew to share their expertise and skills.





GSPC Objective V: The capacities and public engagement necessary to implement the Strategy have been developed

Target 15: The number of trained people working with appropriate facilities sufficient according to national needs, to achieve the targets of this Strategy

Kew is committed to sharing knowledge, skills and expertise with the next generation of plant and fungal scientists. The key strength of the Kew courses is the integration of taxonomic and identification skills with fieldwork, taught by specialists using Kew's plant collections.

Kew also provides a wide variety of equipment and knowledge to our partners, ranging from expertise in seed bank design to the provision of equipment for appropriate technological solutions for moisture measurement, seed drying and storage. We have jointly developed modified incubator–drier equipment with manufacturers to provide a low-cost drying facility. Such equipment supports seed banks in eight countries: Armenia, Dominican Republic, Georgia, Hawaii, Republic of Ireland, Portugal, Spain and Tanzania, with additional partners purchasing the equipment directly.







Target 15 continued:

CASE STUDY 1

UK and Overseas Training

Our specialised departments have successfully shared Kew's expertise and knowledge with scientists around the world:

- The Applied Plant Taxonomy, Identification and Field Survey Skills course has trained 90 individuals from 50 institutions in these skills.
- The Tropical Plant Identification course has trained 108 individuals from 63 institutions in how to recognise the most commonly encountered plant families from the biodiversity-rich tropical regions of the world. The overseas courses in Singapore, Bogor, and Colombia trained 63 participants.
- The Wood Identification course has trained 135 people on how to identify wood using features of their cells and tissues visible only under the microscope.
- Since 2012, Malagasy Grass Identification courses have trained around 100 people.
- More than 150 scientists have been trained to apply IUCN Red List assessment criteria to evaluate extinction risk.
- Since 2015, our seed conservation training has been provided to 862 people from over 50 countries. This equates to 403 seed conservation training days.
- CITES scientific support or training has been provided in China, Georgia, Jordan, Madagascar, Turkey and Uganda.







Target 16: Institutions, networks and partnerships for plant conservation established or strengthened at national, regional and international levels to achieve the targets of this Strategy

Kew works with partners from over 100 countries, and collaboratively our work is helping to achieve the targets of the GSPC. One of these networks is the Millennium Seed Bank Partnership (MSBP), which is the largest *ex situ* plant conservation initiative globally and significantly contributes to Target 8. In the UK, there are excellent networking organisations and partnerships for plant conservation. A few examples of the many partnerships that Kew is involved in are highlighted below.

PlantNetwork is the network of botanic gardens, arboreta and other documented plant collections for Britain and Ireland. PlantNetwork promotes botanical collections across Britain and Ireland as a national resource for research, conservation and education. It also facilitates networking and training among holders of plant collections through a programme of conferences and workshops, a regular newsletter and a well-referenced website.

Kew is a member of Botanic Gardens Conservation International and the Global Partnership for Plant Conservation, working with other botanic gardens to develop future thinking for the *Global Strategy for Plant Conservation*. Kew is a founding member of the Red List Partnership, and Kew scientists are involved in several IUCN plant specialist groups. Kew provides input as a partner to the World Flora Online project and the International Barcode of Life project, both providing major inputs to the GSPC goal of understanding plant diversity.







Target 16 continued:

Kew supports the *Global Plan of Action for Plant Genetic Resources for Food and Agriculture*, which aims to safeguard collections of unique and valuable crop diversity held in gene banks around the world. Plant genetic resources are an essential component for food security through sustainable agriculture in the face of climate change. To aid the conservation and sustainable use of crop diversity, we have been consulted on the review of many gene banks around the world.

Kew's UK National Tree Seed Project launched in 2013 with the aim to collect and bank seed from the UK's tree and shrub species – securing the genetic diversity of this important group of plants. Training over 200 seed collectors, the project has built up a collecting network of over 420 individuals and associated volunteer groups. A restoration training programme is being jointly implemented by Kew and the National Trust staff as part of the Trust's Land, Outdoors and Nature programme. Seed-collecting training courses have also been delivered as part of our work with the MSBP. We led the development of a *UK Forest Genetic Resources Strategy*, establishing a framework to understand, protect and use of the genetic diversity of the UK's trees. This work has since been published in Defra's *Tree Health Resilience Strategy*.



The Global Strategy for Plant Conservation and the Post-2020 Biodiversity Framework

Plant and fungal research and conservation are fundamental to helping address the major challenges facing humanity, such as biodiversity loss, climate change and land cover change. The case studies in this booklet reveal a snapshot of the contributions of Kew and its partnerships to global plant and fungal conservation, sustainable use and livelihoods. The Global Strategy for Plant Conservation (GSPC) has brought together a global community dedicated to the conservation and sustainable use of plant diversity. The 16 targets are providing a focus for international action, and significant progress has been made.

The year 2020 will bring transformative change to the international policy arena. It will mark the end of an important phase of global biodiversity targets delivered under the *Convention on Biological Diversity's Strategic Plan for Biodiversity 2011–2020*. These are the 20 Aichi Biodiversity Targets and the second phase of the 16 GSPC targets. A global framework for biodiversity post-2020 will succeed the work of the Aichi and GSPC targets to achieve the UN's 2030 Agenda on Sustainable Development and CBD's 2050 Vision for Biodiversity.

The global plant and fungal conservation community supports the Sustainable Development Agenda. The Global Partnership for Plant Conservation (GPPC) emphasises the need to ensure that plant conservation remains at the heart of the post-2020 strategy to continue international action, focus and accountability in this area. The GPPC proposes that the post-2020 framework incorporates plant-specific milestones and indicators. The global community has two decades of GSPC experience focusing and implementing plant conservation. This has promoted publicly available information on plants, their uses and conservation assessments. In addition to new partnerships, capacity building has facilitated work on species prioritisation, management plans, protected areas and sustainable plant trade. Progress in these partnerships and actions would likely not have been accomplished without the GSPC driving accountability and focus.

Scientific institutes and botanic gardens are vital global resources that can support and lead this renewed initiative. Their combined collections of many millions of living and preserved specimens with associated information on the uses of plants and fungi, along with their scientific and horticultural expertise and history of capacity building, puts them at the forefront of mainstreaming biodiversity. However, it will take a global movement, national commitments, cross-sectoral stakeholders and individuals to conserve plant and fungal diversity and successfully implement the environmental, social and economic Sustainable Development Agenda.

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