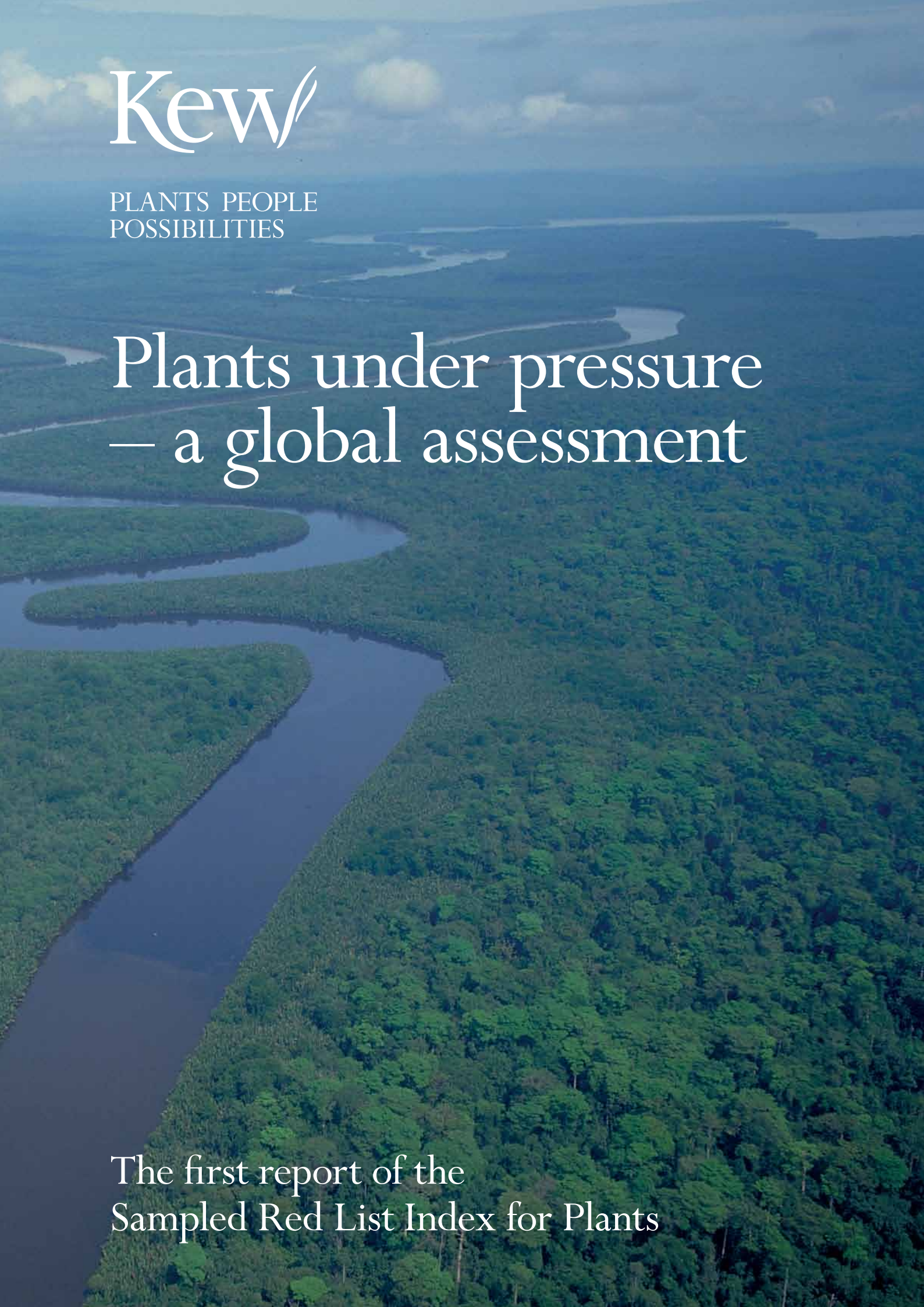


Kew

PLANTS PEOPLE
POSSIBILITIES

Plants under pressure — a global assessment

The first report of the
Sampled Red List Index for Plants

The Royal Botanic Gardens, Kew

The Royal Botanic Gardens, Kew, is the world's premier botanic garden and institute for the study of plant diversity, with unrivalled collections of living and preserved plant specimens, world-class research laboratories and a range of scientific and conservation projects globally. It is a non-departmental public body with exempt charitable status, and about half of Kew's running costs are provided by Defra (Department for Environment, Food and Rural Affairs). Over one million people visit Kew each year. The mission of the Royal Botanic Gardens, Kew is:

To inspire and deliver science-based plant conservation worldwide, enhancing the quality of life

The Natural History Museum

The Natural History Museum, London, is one of the world's great museums and the foremost resource for natural science, home to the largest and most important natural history collection in the world, with over 300 scientists studying 70 million specimens ranging from microscopic slides to mammoth skeletons, minerals and meteorites. It is a non-departmental public body with exempt charitable status and speaks as a voice of authority on the natural world. It is one of the top visitor attractions in the UK, with more than four million visitors a year. Its vision is:

To advance our knowledge of the natural world, inspiring better care of our planet

The International Union for Conservation of Nature

IUCN, the International Union for Conservation of Nature, is the world's oldest and largest global environmental network and home of the definitive international standard for species extinction risk – the IUCN Red List of Threatened Species. It is a democratic membership union with more than 1,000 government and NGO member organizations, and almost 11,000 volunteer scientists in more than 160 countries. IUCN's vision is for:

A just world that values and conserves nature

www.kew.org
www.nhm.ac.uk
www.iucn.org

2010 International Year of Biodiversity

How threatened are plants?

This simple question is still very difficult to answer, even though botanists have been exploring the Earth and studying the incredible diversity of plants for over 300 years.

Every year some 2,000 new plant species are described and the biodiversity of many parts of the world, especially in the remotest regions, remains poorly known. In a collaborative effort between world-renowned scientific institutions, the **Sampled Red List Index for Plants** project gives an accurate view for the first time of how plants are threatened across the world. It represents the first part of an ongoing project to monitor the status of the world's plants.

Key findings:

more than 20% of plants are threatened with extinction

the most threatened habitat is **tropical rain forest**

the greatest threat is **human-induced habitat loss**, mostly the conversion of natural habitats for agriculture or livestock use

gymnosperms (the plant group including conifers and cycads) are the most endangered group

33% of plants are so poorly known that we still don't know if they are endangered or not

Discover the state of plant life worldwide
www.kew.org/plants-at-risk

The Red List Index – responding to the 2010 biodiversity target

In 2002 the United Nations Convention on Biological Diversity (CBD) set a target of achieving *'a significant reduction in the current rate of loss of biodiversity, by 2010'*. Collectively, we have failed to meet that target and the loss of our natural world continues.
From the 2010 baseline presented here, plants will continue to be monitored as part of the overall Red List Index of global biodiversity.

A Barometer of Life

The Red List Index is our 'Barometer of Life': it captures the status of life on earth at a particular time. It can also tell us how this changes over time – whether things are improving or getting worse. The Red List Index measures the extinction risk of biodiversity. As pressures on plants continue to increase, so the needle moves on the Barometer of Life. The Red List Index was adopted by the Convention on Biological Diversity in 2006 to measure progress towards the 2010 biodiversity target. The Sampled Red List Index is an extension of the Red List Index to include species from less well known groups of organisms.

Why are plants important?

Plants provide the foundation for most of the world's ecosystems and are vital for a number of key services:

Provisioning services

Food
Water
Timber
Medicine
Soil
Fibres

In some countries, 80% of the population depend on traditional medicine for primary health care, with plant-based remedies the most widely used.

Traditional Chinese medicine alone uses over 5,000 plant species and traditional medicines in India are based on 7,000 different species.

80% of calories consumed by people come from just 12 species of plants.

Cultural services

Recreation
Aesthetic
Spiritual

Plants play an important part in our wellbeing; try thinking of a world without them!

Regulating services

Climate
Water quality
Erosion control

Plants absorb 20% of fossil fuel emissions.

Forests can be more valuable for their role in regulating water supplies than they are for timber.

Who carried out the assessments?

The monocotyledons and legume groups were assessed by the Royal Botanic Gardens, Kew and the pteridophytes were assessed by The Natural History Museum. For each of these groups 1,500 species were selected at random and each assessed against the IUCN categories and criteria. As there are fewer than 1,500 gymnosperms all species were included, using the existing assessments of the IUCN Conifer and the IUCN Cycad Specialist Groups together with new assessments for the remaining species (Gnetales). We only have preliminary results so far for the sample of 1,500 bryophytes, with a large contribution from the Missouri Botanical Garden. This group is the next to be assessed.

Five major groups

5 major groups of plants have been included in the Sampled Red List Index for Plants:

bryophytes (mosses and liverworts)

pteridophytes (ferns and allied species)

gymnosperms (conifers, cycads and related species)

monocotyledons (includes orchids, bulbs, palm trees and the grass family)

legumes (the family of peas and beans)





How does an index of threatened species work?

The Red List is the world's most authoritative and comprehensive catalogue of threatened species. Any species can be assessed, and the Red List also contains many species not currently threatened.

It provides a rigorous set of criteria to assess the conservation status of a species to see if it is threatened with extinction. Based on these criteria, each species is assigned a category ranging from Critically Endangered (very close to extinction) to Least Concern (under no or very little risk of extinction), or Data Deficient (if there is not enough information to reliably assess the status).

The Problem:

Only about 3% (12,873) of the estimated 380,000 plant species are currently on the Red List, and the majority of those have been assessed because they were already thought to be threatened. This gives a skewed view of the overall conservation status of plants.

The Solution:

By assessing a randomly selected sample of all species we get a picture of the overall threat status for each major group (see left), without having to assess every species. A sample of 1,500 species per group gives a wide enough selection to be representative of all plants and lets us understand the overall picture.

Extinct (EX)

Extinct in the Wild (EW)

THREATENED

Critically Endangered (CR)

Endangered (EN)

Vulnerable (VU)

Near Threatened (NT)

Least Concern (LC)

Data Deficient (DD)

Threatened

EX EW CR EN VU NT LC DD

Why is it called sampled?

Plant groups are relatively poorly known compared to animal groups such as birds and mammals. This is because there are many more species of plants than there are birds and mammals, but there are more scientific experts for birds and mammals. Every species of bird, mammal, amphibian has been assessed, but for much larger groups, such as plants and insects, this would not be possible. Instead a representative sample of species has been selected, so for plants we are producing a Sampled Red List Index.

An analogy: a biodiversity stock market

Another way of thinking about the Sampled Red List Index is like a stock market. Imagine that each species of plant is a publicly-listed company and the conservation status of that plant is the company's share price: as the status of that species changes then so does its 'share price' in the biodiversity 'stock market', and this change, together with changes for thousands of other species, is reflected in the overall value of the Index. As the index goes down, more species move towards extinction.

Asplenium mossambicense
(Aspleniaceae) – pteridophyte

VULNERABLE

There are only two localities known for *A. mossambicense*, one in the Chirinda Forest in Zimbabwe, and one in the Gorongosa mountains of Mozambique. In both these areas the native forest is under pressure from a growing local population and there is no protection for the forest habitat in the Gorongosa mountains.

Welwitschia mirabilis
(Welwitschiaceae) – gymnosperm

NEAR THREATENED

Commonly found across the Namib Desert this spectacular and ancient species warrants concern due to the recent identification of a fungal pathogen that infests female cones and seeds. Evidence suggests seed viability may be reduced and a subsequent reduction in seedling recruitment could cause long-term problems for this species.

How do we know if a plant is threatened?

There are more than 380,000 species of plants known to science and many more yet to be discovered.

Some well-known species of plants have been intensively studied but many others, especially in tropical biodiversity hotspots, are only known from the scientific paper where the plant was first described and have never been studied since. Most plant species have no distribution map or population survey and most countries do not have an up-to-date list of their plant species.

From Darwin to Google: historical records and modern technology

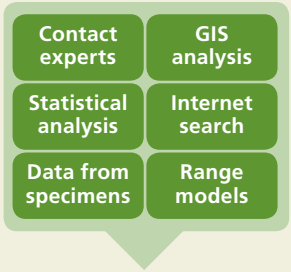
The most comprehensive, easily accessible and reliable information on which to base a conservation assessment for most plant species is the location and range of that species. The best source of this information is the collection of plant specimens held in the world's herbaria. A herbarium is a scientific collection of dried, preserved plant specimens that provide verifiable records of the existence of a species at a given time and place. Automated tools for using specimen records to carry out conservation assessments have been developed.

The herbarium collections at the Royal Botanic Gardens, Kew contain some 8 million plant and fungal specimens, and the Natural History Museum contains 6 million plant specimens collected by thousands of botanists (including Charles Darwin) over hundreds of years, from all over the world. Together with information about the species from botanical literature, from analysis using Geographical Information Systems (GIS), satellite images in Google Earth and the expert opinion of scientists who study that species or the area of the world where it is found, it is possible to assess a species' conservation status and assign a Red List category to most species of plants. All assessments carried out for this project are underpinned by accurate and reliable information on where and when a species has been collected.

Compare the level of threat facing different plant groups
www.kew.org/plant-groups-at-risk

Ephedra frustillata, collected by Darwin in 1833

Combined analysis



Wollemia nobilis
(Araucariaceae) – gymnosperm
CRITICALLY ENDANGERED

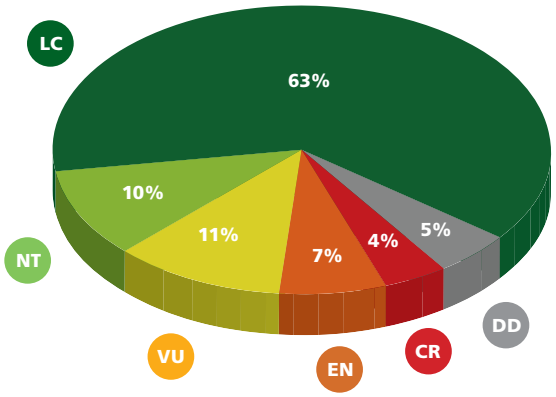
The Wollemi pine was discovered in 1994 in Wollemi National Park, Australia, where fewer than 50 mature individuals are known. Its long-term regeneration from seed is unknown but seems doubtful due to competition with other trees. The small size and limited range of *W. nobilis* means it is under intrinsic risk from any chance event that may occur, such as fire or the spread of disease.

Isoetes biafrana
(Isoetaceae) – pteridophyte
VULNERABLE

I. biafrana is only known from two lakes, one on Mount Oku in Cameroon and one on Bioko Island in the Gulf of Guinea; much of the montane forest in Cameroon has already been logged and the area converted to agriculture, and only a tiny remnant around Mount Oku remains.

Current status of plants

More than 20% of the world's plants are threatened with extinction.



threatened

22%

NT

Many more species (a further 10%) are classified as **Near Threatened**, which means they are not yet threatened but will become so without conservation actions.

DD

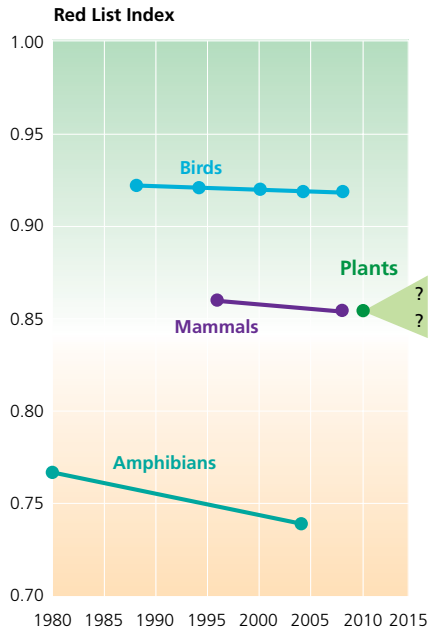
33% of species remain insufficiently known to be able to carry out a conservation assessment; of these, 5% have been classified as **Data Deficient** and the rest are awaiting further investigation.

Plants in comparison with other organisms

The Sampled Red List Index has a value scaled between 1 and 0, where a value of 1 would indicate that no species in the world were threatened, whereas a value of zero would indicate that every species in the world had gone extinct. The Sampled Red List Index value for plants is 0.86, which shows that:

- **Plants are more threatened than birds**
- **Plants are as threatened as mammals**
- **Plants are currently not as threatened as amphibians**

In the future, the sample of plants will be assessed again to see how the threat status of each species has changed. The next point on the graph could show that the situation is improving (the line goes up) or getting worse (the line goes down). The future of plants depends on the conservation actions taken in the next few years.



Galanthus nivalis
(Amaryllidaceae)– monocot

NEAR THREATENED

The common snowdrop was once widely distributed in the East Carpathian Mountains in Central and Eastern Europe. Although it is widely naturalised, including in the UK, during the last decade its native distribution has been considerably reduced due mainly to habitat loss through the increase in residential developments and recreational land-use.

Dalbergia andapensis
(Leguminosae – Papilionoideae)

CRITICALLY ENDANGERED

D. andapensis is a species of rosewood, a highly valued timber that is used in the production of fine furniture and musical instruments. It is estimated that 52,000 tonnes of rosewood and ebony were logged in north east Madagascar in 2009, and this habitat is itself under threat from conversion to agriculture for a growing rural population.

Hotspots of threatened plants

The map shows the degree of threat for plant species in each country: red countries have more plant species under greater threat of extinction, and green countries have fewer plant species that are threatened.

North America

Although most North American species are not threatened, residential development and intensification of agriculture has completely changed the ecological make-up of huge areas of the continent. Of the 400 million acres of historic prairie in the Great Plains, 99.99% in the eastern region have gone.

Brazil – Mata Atlântica

More than 90% of the original Atlantic rainforest has been deforested and converted to agriculture or urban areas. About 6,000 out of 20,000 vascular plants species from the Atlantic rainforest are found nowhere else on Earth.

Species less threatened

Species more threatened

How the map was generated:

The Red List category for each species in the sample was weighted according to the following scheme: Critically Endangered = 5 , Endangered = 4, Vulnerable = 3, Near Threatened = 2 and Least Concern = 1. The colours on the map represent the sum of these values divided by total number of species sampled per country, giving average species threat value per country.

Enough species have been assessed for this study to give an accurate picture about the level of threats to plants across the world; the results are more reliable for countries with more species.

Europe and Asia

Most European habitats underwent massive change in historical times; on a local scale, however, ongoing intensification of land-use and agriculture still threaten many species. Farmland made up 40% of EU land area in 2005 and production in the past 50 years has shifted rapidly to large-scale and heavily mechanised farming.

South East Asia

Conversion of natural forest to oil palm plantations in South East Asia is devastating native rainforest habitats and threatening many plant species. Almost 10% (14 million hectares) of the world's crop area is already in palm oil production, and Indonesia plans to increase its capacity from 6 million to 10 million hectares.

Madagascar

Madagascar is one the world's poorest countries, but it is one of the richest in terms of biodiversity. Habitats are under pressure from a growing population reliant on shifting agriculture and forest is being lost at the rate of 1500 km^2 per year. If this rate continues all primary vegetation will be lost by 2067.

Australia

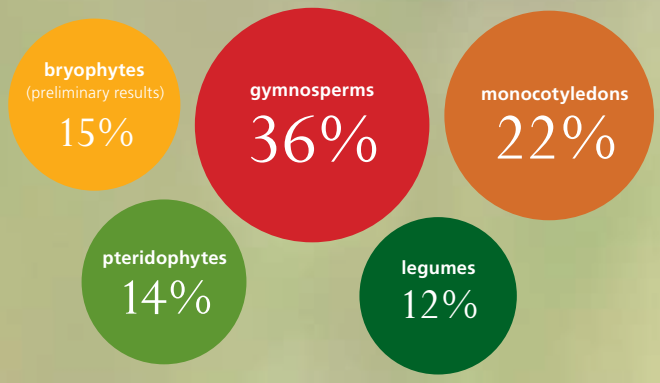
Entire ecosystems are collapsing due to an infestation of *Phytophthora cinnamomi*, originally found in Asia, a soil-borne fungal pathogen that causes roots to rot away. In the Kwongan heathlands of SW Australia more than 2,000 species are threatened by *Phytophthora*, land-clearance and increasing salinity.

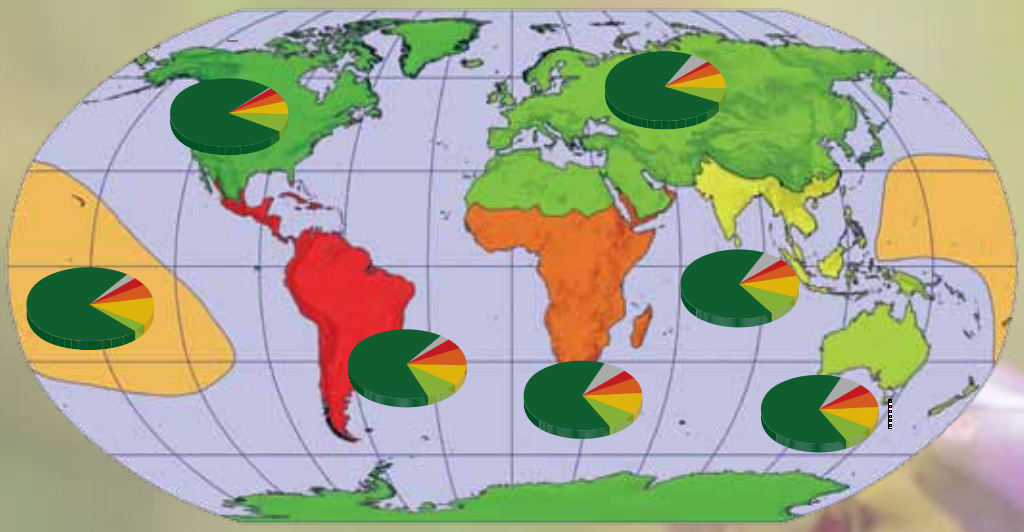
Use our interactive map to explore the state of the world's plant life

www.kew.org/plants-worldwide

Plants in focus

From the results of the Sampled Red List Index it is possible to say for the first time which plants are more threatened, where and why.





Find out which habitats are most endangered
www.kew.org/endangered-habitats

Dypsis brevicaulis
(Arecaceae) – monocot

CRITICALLY ENDANGERED

D. brevicaulis is a very rare palm only known from three sites in the extreme south east of Madagascar and fewer than 50 plants have ever been seen. The coastal forest where it is found is being deforested for fuel and shifting cultivation and there are also plans to mine for ilmenite (a source of titanium dioxide used for white pigment) in this area.

Agrostis trachychlaena
(Poaceae) – monocot

ENDANGERED

It is estimated that fewer than 250 mature individuals of *A. trachychlaena* exist in the wild, found in a very small area (less than 16 km²). It is not known why this species is so rare, although it is unlikely to be the result of human activity; erosion of the volcanic islands and subsequent loss of habitat could have played a part.

Most threatened species are found in the **tropics**, where the greatest diversity of plants exists, with **18-22%** threatened compared with **13%** in temperate regions.

The region of the world with the greatest threats affecting its plant diversity is tropical America, with **22%** of species threatened.

Most of the threatened species identified in this study are restricted to very small areas (smaller than the size of Wales) and are threatened by habitat destruction.

Oceanic islands have fewer species but these are often found nowhere else, and are more likely to be threatened, especially by the introduction of invasive species.

VU

Pteris montis-wilhelminae
(Pteridaceae) – pteridophyte

VULNERABLE

Found in grassland valleys in the highlands of New Guinea, the habitat of this species is threatened by the activities of the Grasberg Mine – the largest copper and gold mine in the world. Spoil from mining activities has a detrimental effect on the habitat quality in surrounding valleys and river systems, and the mountains near Mount Jaya have been heavily impacted.

LC

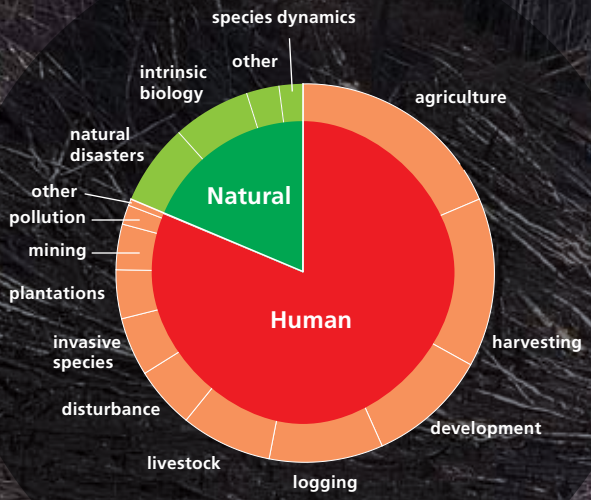
Vicia orobus
(Leguminosae – Papilionoideae)

LEAST CONCERN

Wood bitter-vetch is a rare species found through much of western Europe, including the British Isles, at woodland margins, field edges and rocky places, often on limestone. In Ireland it is considered to be threatened as a result of habitat loss, and is being protected by the National Botanic Gardens of Ireland through the Irish Threatened Plant Species Conservation Programme.

Pressures on plants – the drivers of threat

The results clearly show the impact of our own species on the fate of plant diversity.



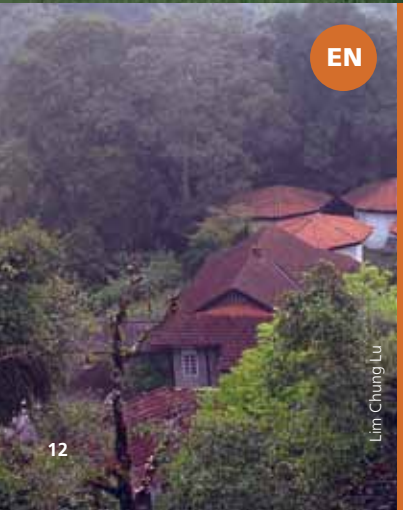
The impact of humanity far outweighs natural threats to plant species, accounting for 81% of threats.

The single greatest threat is conversion of natural habitats to agricultural use, directly impacting 33% of threatened species.

Plants are fundamental in providing ecosystem services – the benefits that people obtain from well-functioning ecosystems. Our own species, while protected against the environment by culture and technology, is still dependent on these ecosystem services. Increasing demand for these services will cause greater stress on the ecosystems that provide them. Pressures on biodiversity will grow in the twenty-first century, especially through population and economic growth, and the additional effects of climate change and pollution.

Discover the threats facing plants

www.kew.org/threats-facing-plants



Diplazium insigne
(Woodsiaceae) – pteridophyte

ENDANGERED

Highland forests of Peninsular Malaysia are threatened by habitat loss for plantations and urbanisation following Malaysia's rapid economic growth; *D. insigne* is only found in very few locations in the Taiping Hills and from Fraser's Hill, which although protected by local forestry officers, is a desirable resort for Malaysians.

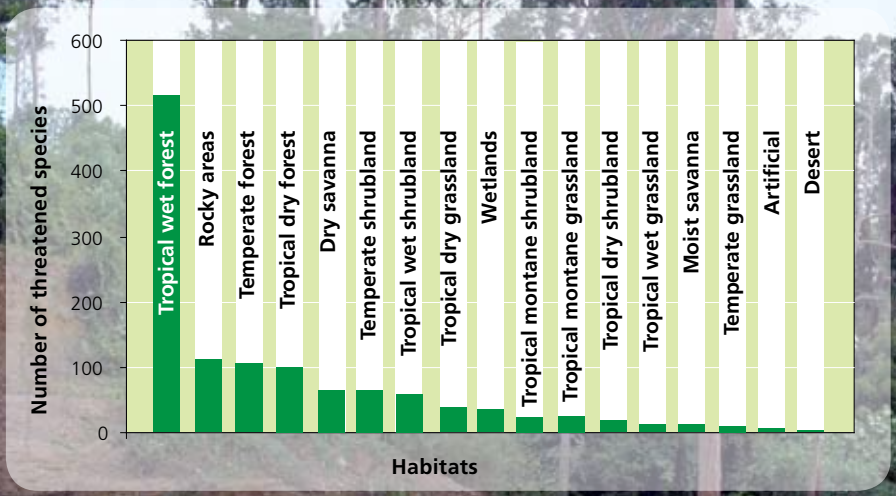
Astragalus sinuatus
(Leguminosae – Papilionoideae)

CRITICALLY ENDANGERED

Whited's Milkvetch is restricted to a tiny area in the state of Washington, USA. Its dry hillside habitat is threatened by invasive, non-native species, by grazing and by agriculture. Seeds have been collected and banked by the Berry Botanic Garden Seed Bank for Rare and Endangered Plants of the Pacific Northwest and the Miller Seed Vault, University of Washington Botanic Gardens.

Life depends on plants – safeguarding our future

Many vital systems and services will suffer if we continue to put pressure on the precious resource provided by plants.



The habitat with the greatest number of threatened species is tropical rainforest, where 63% of threatened species are found.

Areas least suitable for conversion to agriculture, such as wetlands and deserts, contain the smallest proportions of threatened species, with 4% and 0.5% of threatened species, respectively.

More than 20% of plants are already threatened, even without considering climate change.

Plants absorb almost 20% of fossil fuel emissions. This hidden ecosystem service will be greatly affected by impending land use change. Rapid, large-scale extinctions of plant species therefore have many knock-on effects on the status of other groups of species and to man. Clearing and burning of tropical forest also accounts for 20% of global carbon emissions, meaning that reducing biodiversity loss will also make a significant contribution to tackling climate change.

This would be a win-win situation for our own species and countless thousands of others.

Encephalartos altensteinii
(Zamiaceae) - gymnosperm

VULNERABLE

E. altensteinii is found in coastal regions of the Eastern Cape, South Africa, where the number of individuals has declined by more than 30% in the past 50 years. Large numbers have been removed from its native habitat, including 438 plants in one poaching incident in 1995, mainly by horticultural collectors or for medicinal use.

Caliphruria tenera
(Amaryllidaceae) – monocot

CRITICALLY ENDANGERED – POSSIBLY EXTINCT

Only known from two specimens collected in Colombia 150 years ago. Deforestation in the area has caused problems for *Caliphruria* species as they cannot adapt to increased light intensity. Recent surveys have failed to re-find *C. tenera*: there is a chance it still survives, but with every failed survey it moves closer to being labelled extinct.

What now?

This report marks the starting point for the Sampled Red List Index for Plants. It provides the baseline against which future changes can be tracked. And it shows clearly that urgent action is needed if we are to avoid losing 1 in 5 of our plant species.

Updating the Index

We have a snapshot of the current status of plant diversity but to show trends over time the species will need to be assessed again, and again, every five years. Targeted fieldwork is needed to update our information, especially for plants whose status is changing rapidly. Species which have undergone a change on the ground, becoming more (or less) threatened, can be distinguished from those whose category has changed simply because our knowledge and understanding of the threats affecting them is now better. Only genuine changes in status will drive the Index.

Given enough resources we can mobilise the international network of local botanists and botanic gardens to establish the Sampled Red List Index for Plants as a broad-based monitoring scheme. Major natural history collections and governments also have a big role to play as the Index relies heavily on digital collections data. Enhancing our website to allow uploading of photographs and population survey data will allow more input from scientific experts and citizen scientists. This input will be crucial for monitoring future trends in the status of plant diversity.

Taking action to reverse the trend

22% of plants are already under threat from human activities even before the impacts of climate change are taken into account. The urgency of the situation cannot be overstated. The Index provides a global picture of plant conservation status but most of the positive actions required to reverse the current rate of biodiversity loss must take place locally, nationally and regionally. We need to increase our efforts to help safeguard the future for the world's plants, and for ourselves.

A global response to the loss of biodiversity

The Royal Botanic Gardens, Kew and the Natural History Museum, London are already working with many individuals and partner organisations worldwide taking positive action to conserve and restore plant diversity.

- **Kew is home to the Millennium Seed Bank Partnership, the world's most ambitious plant conservation project that already stores seeds of 10% of all plant species and is aiming to meet a target of 25% by 2020.**
- **The NHM and the Instituto Nacional de Biodiversidad (INBio) are producing the first complete plant inventory for one of the world's top hotspots of plant diversity in Costa Rica.**
- **Kew is working with local people to restore habitats and develop sustainable livelihoods, ensuring a brighter future for the plants and the people who depend on them.**
- **Kew is celebrating a successful collaboration with Conservation International in the Itremo Massif Protected Area Project in Madagascar helping conserve its unique and highly threatened flora.**
- **The NHM is involving a wide cross-section of society in recording urban tree diversity across the UK.**
- **RSPB is helping to reduce the impact of invasive species in the South Atlantic Islands with support from Kew scientists.**
- **The NHM has recently opened the new Darwin Centre, allowing visitors unprecedented access to the behind-the-scenes activities of a biodiversity research institute.**
- **Kew is collaborating with Fauna and Flora International and the Cristalino Ecological Foundation in Brazil to help secure the 184,000 hectare Cristalino State Park and its surroundings – one of the highest priority conservation areas in the Brazilian Amazon.**
- **The NHM is home to the Angela Marmont Centre, a dedicated resource for public involvement with the biodiversity of the British Isles.**
- **Kew's Great Plant Hunt is an innovative resource that inspires primary school children to value plants.**

We need to redouble our efforts and recruit more people and resources to take action for plants before it is too late.

The world cannot afford to lose 1 in 5 of its plant species; we must all work together to conserve what we have.

PLANTS PEOPLE POSSIBILITIES

Project co-ordination: Neil Brummitt and Steven Bachman

SRLI team: Sara Albuquerque, Elina Aletrari, Kei Andrews, Guy Atchison, Elisabeth Baloch, Barbara Barlozzini, Alex Bell, Raffaele Boccardo, Alice Brunazzi, Julia Carretero, Marco Celesti, Helen Chadburn, Edoardo Cianfoni, Chris Cockel, Vanessa Coldwell, Benedetta Concetti, Sara Contu, Farida Danmeri, Anna Dennis, Aisling Devine, Philippa Dyson, Poppy Fraser, Lauren Gardiner, Nadia Ghanim, Hannah Greene, Alice Groom, Ruth Harker, Della Hopkins, Suzanne Jenkins, Helen Lockwood, Christine Loftus, Debora Lombrici, Lucia Lopez, Patricia Malcolm-Tompkins, Cliodhna McCartney, Kirsty McGregor, Laura Moreno, Keara Nazar, Mireya Quiton, Florence Romand-Monnier, Rosalind Salter, Will Saunders, Robert Segrott, Hannah Thacker, Leighton Thomas, Sarah Tingvoll, Barbara Turpin, Gemma Watkinson and Katerina Wojtaszekova.

Project direction and supervision: Eimear Nic Lughadha, Justin Moat

Line-management: Alan Paton and David Mabberley

Special thanks to the following colleagues without whom this project would not have been so successful:
Jonathan Baillie, Monika Bohm and Ben Collen (ZSL), Craig Hilton Taylor (IUCN), Aljos Farjon (IUCN Conifer Specialist Group), John Donaldson (IUCN Cycad Specialist Group), Mark Hughes and Stuart Lindsay (Royal Botanic Garden, Edinburgh), Bob Magill (Missouri Botanical Garden), Tom Meagher (University of St. Andrews), and to the many experts at Kew, NHM and around the world who contributed their taxonomic or regional expertise to the assessments.

The Sampled Red List Index for Plants project was designed and undertaken as a contribution to work of: The Convention on Biological Diversity (CBD) and its Global Strategy for Plant Conservation; the Global Partnership for Plant Conservation; the Consortium of Scientific Partners to the CBD; the IUCN and its Red List; and the 2010 Biodiversity Indicators Partnership.

Design: Jeff Eden for Design and Photography, RBG, Kew.

Images: RBG, Kew unless specified.

Funded by:

defra Department for Environment Food and Rural Affairs

Charles Wolfson Charitable Trust

Esmée Fairbairn Foundation

RioTinto

World Collections Programme

Royal Botanic Gardens, Kew
Richmond
Surrey
TW9 3AB
United Kingdom
www.kew.org