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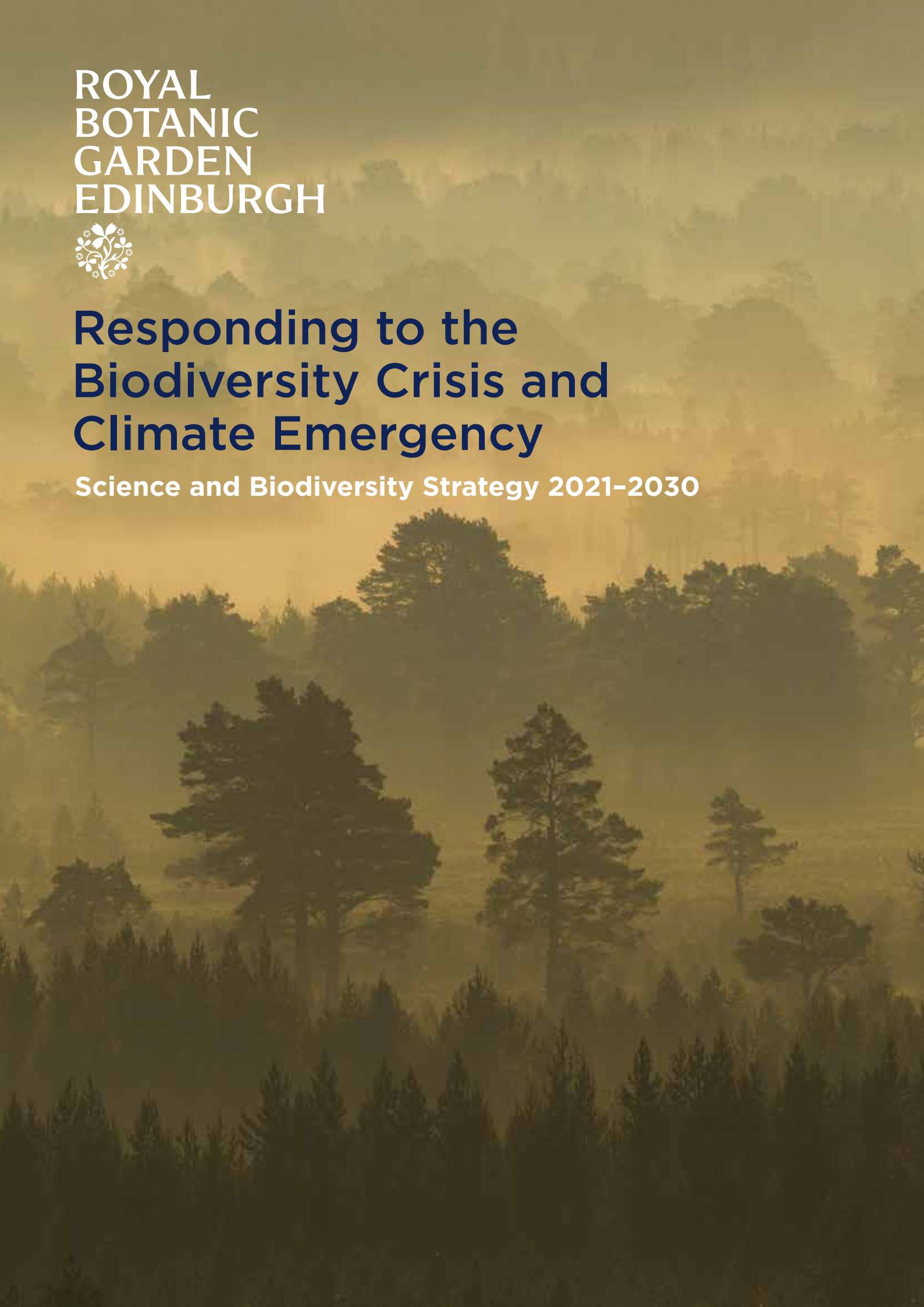
# Responding to the Biodiversity Crisis and Climate Emergency

## Science and Biodiversity Strategy 2021–2030



“Biodiversity is the totality of all inherited variation in the life forms of Earth, of which we are one species. We study and save it to our great benefit. We ignore and degrade it to our great peril.

**E. O. Wilson**

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Our mission is to explore, conserve and explain the world of plants

# Contents







Cover image: Pine forest, Rothiemurchus Forest, Cairngorms

# Executive Summary

**The Science and Biodiversity Strategy of the Royal Botanic Garden Edinburgh is a direct response to the Biodiversity Crisis and the Climate Emergency. It reflects the urgent need for widespread action to:**

- Secure a nature-rich future in the face of global environmental change
- Develop nature-based solutions to climate change
- Support the sustainable utilisation of the planet's natural resources

**The Strategy is based around the three key pillars that underpin RBGE's overall mission to explore, conserve and explain the world of plants and to build a positive future for plants, people and the planet.**

Above: *Dracaena cinnabari* (dragon's blood tree) is endemic to Soqotra, Yemen, and threatened with extinction

## Pillar 1: Research – Unlocking Knowledge and Understanding of Plants and Fungi for the Benefit of Society

### Theme 1: Discovery Science: Understanding plant and fungal diversity

**KEY PRIORITIES**

- Accelerating biodiversity discovery, characterisation and mapping, to support conservation planning and land-use choices
- Technological innovation including large-scale use of genomic data for biodiversity characterisation and monitoring, and development of data-portals and workflows to support large-scale analyses of biodiversity data and trends

### Theme 2: Global Environmental Change: Understanding biodiversity and ecosystem change

**KEY PRIORITIES**

- Understanding, quantifying and predicting drivers of change leading to biodiversity loss, at scales ranging from individual species to major biomes
- Developing and implementing rapid threat assessments to prioritise conservation actions and interventions to minimise biodiversity loss and extinction

### Theme 3: Conservation and Sustainability: Delivering science to enable the conservation and sustainable use of biodiversity

**KEY PRIORITIES**

- Developing integrated strategies to support the conservation and sustainable utilisation of natural capital and the maintenance of ecosystem services
- Developing and implementing restoration plans that lead to net gains for biodiversity and/or nature-based solutions to climate change

## OUTCOME

**Scientific knowledge and solutions to address the biodiversity crisis and the climate emergency, and to support sustainable development and green recovery**

## Pillar 2: Collections – Conserving and Developing Botanical Collections as a Global Resource

### **Collections Custodians:** Curating and enriching the botanical collections held at RBGE, and supporting the wider global network of botanical collections

**KEY PRIORITIES**

- Increasing the number and diversity of threatened plant species in *ex situ* conservation collections to protect against extinction
- Collections digitisation to enable global access to collections and data, to support scientific and cultural research, and to underpin conservation planning
- Curating and protecting the collections held at RBGE, and enhancing the environmental sustainability of our collections management practices

### OUTCOME

**Botanical collections safeguarded, enriched and widely used as conservation, scientific and cultural heritage resources**

## Pillar 3: People – Enriching and Empowering Individuals and Communities through Learning and Engagement with Plants and Fungi

### **Knowledge and skills sharing:** Growing global capacity in biodiversity science, conservation and horticulture

**KEY PRIORITIES**

- Establishing a Biodiversity Skills Centre, mobilising and democratising knowledge to address national and international training needs in biodiversity science, horticulture, practical conservation and sustainability
- Targeted programmes translating research into practice, working with scientists, communities and governments in Scotland and around the world to understand, conserve, restore and sustainably use biodiversity

### OUTCOME

**Increased inclusivity, and enhanced livelihoods, skills and wellbeing of communities in Scotland and around the world**

# The World in 2021

## Major Global Environmental Challenges

### The Biodiversity Crisis

40% of plant species are threatened with extinction, with a >100-fold increase in extinction rates leading to unprecedented losses of biodiversity, disruption of ecosystem processes, and direct impacts on human livelihoods, health and wellbeing.

### The Climate Emergency

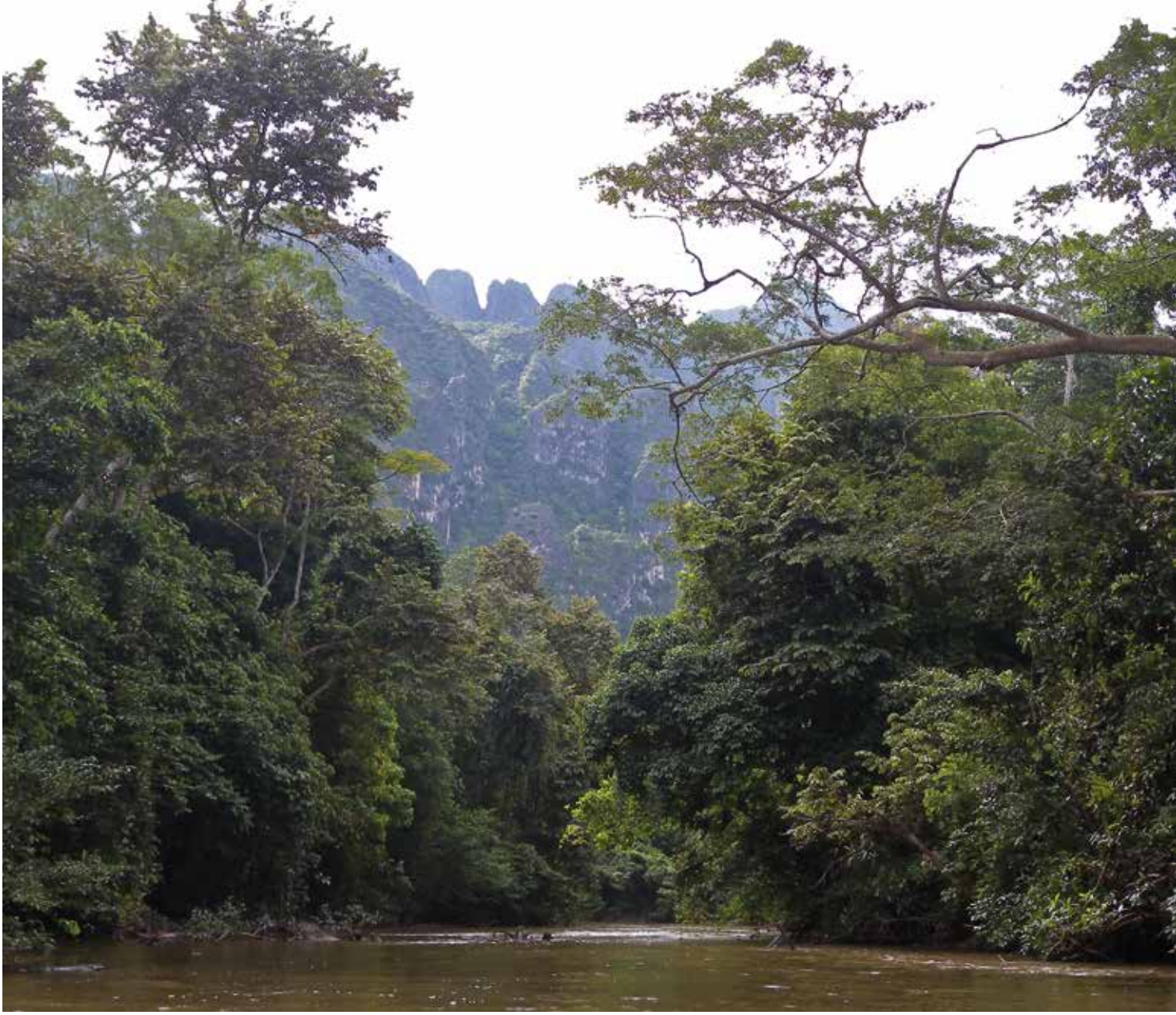
Burning of fossil fuels, deforestation, intensive land use and other human pressures leading to unprecedented changes to the global climate, with major impacts projected on food and water security, health, livelihoods, infrastructure and the environment.

### Sustainable Development

Biodiversity loss and climate change are inextricably linked to human wellbeing. Major changes in patterns of consumption, land use and sustainable use of natural resources are needed to meet the United Nations' Sustainable Development Goals by 2030. The COVID 19 pandemic highlighted the interrelationship between environmental health and human health, and the massive humanitarian, social and economic costs of wider environmental degradation.

### Our Role

- To provide authoritative and accessible scientific evidence informing decision-making to reduce biodiversity loss, to mitigate and adapt to the impacts of climate change, to support the sustainable use of plant biodiversity, and to promote planetary health and a green recovery.
- To be custodians of globally important botanical collections held at RBGE, and to support the wider development of international botanical collections to underpin research and conservation, and protect species from extinction.
- To deliver training to develop skills and grow capacity in plant biodiversity science, conservation, and horticulture both nationally and globally.



## Key National and International Policies

**Our work is guided by key national and international policy frameworks including:**

- **To take urgent action across society to put biodiversity on a path to recovery for the benefit of planet and people**
  United Nations' Convention on Biological Diversity, 2030 Mission

- **Preventing, halting and reversing the degradation of ecosystems worldwide**
  United Nations' Decade on Ecosystem Restoration

- **A better and more sustainable future for all**
  United Nations' Sustainable Development Goals

- **One Earth. One home. One shared future**
  Scottish Government's Environment Strategy for Scotland

# Science and Biodiversity Strategy 2021–2030

# Research

## Unlocking Knowledge and Understanding of Plants and Fungi for the Benefit of Society

### OUTCOME

**Scientific knowledge and solutions to address the biodiversity crisis and the climate emergency, and to support sustainable development and green recovery**

# Research Theme 1: Discovery Science

## Understanding Plant and Fungal Diversity

Understanding the diversity of life on earth is critical to biodiversity conservation, utilisation and a healthy planet, yet major knowledge gaps remain. Many species await formal discovery and description, and even for well-known species there are significant gaps in our understanding of their biology, ecology and distributions.

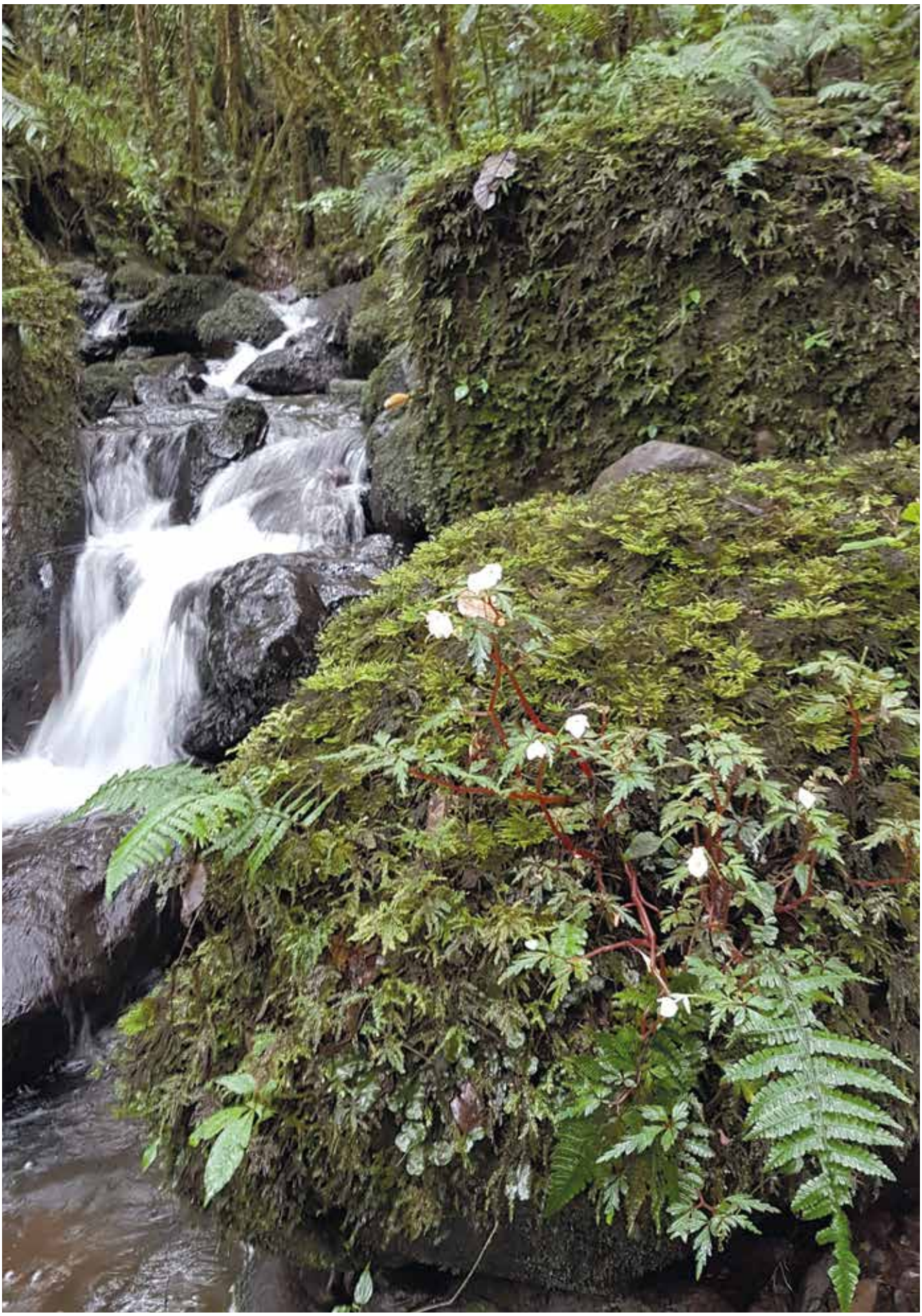
## Species characterisation

**Accelerating species description and mapping to enhance baseline knowledge of the world's plant and fungal diversity**

### Our foci

- Socio-economically important species groups where biodiversity characterisation supports sustainable utilisation and conservation planning
- Highly diverse but poorly known groups of tropical herbaceous plants where many species are undocumented and face imminent threat of extinction
- Assemblages of globally rare oceanic bryophytes and lichens, a key component of Scotland's biodiversity
- National- and regional-scale biodiversity characterisation where species diversity and threats are high, but where major knowledge gaps impede conservation and sustainability planning

**Species description is a race against time. Up to 20% of plants (100,000 species) have yet to be scientifically described, and 40% are estimated to be under threat of extinction. Our discovery science focuses on species-rich and economically important groups in biodiverse, understudied and threatened parts of the world, providing vital evidence to prioritise conservation action. One of these is *Begonia*, a genus of over 2,000 poorly understood herbaceous species of tropical forests. Many *Begonia* species are at high risk of extinction. We are working to understand and protect the diversity in this important 'model' plant group, with perhaps as many as 500 species awaiting description in the forests of New Guinea and Borneo alone.**



Above: *Begonia maguniana*, described in 2019, New Guinea

At the centre of the Himalaya, Nepal's remarkable plant diversity is under increasing threat from the effects of climate change and habitat degradation. Generations have relied on Nepal's natural plant resources for medicine, food, fire and shelter, but as species and ecosystems are threatened, so too are livelihoods. With our Nepali partners, we are working to fill the gaps in base-line floristic knowledge needed for effective conservation and sustainable use of natural resources. We will apply this research locally, sharing knowledge and building understanding amongst communities, to improve management of Nepal's forests and fields for the benefit of plants and people.

# Biome characterisation

**Large-scale characterisation of the composition, function and distribution of major biomes to enhance understanding of key ecosystems that support biodiversity, drive the global carbon cycle, regulate climate and benefit humanity**

## Our foci

- Characterising the species and functional trait composition of major biomes and combining field and herbarium records with spatial modelling to develop data-driven authoritative understanding of their distributions
- Developing field, experimental and model-based analyses of species traits and ecosystem composition to enhance understanding of links among biodiversity, ecosystem function and ecosystem resilience
- Understanding and quantifying processes of ecosystem assembly to develop a predictive understanding of ecosystem and biodiversity change in relation to human actions and climate change

Above: Marañón Valley, Peru

**South America is the most species-rich continent in the world, with multiple extraordinarily diverse hotspots, many threatened by climate change and deforestation. We are working to build understanding of the distributions and limits of South America's biomes and how they are responding to global changes in land use and climate. Our work will generate data and maps to support protection of these ecosystems and the many rare and threatened species that inhabit them.**

# Biodiversity genomics

**Harnessing innovations in DNA sequencing technologies to characterise genome sequence variation in wild plant and fungal species, unlocking knowledge on their nature, properties and function**

## Our foci

- Developing protocols and implementing workflows to generate and analyse genome sequence data from diverse sample sets
- Utilising genomic data to understand the nature of plant species boundaries and the genomic basis of plant adaptations

**The millions of specimens held in the world's herbaria each contain a wealth of largely unexplored information – in their DNA. Our expanding research in the field of herbarium genomics aims to unlock this potential, combining methods of working with ancient DNA with new sequencing technologies to develop protocols for routine recovery of DNA sequence data from herbarium specimens. This will maximise the utility of global preserved plant collections, expanding their application across a wealth of disciplines including environmental change, plant-pathogen interactions, and microbiomics, and generate insights into plant genomic diversity and evolution.**

# Biodiversity bioinformatics

**Developing enhanced methods and workflows for data management and sharing, to enable large-scale mobilisation and analyses of biodiversity data and trends**

## Our foci

- Developing and enhancing the World Flora Online portal as a global hub for plant biodiversity data
- Developing and managing informatics systems and pipelines to support data management, analyses and data serving to external aggregators
- Collaborating with partner universities, botanic gardens, and natural history institutes to create informatics solutions to support plant biodiversity and collections data infrastructure

Above: *Araucaria araucana* forest, Chilé

**The World Flora Online (WFO) is a critical tool in our mission to halt plant extinction. This online portal enables open access to high-quality floristic information on the world's plants to underpin conservation planning, and a stable consensus classification for science and conservation. Backed by all Parties of the Convention on Biological Diversity, and supported by 43 partner organisations, the WFO is putting authoritative data into the hands of the people that need it. We will manage and lead the taxonomic networks developing the consensus classification, upload new floristic data through our regional teams and provide leadership on the WFO Council.**

# Research Theme 2: Global Environmental Change

## Understanding Biodiversity and Ecosystem Change

Human pressures on the natural environment are leading to unprecedented global impacts including loss of biodiversity, extinction, environmental degradation and climate change. Key contributing factors include deforestation, urbanisation, land-use change, invasive species, pests and pathogens, unsustainable use of natural resources, and wildlife crime. In light of these pressures, sustainable management of the world's natural resources requires an understanding of how biodiversity is responding to global environmental change.

## Threat assessment

**Developing and deploying rapid threat assessments to prioritise conservation actions to minimise biodiversity loss and extinction**

### Our foci

- Coordinating global species-level threat assessments for economically and ecologically important plant groups such as conifers and rhododendrons
- Combining distributional data, earth observation and spatio-temporal analyses to deliver large-scale conservation assessments for threatened species and habitats

**The Middle East contains an amazing diversity of culture, landscapes and plants, but huge gaps exist in our knowledge of the region's biodiversity and the threats it faces. Working with local partners, our Centre for Middle Eastern Plants has completed IUCN Red list assessments for all endemic plants as well as all trees of the Arabian Peninsula. We are now developing a training course with the IUCN Species Survival Commission to further co-create regional capacity for plant Red Listing in West Asia and Arabia, which will guide local conservation programmes.**

Above: *Dracaena serrulata* (Endangered)

# Ecosystem change

**Understanding macro-scale drivers of environmental change to predict and quantify threats to biodiversity and society**

## Our foci

- Linking knowledge of ecosystem assembly, function, and climate change projections to predict biome-level responses to environmental change, and associated impacts on ecosystem services and sustainable use of ecosystems
- Quantifying, monitoring and predicting large-scale land-use change to inform biodiversity threat assessments, and to provide baseline data to underpin land-use decisions to support biodiversity and livelihoods

Above: Savanna-forest margin, Mwekera, Zambia

Savannas – a globally important biome supporting a fifth of the World's population – are threatened by rapid and accelerating tree encroachment linked to rising atmospheric carbon dioxide and inappropriate land management, causing losses of biodiversity and ecosystem function. Although the patterns of this change are well characterised, there is little understanding of how biodiversity and ecosystem function respond to, and reinforce, such transformation. In a rapidly changing world, we will build the new knowledge urgently necessary to guide policy and management interventions promoting diverse and resilient savanna ecosystems for both people and nature.

# Biomonitoring technologies

**Developing effective biomonitoring technologies to enable high-throughput and high-resolution assessments to monitor biodiversity change and address losses**

## Our foci

- Development and application of protocols and reference libraries to support DNA-based species identification and monitoring of biodiversity
- Development and application of chemical assays for identification of species threatened by wildlife trade

Telling species apart is difficult. This simple statement underlies a major challenge in understanding the distribution of biodiversity, monitoring biodiversity change and understanding species interactions. It also impacts on many practical tasks such as product authentication to identify species in food, medicine and other consumer goods, and timber identification to support wildlife crime enforcement. To address the challenge of telling species apart, RBGE has played a major role in an international collaboration to develop standardised DNA barcoding identification systems for plants, from liverworts to tropical trees. Our future work aims to accelerate the construction of DNA barcode reference libraries to support biodiversity discovery, identification and biomonitoring, and develop higher resolution plant DNA barcodes capitalising on the increasing availability of genome sequence data.

# Plant health and biosecurity

**Understanding and predicting plant health threats from emerging pests and diseases to inform threat assessments and biosecurity planning**

## Our foci

- Synthesising evidence and transferring knowledge via Scotland's Plant Health Centre, providing advice and guidance on key pest and disease threats to the natural environment and horticultural sectors in Scotland
- Elucidating the ecological and evolutionary processes determining plant-pathogen dynamics to enhance predictive understanding of their likely impacts on the natural environment

Above: Testing *Phytophthora* resistance in the popular ornamental *Chamaecyparis lawsoniana*

**Introduced and emerging pests and pathogens are a major threat to biodiversity worldwide, and present a particular challenge to *ex situ* conservation activities. RBGE's Plant Health programme will refine conservation and management practices through evidence informed by epidemiology and invasion biology. This will help our natural environment, horticultural, agricultural and forestry sectors to resist as yet unknown future threats, and reduce the risk that pests already present in Scotland become more problematic.**

# Research Theme 3: Conservation and Sustainability

## Delivering Science to Enable the Conservation and Sustainable Use of Biodiversity

Current rates of biodiversity loss are >100-fold above baseline extinction rates. Without rapid and transformative societal change, global warming is projected to exceed 2°C within a few decades, with major disruptions to food and water security, health, livelihoods and the environment. Halting biodiversity loss, and climate change mitigation and adaptation, require urgent, effective, evidenced-based interventions.

## Species and habitat restoration

**Developing and implementing restoration and recovery plans that lead to net gains for biodiversity and/or nature-based solutions to climate change**

### Our foci

- Restoration and recovery of threatened plant species, establishing viable *in situ* populations to reverse declines and avoid extinction
- Supporting the design and effective implementation of large-scale ecosystem restoration programmes aimed at enhancing biodiversity, and climate change adaptation and mitigation

**Temperate rainforest is home to an extraordinary abundance and diversity of epiphytic mosses, liverworts, and lichens. Scotland is home to the best remaining examples of temperate rainforest in Europe – although even these are fragmented and threatened. We are working to demonstrate how these forests can be managed and restored. Through spatial planning and on-the-ground action, we aim to develop approaches to maximise microhabitat diversity and provide microrefugia for rainforest specialists under changing climate conditions.**

# Urban biodiversity

**Developing protocols and implementation plans to enhance biodiversity in urban areas and the built environment**

## Our foci

- Partnership development of city-scape conservation programmes designed to increase biodiversity and promote human health and wellbeing
- Horticultural research to develop protocols and solutions for climate change adaptation and mitigation, including raingardens, green walls and green roofs
- Development of partnerships with industry to upscale urban greening to enhance health, wellbeing and biodiversity, and to deliver nature-based solutions to climate change

Above: Dawyck's green roof

**Urban blue and green infrastructure provide increasingly essential resilience to climate change and weather extremes, such as flooding. Our expanding work in this area focuses on the biodiversity of urban water bodies, green roofs, raingardens and other adaptation options that enhance biodiversity and provide human benefits. This work aims to provide best practice exemplars for Adaptation Scotland and the global resilience platform, WeAdapt.**

# Sustainable development and utilisation of biodiversity

**Developing integrated plans and strategies to support the conservation and sustainable utilisation of natural resources and the maintenance of ecosystem services**

## Our foci

- Optimising land-use decisions and trade-offs to balance livelihoods and human needs with biodiversity conservation and climate change mitigation
- Assessing the status of wild plant species in trade, and enhancing management strategies to promote sustainable use
- Exploring the potential for new uses of plants for food, medicine, and other societal benefits

**Left: Rubber plantations on hills in southwest China**

**Driven by the automobile industry, global demand for rubber has rocketed. Natural rubber from the tree *Hevea brasiliensis* is an important constituent of vehicle tyres, and its production arguably produces fewer carbon emissions than that of synthetic rubber, making planting rubber trees seem like a win-win strategy. However, vast single-species rubber plantations often replace natural forests, and cause erosion, carbon emissions, and water pollution. In addition, the rubber price is very volatile: price fluctuations expose the relatively small-scale farmers responsible for most plantations to high levels of risk. We are working to make rubber production more sustainable, by collaborating with local partners to identify areas where rubber farming is most risky – environmentally and economically – and to underpin certification efforts for genuinely sustainable 'green rubber.'**

# Collections

## Conserving and Developing Botanical Collections as a Global Resource

**OUTCOME**

**Botanical collections safeguarded, enriched and widely used as conservation, scientific and cultural heritage resources**

# Collections Custodians

## Curating and Enriching the Botanical Collections Held at RBGE, and Supporting the Wider Global Network of Botanical Collections

Natural history collections represent a globally important resource for research and conservation. Collections held at RBGE include a world-class herbarium of three million preserved plant specimens, a globally important living plant collection of 13,598 species, and an extensive botanical library and archive. These collections have been acquired over centuries, and there is a pressing need to acknowledge their often exploitative historic origins and ensure they are now accessible for use in an equitable fashion to support societal needs. A concurrent, wider challenge exists in supporting the development of botanical collections internationally, particularly in the world's most biodiverse countries.

## Enhancing the conservation value of living collections

**Increasing the number and diversity of threatened plant species in *ex situ* conservation collections to protect against extinction**

### Our foci

- Increasing representation of the world's plant diversity in botanic garden living collections in collaboration with the global network of botanic gardens
- Working with partners to increase the number of threatened plant species in conservation collections as an *ex situ* resource and as a source of material for restoration programmes
- Researching and developing horticultural methods and protocols to support *in situ* and *ex situ* conservation of threatened plant species

Above: The Chilean Hillside at Benmore acts as a safe site for Endangered *Araucaria araucana* and other conifers

A third of all conifers – trees of hugely important ecological and economic value – are threatened with extinction. Our International Conifer Conservation Programme is a worldwide programme combining taxonomic, conservation, genetic and horticultural research with capacity building to further conifer conservation. Our priority activities include reassessing the conservation status of 950 conifer taxa globally, incorporating forest losses and climate change impacts and predictions, and developing a new Conifer Action Plan. We will also undertake genetic and taxonomic research, supporting *in situ* and *ex situ* conservation programmes for the most threatened species.


Over a quarter of *Rhododendron* species are threatened with extinction. We house one of the world's leading conservation collections of *Rhododendron*, including 70% of all known tropical and subtropical *Vireya* species. We are using micropropagation techniques to rejuvenate our historic collections and produce disease-free material for repatriation to their countries of origin. As leader of the Global Conservation Consortium for *Rhododendron*, we will share knowledge and expertise in Rhododendron cultivation across the world, supporting *ex situ* conservation of threatened taxa within their native regions.

Scotland is home to several habitats of global importance, including temperate rainforest, oceanic heath and machair grassland, and species not found elsewhere in the UK. We aim to cultivate at least 75% of Scotland's threatened plant species in our *ex situ* collections, to protect against losses in the wild. These collections in turn provide a resource to introduce rare species back into the wild, alongside landscape management to support their survival and expansion. Our combined scientific and horticultural expertise, and collaborative working with innovative landowners in the Cairngorms National Park, has already enabled us to increase genetic diversity and double the number of populations of the alpine blue sow-thistle (*Cicerbita alpina*), bringing it back from the brink of extinction in Scotland. We will carry out larger-scale exemplar translocation projects, bringing hundreds of genetically diverse plants into multiple new locations, where they will be carefully monitored and used to guide future species-recovery programmes. A similar programme for one of Britain's rarest ferns, oblong woodsia (*Woodsia ilvensis*) will use research conducted on our collections to inform future conservation and translocations.

Below: *Cicerbita alpina*

# Digital collections

**Digitising the preserved collections at RBGE, and supporting wider development of international digital collections infrastructure, to enable global access to support scientific and cultural research, and to underpin conservation planning**

## Our foci

- Accelerating image capture of herbarium specimens to complete the digitisation of the RBGE herbarium to enable global access to high-resolution images and data
- Developing workflows and pipelines to build and enhance the global infrastructure for online natural science collections
- Cataloguing and digitising important components of the library and archive collections to enable global access and to facilitate scientific and cultural research
- Expanding citizen science and crowdsourcing projects to accelerate data capture and engage a wider audience with digital collections and their uses

**Our herbarium contains over three million plant specimens, many centuries old. Digitising these to improve global access to the specimens and the data they contain is a key strategic priority. We have already digitised over a sixth of the RBGE herbarium, and are now focusing on specimens from Nepal (to facilitate the production of the *Flora of Nepal*), and Scotland to engage new audiences of citizen scientists and increase awareness of Scottish plant biodiversity.**

# Collections care and maintenance

**Maintaining our standards of collection care and curation, data management, verification and accessibility**

## Our foci

- The Edinburgh Biomes project – a major renovation programme to replace and refurbish our Edinburgh glasshouses to protect the living plant collection
- Maintaining routine care, conservation and curation of collections to ensure their long-term legacy value
- Improving the layout and environmental conditions of the preserved collections to protect their contents and improve access

Above: Lilian Snelling's 1916 *Primula rupicola* drawings from the RBGE Archive

**Our Library, Art and Archives are an internationally important resource for botanists and other researchers. We will continue to develop these collections, providing enhanced access through cataloguing and digitisation, and ensuring their long-term preservation by creating improved and expanded storage. We will develop the RBGE Florilegium, creating a collection of beautiful art inspired by botany, to engage new audiences with RBGE science as it addresses the challenges of the climate crisis and biodiversity loss.**

# Horticultural sustainability

**Innovation in management practices to reduce the environmental impacts of maintaining the collections, to increase their resilience to emerging threats, and to promote biodiversity on our estates**

## Our foci

- Integrating environmental change research into collections management plans, including climate change projections and plant health threats
- Collaborative research to increase horticultural environmental sustainability including low-energy and low-emission glasshouse technology, and low environmental impact growing practices
- Management of the RBGE estate to promote its value as a habitat supporting a diverse and flourishing wildlife community

**Edinburgh Biomes is a landmark development project, initiated in 2020, RBGE's 350th year. Its aim is to secure the future of the internationally important living collection and greatly enhance our horticultural, educational and visitor infrastructure and facilities, with a focus on sustainability. This major programme of work will:**

- **Refurbish the Garden's A-listed heritage glasshouses to protect their structures, safeguard the living collection and create a greatly enhanced visitor experience**
- **Build an iconic new glasshouse to accommodate key elements of the living collection and provide a focal point for public engagement**
- **Replace the ageing and failing research glasshouses to avoid catastrophic loss of the plants they contain**
- **Build a dedicated Plant Health Centre to support the protection of the living collection from pests and diseases, and increase Scotland's capacity in plant biosecurity facilities**
- **Develop our education facilities to support training and learning in horticulture, botany, biodiversity science and conservation**
- **Replace existing heating and power systems and improve energy efficiency to greatly enhance the sustainability of our operations.**

## Botanical Collections – a Global Resource

The botanical collections in the care of the Royal Botanic Garden Edinburgh have been acquired over many centuries, reflecting a diverse history of collection and curation. They contain items of global scientific and cultural importance, and are part of a worldwide network of collections held in botanic gardens, museums and universities around the world.

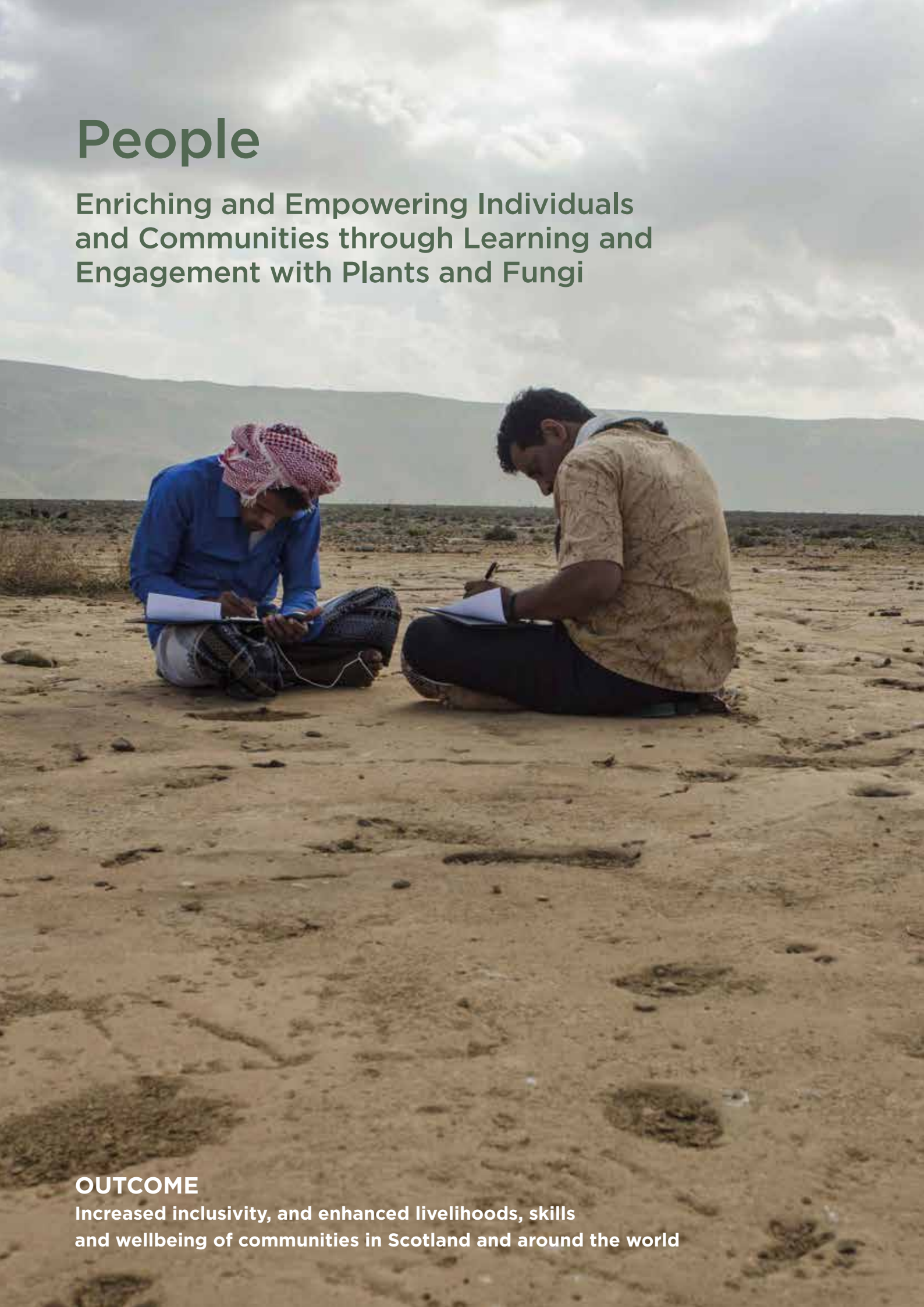
As custodians of the collections held at RBGE, we have a clear responsibility to support equitable, fair, legal, and just access. Of particular importance is enhanced accessibility and the use of the collections to support the conservation and sustainable use of biodiversity in the countries from which they originated, particularly those in the global south.

Key priorities include digitising the preserved collections to enable access; use of our collections to support reintroduction and restoration programmes; and support for the development and enrichment of national botanical collections in biodiverse countries.

Effective and transparent communication about the origins of our collections is vitally important, given that many specimens were acquired during the colonial period. Such dialogue is key to fully represent the nature and history of the collections, and to guide their future use and interpretation.

# People

## Enriching and Empowering Individuals and Communities through Learning and Engagement with Plants and Fungi



**OUTCOME**

**Increased inclusivity, and enhanced livelihoods, skills and wellbeing of communities in Scotland and around the world**

# Knowledge and Skills Transfer: Building Global Capacity in Plant Biodiversity Science, Conservation and Horticulture

Major skills gaps currently exist in taxonomy, biodiversity conservation and horticulture. There are also significant disparities in access to education and knowledge of these disciplines. Collectively, this impedes action to address biodiversity loss and climate change, and perpetuates inequality of opportunity. There is also a need to enhance knowledge at the community level to support informed decision-making for land-use and livelihood choices, consumption patterns, and biodiversity management.

## Skills and training

**Establishing a Biodiversity Skills Centre to maximise the efficiency, inclusivity and reach of our specialist training programmes, and expand our capacity to deliver online training**

### Our foci

- Taxonomic training: delivering training in plant taxonomy to support the generation of baseline biodiversity data, particularly in species-rich countries
- Biodiversity science: supporting researchers and practitioners to develop skills and understanding of plant science, ecology and conservation
- Conservation horticulture: delivering specialist training in horticultural best practice with a strong focus on cultivation, collections management, and recovery and restoration programmes
- Urban greening: developing and sharing skills in environmental horticulture and the use of plants and landscaping to improve health and wellbeing and to support the green recovery
- Cultural heritage: working with local communities and partners to support interdisciplinary training and studentships linking cultural and natural heritage research

**In the face of unprecedented global crises, the need for trained botanists to understand biodiversity and address its decline has never been greater. Tapping into the wide range of scientific, horticultural and educational resources and expertise of RBGE, our MSc in Biodiversity and Taxonomy of Plants provides a unique learning environment and comprehensive training for future plant scientists and conservationists from around the world. The programme is developing rapidly and constantly to incorporate online learning and new scientific knowledge and techniques.**

# Community conservation

**Targeted programmes linking research directly into practice, working with local communities in Scotland and globally to conserve, restore and sustainably use biodiversity**

## Our foci

- Integrating biodiversity science with community livelihoods and land-use choices to support sustainable development and sustainable use of natural resources
- Supporting community groups to enhance their local environment by transforming urban sites and infrastructure to support biodiversity, wellbeing, and local food production
- Supporting community programmes to use plants, horticulture and landscaping to mitigate against weather extremes and the effects of climate change

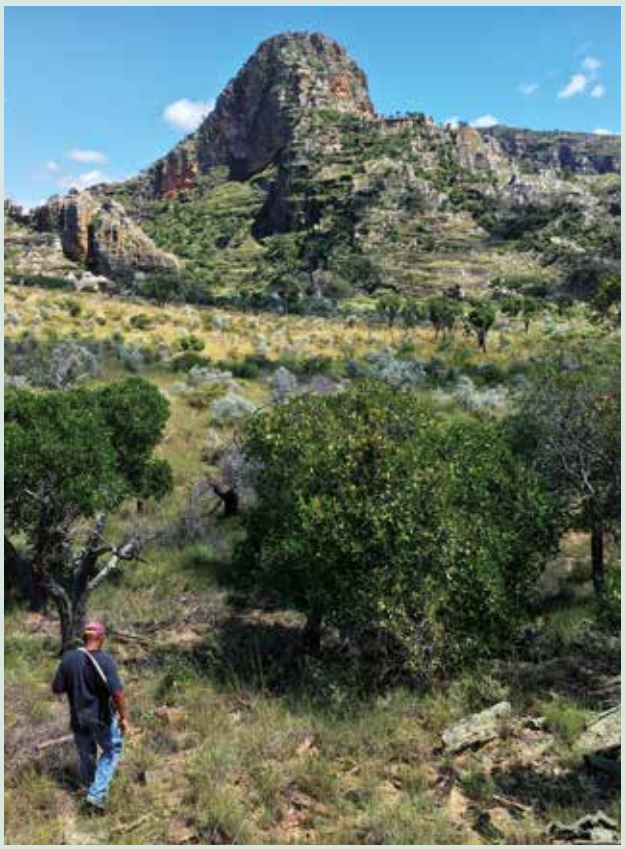
We play a leading role in the Edinburgh Living Landscape's flagship Shoreline Project, strengthening connections between the communities, biodiversity, and cultural heritage of Edinburgh's coastline. We will work with local partners to remove invasive coastal species and improve remnant sand dune habitats, restore and create coastal meadows, increase habitat connectivity and value for pollinators, and to install rocky habitats for intertidal marine life facing habitat loss due to advancing sea levels.

Tanzania's forests and woodlands cover an area twice the size of the UK. Tenure is often unclear, and unregulated clear felling and degradation are widespread. Community-Based Forest Management allows local communities to become forest owners, on condition that the area is sustainably managed, an approach which can reduce forest loss and at the same time generate livelihood benefits. However, in practice there are many obstacles, such as an increasing demand for land for cash-crops. RBGE will work with Tanzanian partners to develop best practices for Community-Based Forest Management, and to highlight its positive impacts on biodiversity and the socio-economic situation of communities. An overriding aim for this work is to identify management practices that support both livelihoods and forest conservation.

Left: Community forest patrol, Tanzania

We help foster sustainable development by collaborating with communities, development and conservation organisations to understand the relationships between socio-ecological systems and short- and long-term environmental change. In Madagascar, we will work with local communities, and national and international organisations to study the impact of fire and grazing management practices on livestock health and forest diversity in the Central Highlands, aiming both to reduce poverty and protect primary forest.

Right: Endemic tapia (*Uapaca bojeri*) trees, Madagascar



# Ways of Working

Our scientists work with hundreds of partners around the world. Our geographic foci are Scotland and countries where there are major threats to plant biodiversity, including those in South America, sub-Saharan Africa, the Middle East and central Asia, China and the Himalayan Region, and South East Asia. Partnerships are fundamental: effective and equitable collaboration is key to addressing major societal challenges and is central to our work.

**In undertaking our work, we will adhere to the following principles:**

- **SOCIAL JUSTICE:** We will work to ensure equity and inclusion in all dimensions of our work, locally and globally
- **ACCESSIBILITY:** We will promote open access to our research to maximise global benefits, and ensure fair and equitable access to our collections while ensuring that all our work is compliant with national and international legislation
- **RESPECT:** We will seek to understand local cultures and customs, and ensure we act responsibly and with respect
- **RELEVANCE:** We will strive to ensure our work addresses societal and environmental needs and maximises benefits to stakeholders and partners
- **SUSTAINABILITY:** We will minimise the environmental impacts of our work

**Above: We co-authored papers with scientists in 120 countries over the last five years**

## Beyond the Science and Biodiversity Strategy

Beyond our Science and Biodiversity Strategy, the biodiversity crisis and the climate emergency provide major foci for all our activities at RBGE, alongside human health and wellbeing, and social justice.

Our public engagement programme and interpretation in all our four Gardens have a major emphasis on engaging and informing the public about the importance of plants, biodiversity and environmental sustainability.

Our education remit includes a diverse and wide-ranging programme of formal and informal courses, with an overriding aim to grow skills and understanding about plants, biodiversity, horticulture and the natural environment.

The biodiversity crisis and the climate emergency are also major drivers for how we run our business and our estates, including integration of our research and conservation activities with business operations to promote biodiversity and minimise environmental impacts.