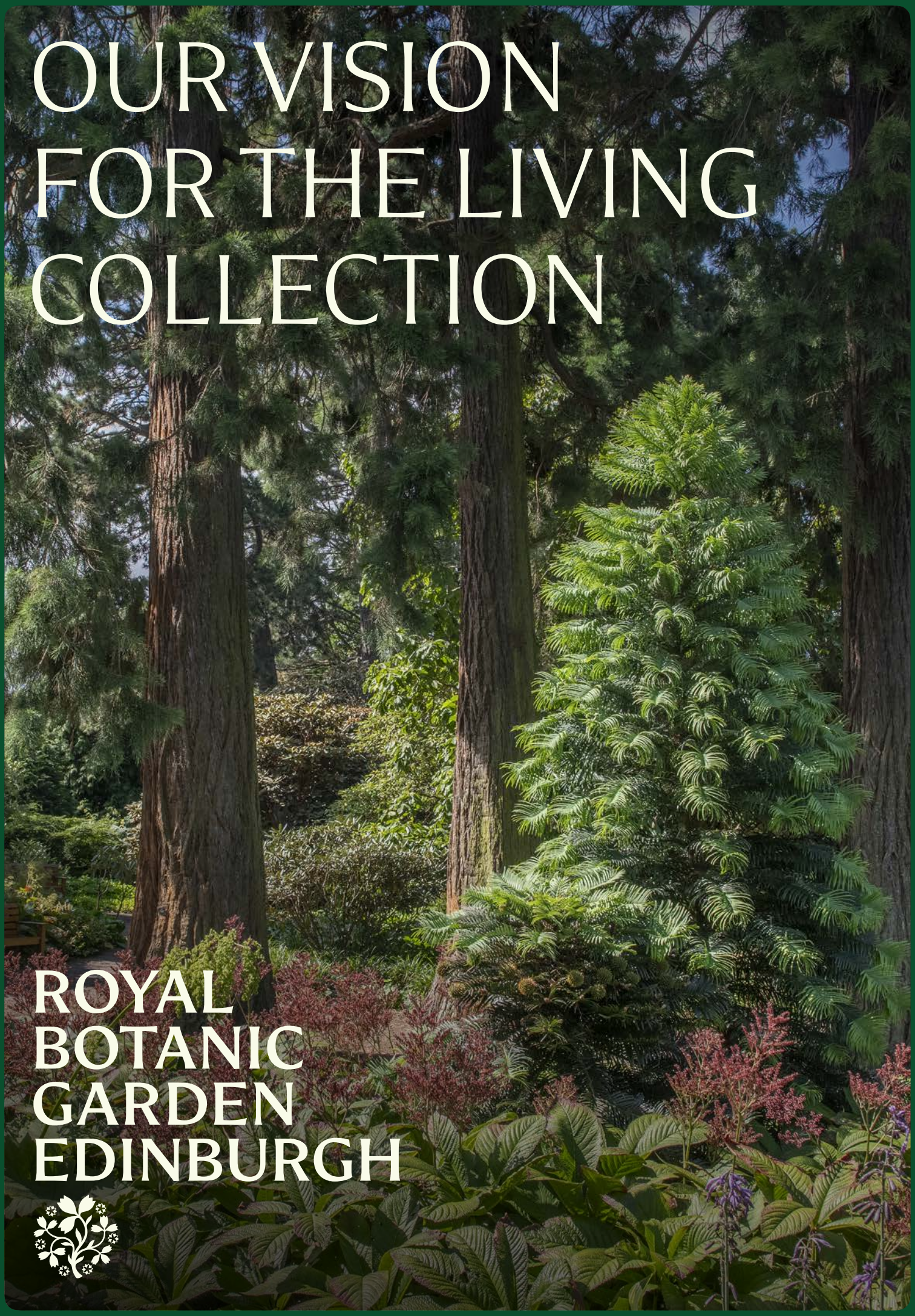
OUR VISION FOR THE LIVING COLLECTION



ROYAL BOTANIC GARDEN EDINBURGH

THE VISION FOR THE LIVING COLLECTION AT THE ROYAL BOTANIC GARDEN EDINBURGH

Our vision is a positive future for plants, people and the planet.

Our mission is to explore, conserve and explain the world of plants for a better future.

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WHY DOES THE ROYAL BOTANIC GARDEN EDINBURGH COLLECT PLANTS?

Plants form the basis of life on our planet. Our survival depends on their survival. Yet species are disappearing at the fastest rate in our history because of habitat loss and environmental disruption. The critical work of botanic gardens in collecting, growing and researching enables us to understand, conserve and explain the world of plants to everyone. This will help us to overcome our current challenges and to build a sustainable future.

Our work contributes to at least five of the UN Sustainable Development Goals:

- good health and well-being
- sustainable cities and communities
- climate action
- life on land
- partnerships for the goals

The Convention on Biological Diversity (CBD) guides our approach to managing the living collection. The CBD's mission is 'to take urgent action across society to put biodiversity on a path to recovery for the benefit of planet and people'.[1]

We use different plant species for food, shelter, clothing, fuel, medicines and much more, but we have not identified all the plant and fungi species that are out there in the world, nor the essential new uses that we could find for many of them.

With almost half of flowering plants thought to be at risk of extinction, how do we decide which ones to conserve and display? The Living Collection Policy drives our decision-making about what to collect, where to collect it from and how to collect it. It also guides our management of the living collection as a resource for research, education and visitor enjoyment.

It is up to us to work together to find solutions and conserve plant life. The need for this has never been greater, nor more urgent.

Climate change poses massive challenges for humans and for the natural world, but plants can help us to adapt. Leaves, stems, roots and soil absorb and slow down extreme rainfall. They cool down overheating cities, trap air pollution, and clean our water and soil. By using plants in nature-based solutions, we can make our cities more resilient to the impacts of climate change and our urban areas healthier and happier places to live.

◄ *Pyrus korshinskyi* (Kazak pear), is a Critically Endangered species of wild pear native to Central Asia. RBGE's living collections of such species contribute towards global conservation goals.

► The UN's Global Goals for Sustainable Development. RBGE's work contributes directly towards goals 3, 11, 13, 15 and 17.

1. Convention on Biological Diversity (2024) https://www.cbd.int/convention

CURATION

How do we prioritise what to collect and what to grow?

The International Union for the Conservation of Nature (IUCN) Red List threat assessment process is a widely recognised and robust way to measure the survival status of a species, whether plant, fungus or animal. Established in 1964, the Red List is compiled twice a year. The survey process includes checking that correct names are used and that population locations, threats and conservation actions are identified. The Red List is our starting point for identifying how threatened a plant is in the wild. We can check shared data to gauge the situation for a species in cultivation and then piece together a picture of which species are threatened, according to the Red List categories.

We work collaboratively on the IUCN surveys, developing skills and capacity in many different parts of the world. For example, the Centre for Middle Eastern Plants is helping to identify and survey threatened species on the Arabian Peninsula. In Nepal, RBGE is helping to compile the first complete record of plants, which is published in the *Flora of Nepal*. We also work with staff in the National Botanic Garden of Nepal to build the horticultural skills required to propagate, grow, manage and conserve living collections there.

▼ The Nepalese area in the Edinburgh Garden. Many of the plants are collected on collaborative field trips undertaken to produce the *Flora of Nepal*. The stone gateway is typical of structures found in the landscapes of the high Himalayan district of Bajura, Sudurpashchim, Nepal.

LIVING COLLECTION STATISTICS

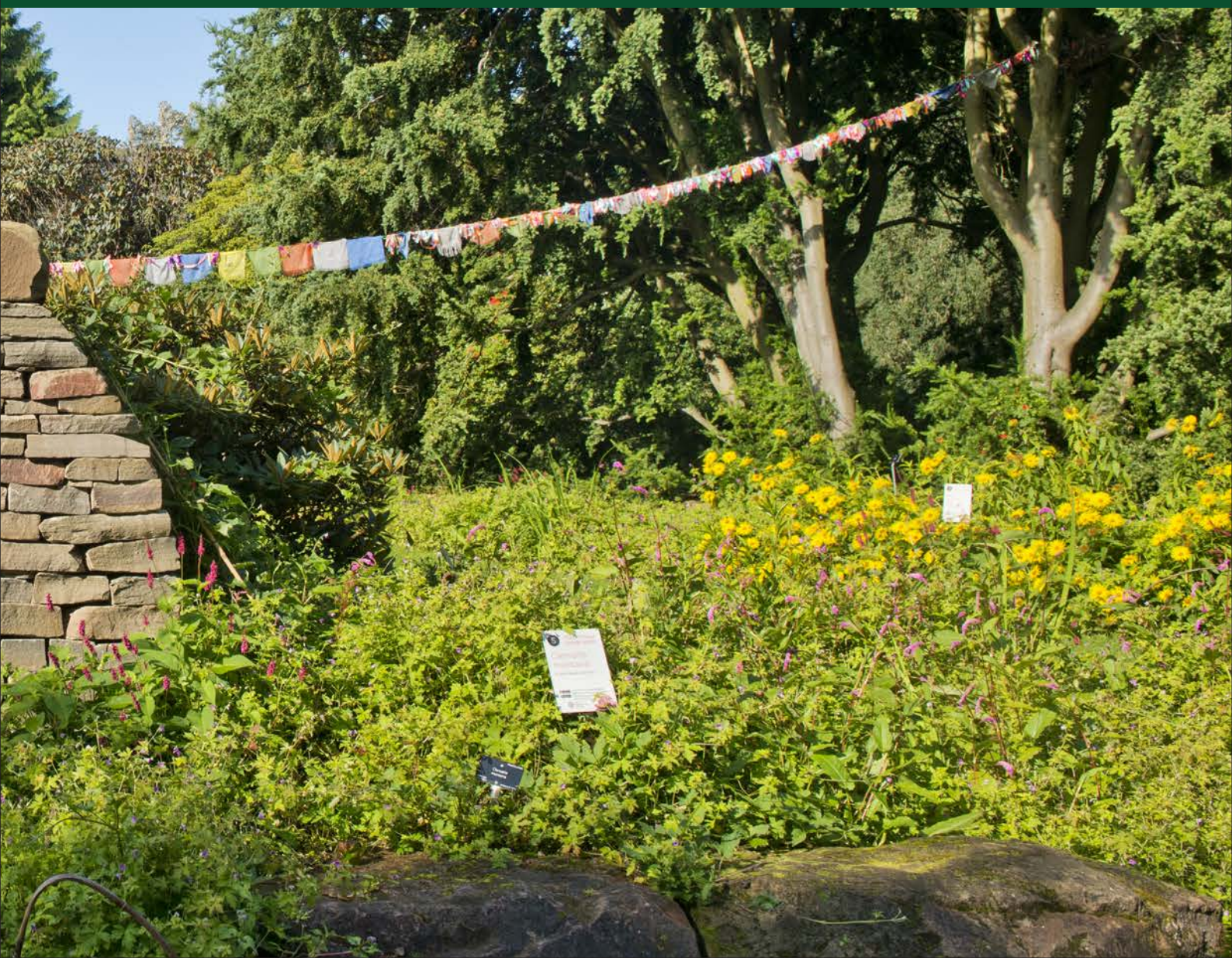
13,521	Number of species in collection
35,500	Number of accessions*
7,335	Number of accessions verified†
17,706	Number of wild-collected living accessions
1,184	Number of threatened taxa‡
152	Number of countries represented
65	Number of garden staff

Statistics from *Catalogue of Plants* (RBGE, 2021).

* An accession is a selection of plant material collected from a single species, collected at one time from a specific location.

† If an accession is described as 'verified', it means that its name has been confirmed.

‡ Taxa is the plural of taxon, a named family, genus, species or subspecies.



COMMUNICATION

We must act together and responsibly

► The Botanics Cottage is a sensitively and sustainably restored 18th-century building that now serves as a hub for community and education events at the centre of RBGE's Engaging Gardens project.

Global networks are critical to conserve species, and RBGE is just one of over 3,000 botanic gardens worldwide. We are a Patron Member of Botanic Gardens Conservation International (BGCI), the world's biggest plant conservation network. Membership means we can share plant collection information, expertise and much more. Communication between gardens gives us a clear picture of where threatened plants may be in other living collections. Networks hosted by BGCI enable botanic gardens to share plant material for conservation purposes.

Keeping good plant records is a key responsibility for botanic gardens. Accurate, up-to-date records provide evidence of how well we are conserving a species in the collection. Sharing information alongside plant material with our networks strengthens our conservation efforts.

Garden visitors do not always see this behind-the-scenes work. They will, however, see the labels illustrating important collecting information. Labels are also used to illustrate specific projects. For example, a yellow label indicates that the plant is part of the phenology project, which records flowering, leafing and fruiting times. Data from this project, collected over the last 20 years, is now telling us that many plants are flowering a month earlier on average, owing to our warming climate.

CASE STUDY

Know your onions – RBGE conserves threatened plants in Tajikistan

In rural Tajikistan, wild plants are vulnerable through over-harvesting. Although the country is rich in nature and in plant species, there is extreme poverty. Wild plants to be sold for food and export are a valuable resource, with many species growing nowhere else in the world.

Onions are one of Tajikistan's main exports, but over-harvesting is severely depleting wild populations. With funding from the UK Government's Darwin Initiative, RBGE has worked with partners to teach horticultural skills that support local harvesters to propagate and grow on plants for sale. Tajik communities use these skills to develop sustainable plant nurseries, create new income streams and reduce the volume of plants harvested from wild populations.

► Onion (*Allium* sp.) leaves in a market in Tajikistan.

CONSERVATION

The accelerating impact of climate change and habitat loss

The biggest current threat to plant life is the loss of habitat through the removal of forests (deforestation), and the increase in use of land for livestock grazing. In Scotland, habitat loss also occurs through over-grazing by wild deer. Climate change exacerbates the pressure on dwindling wild plant populations. Whilst plants can adapt to climate changes over millennia, they cannot adapt quickly enough to the rapid changes we are now seeing.

Botanic garden researchers in Melbourne and Tasmania, Australia, have developed a Climate Assessment Tool to help us predict the impacts of the changing climate on our tree collections. Climate predictions are that average temperatures will rise, enabling a broader range of plants to be grown in the four Gardens that comprise RBGE: Edinburgh, Benmore, Dawyck and Logan. However, more extreme rainfall and periods of drought could present new challenges, especially if they occur in the seasons that do not suit plant growth and we experience more wet winters and dry springs.

In future, botanical collections around the world may not have the conditions required to grow many of the plants they currently conserve. RBGE will help to transfer plants from other collections to more suitable locations when requested, as well as restoring and safeguarding species in the wild.

► *Cicerbita alpina* (Alpine blue sow-thistle), a threatened species that is being conserved by RBGE and partners with support from the Scottish Government's Nature Restoration Fund.

▼ *Woodsia ilvensis* (oblong woodsia) ferns growing from spores germinated at RBGE. This species is a key conservation priority for Scotland.

CASE STUDY

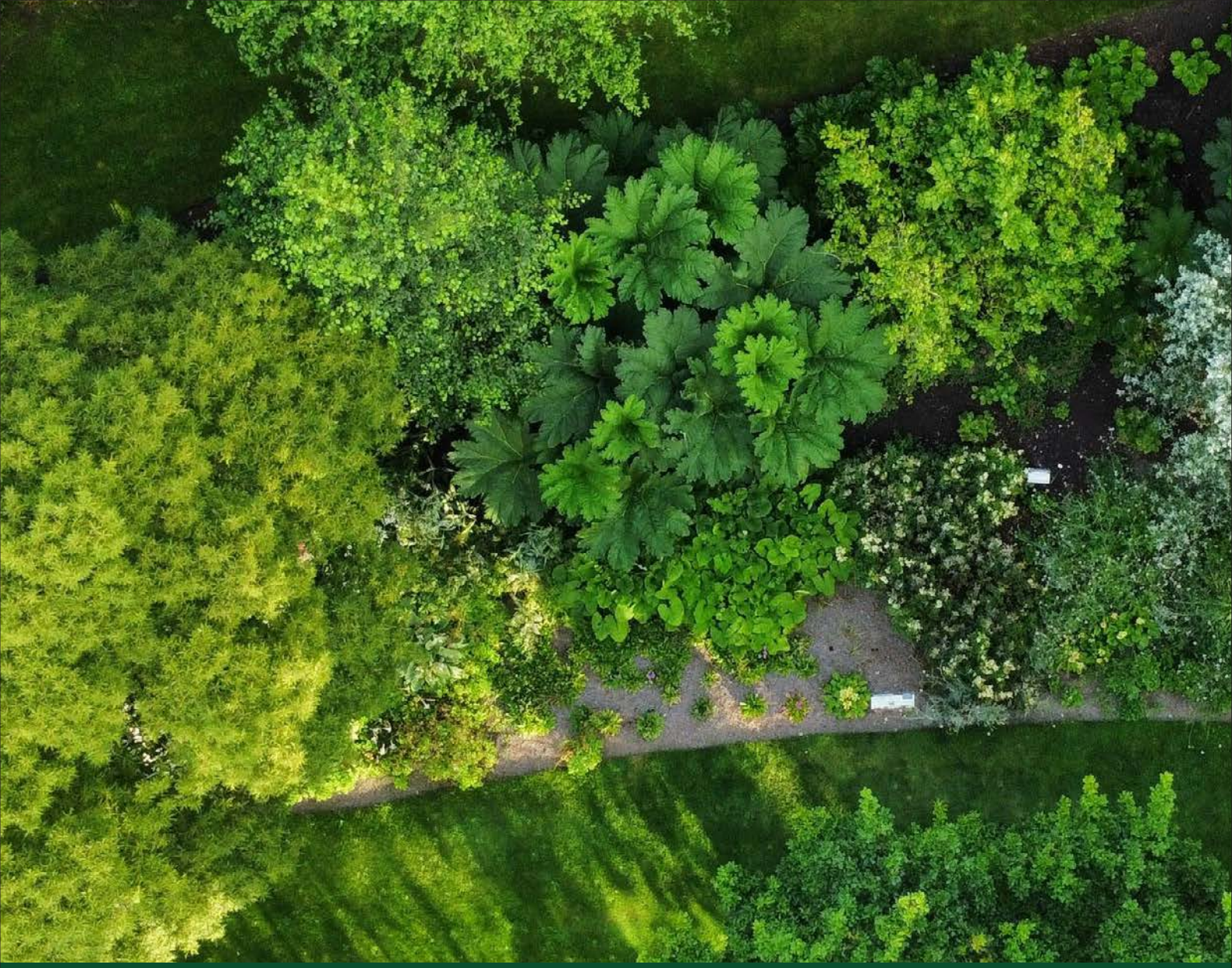
Species conservation in Scotland with the Nature Restoration Fund – the Alpine blue sow-thistle

Because of habitat loss through over-grazing, the Scottish native population of the Alpine blue sow-thistle has dwindled to such low levels that the species is assessed as Vulnerable in the UK. Science and Horticulture teams at RBGE are working together to conserve this species and ensure its survival with support from the Scottish Government's Nature Restoration Fund (NRF). The NRF is administered by NatureScot and supports projects throughout Scotland delivering activities to protect and restore Scotland's biodiversity.

Conserving a threatened species involves several steps: first, plant material and data are collected from the wild and the plant material is grown on for study at the Garden. It is then propagated and crossed with a range of different plants of the same species but that are perhaps growing in different geographic populations, so that the gene pool is as strong and resilient as possible.

The population is then bulked up, so that large numbers of the species can be reintroduced into different locations in the wild. This involves working with many landowners. These populations are then monitored over years to ensure that the species is surviving and thriving. Technological innovation enables us to use remote sensing and satellite imagery to survey large areas of the country.

RBGE's NRF programme runs from 2023 to 2026. We are conserving ten species in the current programme: *Cicerbita alpina* (Alpine blue sow-thistle), *Hedlundia arranensis* (Arran whitebeam), *Hedlundia pseudofennica* (Arran service-tree), *Hedlundia pseudomeinichii* (Catacol whitebeam), *Malus sylvestris* (crab apple), *Melampyrum sylvaticum* (small cow-wheat), *Polygonatum verticillatum* (whorled Solomon's seal), *Saxifraga hirculus* (marsh saxifrage), *Ulmus glabra* (wych elm) and *Woodsia ilvensis* (oblong woodsia).



CULTIVATION

Adaptive management and using plants in nature-based solutions

As the seasons and weather patterns become more erratic, so botanic and other gardens have to be more flexible and less prescriptive about when certain routine tasks are carried out. Garden areas and sub-collections will also have to play a new role. We will use plants to help adaptation to climatic changes. For example, a rain garden could be created to absorb surface water in an area that floods frequently, enabling visitors to continue to use the Garden even in rainy conditions.

Plants can help us adapt to climate change, allowing us to mitigate against some of its more dramatic and dangerous impacts, such as flash flooding and heat-waves. By incorporating more plantings and green spaces, such as rain gardens, into urban areas, stormwater surges can be slowed down, helping existing drainage systems to cope. Built-up areas can be cooled down with shade created by street trees and climbing plants growing up buildings as green walls.

Environmental conditions in urban areas tend to be harsh, and plants in cities contend with big variations in water and nutrient availability, wind and temperature. It is likely that there are species in the wild that will thrive in these challenging conditions. We will collect these plants to research, measure and enhance delivery of some of these benefits. In 2024, we embarked on a five-year research programme, Plants with Purpose, to develop more practical knowledge in this area.

CASE STUDY

Rain garden and stormwater planters

In 2018, work began on the creation of a rain garden in a low-lying hollow in the Edinburgh Garden that flooded repeatedly, causing interruption to nearby visitor footpaths. In partnership with Heriot-Watt University, plants were chosen for their tolerance of heavy rainfall as well as drought, and a free-draining growing medium was formulated to optimise water penetration. The rain garden was designed to be a living laboratory, and RBGE continues to conduct research into the changing performance of plants and growing media over time with staff and students from Heriot-Watt.

This area of the Garden has not flooded since the rain garden was created, and it has become a popular demonstration feature for policy makers and industry as well as general visitors. With almost 1 million visitors to the four RBGE Gardens each year, such features are an educational resource and powerful demonstration of what is possible with nature-based solutions and how simple these solutions can be.

Stormwater planters were installed on new buildings in 2024 as part of the Plants with Purpose programme. Each is planted up with distinct species and different combinations of growing media, and their performance is being monitored by staff and researchers.

▲ An aerial view of RBGE's rain garden – a living laboratory and a nature-based solution to increased rainfall.

► A small white butterfly feeding on *Ligularia dentata* 'Othello' (leopard plant), in the rain garden.

COMPLIANCE

Managing pest and disease risks in our plant collections

The movement of plant material is recognised as one of the main pathways for the introduction and spread of new pests and diseases (plant products, woody packing materials, wood and bark are also major pathways). The impact of an outbreak can be devastating for plant collections, and there is often no financial support for treatment or removal of diseased material. Recent outbreaks at RBGE include the widespread water-borne *Phytophthora ramorum* at Benmore, where removal of more than 300 Japanese larch trees was ordered under a Statutory Plant Health Notice.

RBGE was the first UK public garden to be awarded certification under the Plant Healthy scheme, ensuring that biosecurity protocols and guidance are robust and clearly audited. For example, any new plant material coming into the Gardens is subject to a strict quarantine regime before it is allowed to be planted out. Staff training has also been developed to ensure that all RBGE staff, and not just those working in horticulture, science and education, are familiar with biosecurity practices.

Garden visitors and contractors are also made aware of their responsibilities. Disinfectant footwear baths are at the entrance points to the Gardens to minimise the risk of pests and diseases being carried on footwear and wheels.

► *Paphiopedilum lawrencianum*, (Lawrence's paphiopedilum), is Critically Endangered and is protected by CITES regulations restricting the trade of all orchids.

▼ Footwear bath to reduce spread of soil- and water-borne diseases.

Botanical artists at RBGE capture the extraordinary flowering event of *Amorphophallus titanum* (titan arum)

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