

## Phase 1 figures



**10,989,269**  
seeds



**963**  
collections



**5,130**  
individual trees  
geotagged



**517**  
targets met

## Phase 2 figures



**>300**  
collections



**>1,400**  
geolocations



**c.227**  
targets met

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The UKNTSP was first established in 2013 to capture multi-provenance seed collections from a range of UK trees and shrubs across their native distributions. This was partially in response to the growing threat from pests and diseases. The methods employed through the UKNTSP are such that this resource will be available for research and conservation use into the future.



The UKNTSP is funded by players of People's Postcode Lottery.



Rowan seedlings

## Project Officer update

I can't quite believe we have come to the end of Phase 2 already; it only seems like yesterday my head was swimming with the challenges of attempting Salicaceae collection and banking. And now, with over 70 Salicaceae collections processed and safely banked, averaging 56% viability overall, here we are! We knew they would be a challenge, but these results are fantastic. The collections will continue to be monitored over the coming years to see how they fare.

With over 300 seed collections in the bank from Phase 2, combined with more than 900 from Phase 1 and a few pre-UKNTSP collections, we now hold seed for approximately 73% of the total possible targets over Phase 1 and 2 of the project. Broken down by species group, this equates to approximately 40% of Group 1 species (Salicaceae), roughly 64% of Group 2 species (berberis, hazel, alder buckthorn, spindle, privet, purging buckthorn, guelder rose and wayfaring tree) and around 85% of Group 3 species (mainly collected in Phase 1). Exact species lists can be found in the updated Annex 1 of the manual.

The numbers are slightly lower for Groups 1 and 2 as Phase 2 had a slightly different set up to Phase 1, in that we were not attempting to make a collection for all targets. For example, there are 42 possible targets across aspen (*Populus tremula*) and black poplar (*Populus nigra* subsp. *betulifolia*), but we were only aiming to make two collections given the challenges of collecting seed from these species. The collections made over the

seven years of this project represent a significant contribution towards *ex situ* conservation of the UK's Forest Genetic Resources. On page 4 we discuss what happens to the UKNTSP collections now, including how to access them.

Also on page 4, we summarise some of the recent and upcoming publications arising from the project. While this summary focuses on Kew-based publications, there have been many more stories emerging from yourselves in national and local news outlets across the country. Ian and I have enjoyed reading all these, so do continue to share them with us.

Finally from me, I would just like to say a massive thank you. I have really enjoyed working with you all throughout the project, and the scale of what we have achieved for the *ex situ* conservation of our woody flora is a testament to your commitment and efforts. Over 80% of the UKNTSP collections have been made by partners or donors. This year alone, more than 110 volunteers have been collecting for the project.

Although the UKNTSP is finishing at the end of March, the work of the UK seed conservation team here at the Millennium Seed Bank is continuing. If you would like to keep up to date with what's going on, please check out our team twitter (@Kew\_MSBUK) or our webpage ([kew.org/science/our-science/projects/banking-UK-seeds](http://kew.org/science/our-science/projects/banking-UK-seeds)).

**Alice Hudson**  
UKNTSP Project Officer

## Fieldwork Officer update

Following on from the challenges of Salicaceae collecting in 2019, collecting in the autumn (between August and November) proved to be no less of a challenge. As well as targeting the newly added Phase 2 species, such as spindle and buckthorns, extra effort was made to pursue targets missed during the previous six years of collecting. Many of these had been missed due to their restricted occurrence in specific seed zones. I came to think of these as the 'high-hanging fruits' – surely some of them were achievable targets?

Many of these 'high-hanging fruits' were high altitude targets (>300 m) and so we set off up steep, boggy and often windswept hills to increase the number of upland collections as much as possible. Despite our travails, we managed only three further collections. Often our targets would simply stop occurring in the woodlands we visited above the 300 m threshold, or the trees ceased fruiting well enough to make a good collection. Although only a further three collections were made (ash, yew and spindle) they are valuable additions to the 132 upland collections already made by the UKNTSP.



Image © RBG Kew

Kew fieldwork and tree climbing team in pursuit of large-leaved lime in Shropshire. L-R Katie Thorpe, Ian Willey, Russell Croft and Harriet Fermor

We had more success in pursuit of four species that have somewhat eluded the project in previous years. The reasons for their continued evasion are multiple, but they are characterised by restricted distribution in the UK or have particular seeding requirements. Of these elusive species, we made good collections of midland hawthorn, wild service, black poplar and large-leaved lime.

Making a collection from a population of both male and female black poplar was a great achievement for the project. As one of the UK's rarest native trees, it was a priority to obtain naturally fertilised seed from a wild population – and I can happily report the seed collected has now been successfully banked and germination tested. Another valuable collection is that of large-leaved lime from ancient woodland in Shropshire. Scarcer than its small-leaved relative, it has proven difficult to collect because seed production is dependent on warm early-summer temperatures. Our tree climbing team at Wakehurst battled their way to the top of the canopy, where viable seed is produced, to make an impressive seed collection. It's good to know that the seeds banked from some of Britain's rarer trees are now safe from future threats and will form a valuable resource going forward.

The UKNTSP has been a tremendous project to work on and I feel privileged to have witnessed first-hand the diversity of woodland across the UK over the past few years. It's been a joy to meet landowners, conservation practitioners and community groups responsible for conserving native woodlands and I have learnt a lot in the process. Thanks to everyone's involvement over the past seven years, we have created a nationally important collection that will be a crucial part of our woodland's future.

**Ian Willey**  
UKNTSP Fieldwork Officer

## A note from the head of the UKNTSP advisory board

What seemed an ambitious, demanding and all-embracing conservation project when we started in 2013 is now coming to an end. The time has flown by, challenges have been overcome and we've achieved hugely beneficial outcomes for UK conservation and for the long-term survival of our precious native trees and shrubs. These successes have been shared among us through these newsletters, partners' events and the magnificent publicity that this project has attracted throughout its life. But the most important link in the chain has been your involvement, your commitment and your dedication to the project and to UK conservation.

At the heart of this project are the committed groups of volunteers across the UK who have been out in all weathers to collect, clean and process seeds so that they can be stored at the Millennium Seed Bank, providing future options for these species. For that I want to extend my heartfelt thanks to all of you for being part of this project and for ensuring its success. We couldn't have done it without you.

**Colin Clubbe**  
Head of Conservation, Kew

## Project notices

- A final plea, if you are able to please could you check inside any herbarium presses you have for any specimens that may have been over looked. If you do find any, please could you email us to let us know (alice.hudson@kew.org).
- If you have any GPS data you may not have sent through, please could you send it through as soon as you are able.
- The project Facebook page will be closed at the end of the project. This will occur during March.
- If you have any leftover equipment that you will not be able to make use of please can you email us (alice.hudson@kew.org) to let us know. We will look into arrangements for getting this returned to us.
- You will not be able to use the DHL account after 31 March. Unfortunately, this means that we will not be able to accept any further seed collections or plant material for the UKNTSP after this date. Any seed collections or plant material received, unless pre-agreed, will be disposed of.

## Phase 2 summary

Over the course of Phase 2 we have received over 300 collections from across the UK, covering 38 different species and sampled from over 2,800 plants. For both spindle (*Euonymus europaeus*) and wayfaring tree (*Viburnum lantana*), we now hold seed from each target seed zone (some targets were also met through Phase 1 and pre-UKNTSP collections). These are the only species for which we have a collection for every target, other than yew (*Taxus baccata*) and many of the Sorbus complex species (*Aria*, *Hedlundia*, *Cormus*, *Karpatiosorbus*).

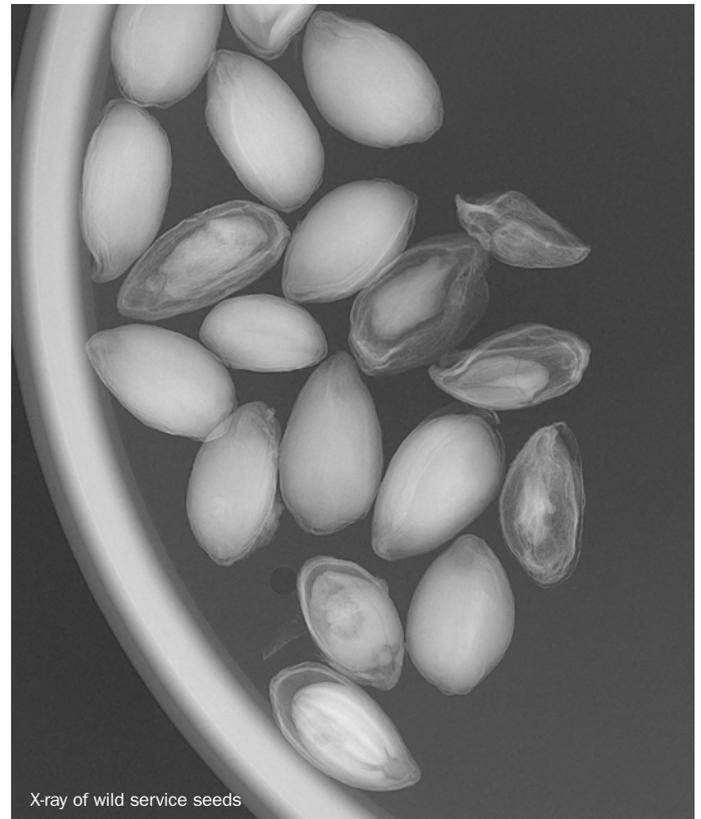
As this was our last collecting year, it's inevitable that many of the collections left were the challenging ones – there's a reason they've not been collected! One of the most difficult species to collect (aside from the willows!) has proven to be wild service (*Torminalis glaberrima*). They are certainly beautiful trees, with a unique leaf shape, but they have been tricky to locate in many seed zones. According to the literature, they generally only seed biennially in the UK and have suffered as a result of the reduction in traditional woodland management (Thomas et al., 2017 and references therein). From our own data they also generally have a high proportion of empty and infested seeds (approximately 40% across UKNTSP collections banked).



Image © RBG Kew / Ian Willey

Wild service leaves and fruit

During Phase 1 of the project, 11 collections were banked, totalling just under 8,500 seeds towards five of the nine targets. Over Phase 2, an additional 11 collections have been banked, taking the total number of seeds banked to more than 13,300. This also means there are now collections towards seven of the nine possible targets.



X-ray of wild service seeds

Image © RBG Kew

We don't have any final figures for the project yet, as some of the 2019 collections are still being processed and there are a few verifications we have yet to do, the outcomes of which could impact the number of targets met. But, excluding the willows, in the region of 1.5 million seeds have been collected from across the UK during Phase 2.

## Recent project publications

Over the course of the project, many of you have indicated an interest in starting your own conservation tree nurseries or asked us questions about germinating tree seeds. One of the aims of the project has been to share as much of our data as possible. Most recently, the genetic risk assessments that Dr Roberta Gargiulo undertook on each species have been published online, and we are in the final stages of getting our germination protocols ready to be published online as well.

The genetic risk assessments were undertaken at the start of each phase of the project and include a literature review on the current state of genetic knowledge about each species, along with what is known in terms of pollination mechanisms and life-history factors that can impact the genetic structures of populations. The aim of these assessments was to look at the risks associated with sampling the genetic diversity of each species across

the UK, and ask: Are there patterns in genetic diversity? Are there specific populations that contain unique genetic diversity and should be sampled? The results of Roberta's assessments are now accessible through the Kew Research Repository ([kew.iro.bl.uk](http://kew.iro.bl.uk)).

In the next few weeks we are also hoping to get the germination protocols for the main species published online. These will also be available via the Kew Research Repository. This will likely be a page explaining the standard protocols we use at the Millennium Seed Bank for our germination tests, including temperature treatments and timings. The protocols are the result of testing across multiple populations and individuals and are the conditions we have found to produce the most successful germination. We will continue to update these as more information becomes available from ongoing tests.

## What happens to the seeds now?

Throughout the entirety of the project we have emphasised that the collections are being made for conservation and research uses. Once the collections have been processed and counted, depending upon the number of seeds within the collection, they may be split between active and base stores. If the collection contains more than 250 seeds per tree it is split.

For split collections, the base store has a minimum of 250 seeds per maternal tree and this becomes the core conservation collection. The remaining seeds are placed into the active store – these are the seeds made available for bona fide research and conservation uses. The collections are split in this manner to reduce the number of times collections may be defrosted and re-frozen if regular requests are made. By keeping the base collection separate, these remain frozen unless required. Collections with fewer than 250 seeds are not routinely made available.

Before any seed collections of greater than 250 seeds are made available, they undergo both identity verification and viability testing. This is standard procedure across all collections here at the Millennium Seed Bank. Verification is based on herbarium specimens sent in with the collections. Viability testing is needed to make sure that the collections contain seeds which are alive.

We do the viability testing in one of three main ways. The predominant method is germination testing – trying to germinate the seedlings. However, this can be a timely process, particularly if the species have a long dormancy period. It can take more than six months, and in some cases (such as holly) up to three years. This creates a long delay between receiving the seed and being able to make it available. If we know a species has a long dormancy period, then we can do either a tetrazolium test or an imbibed cut test. Both are still viability tests (although they do not give a germination percentage) and can be done over a much shorter time frame.

They aim to establish whether the tissue inside the seed is alive or dead, giving us a percentage viability of the collection.



Once all these checks have been undertaken, the collections are available for use. If you are interested in accessing any of the collections, please email [ukntsp@kew.org](mailto:ukntsp@kew.org) with your enquiry.

# The art of UK tree seeds

Faced with overwhelming evidence of the importance of trees to the management of climate breakdown, I have decided in recent years to respond through my creative practice. Last year I exhibited work at the Manchester Museum demonstrating the invisible value of urban trees as part of our natural life-support systems, in response to a substantial removal of trees in my own city, Manchester. This led me last summer to begin a creative collaboration with the Millennium Seed Bank's UK National Tree Seed Project, as part of my MA Art and Science studies at Central Saint Martin's College, University of the Arts London.

In 1980–81, while at my first job in Manchester's parks department, I witnessed whole avenues of magnificent English elms succumb to Dutch elm disease. Almost 40 years later, in 2019, ash dieback and oak processionary moth were taking their toll on our native stock of trees. I wanted to explore how, through the creation of a genetically representative seed collection of native species, the UKNTSP was responding to increased threats from pests and disease. I wanted to explore the potential both to breed resistant strains of species and to re-stock the landscape after the ravages of new biological threats. I am grateful for the positive response to my approach, which enabled me to make a start in August.

I interviewed a number of the key RBG Kew staff responsible for the project and took part in fieldwork in the Midlands, Scotland and Yorkshire. As well as embracing the methods and rationale of the project – learning through doing – I filmed the RBG Kew staff and project volunteers about their motivations and their relationships with trees. Visits to the Kew Herbarium and to the Millennium Seed Bank at Wakehurst completed my fieldwork.

At the same time, I was commissioned by the London Institute of Medical Science to work with three of their research scientists working respectively on human diet and obesity, hormone disruptors in the environment and microbial resistance to antibiotics. All offered clear evidence that systems – economic, cultural, environmental, political – had as much, if not more, influence on the health of certain individuals as their own actions and metabolisms. Setting up a thought experiment and bringing in Ian Willey from the UKNTSP, we explored the similarities and differences in the external influences on the health of a deprived individual in London and those on an urban tree, sharing evidence, insights and cross-disciplinary thinking in a creative environment. The result was a large woodcut triptych, *A Picture of Health: A Deep Connection*, exhibited at Elephant West gallery and the Science Museum in November.

Now I am working on my artistic response to my experience with the UKNTSP. I'm planning a short film and a series of monoprints focused on six of the native species whose seed I was involved in collecting, which I hope to be able to show early next year.



Image © Phil Barton

I would like to thank Ian Willey, John Dickie and all the staff and volunteers I worked with for generously providing their access, time and expertise to this inquisitive artist. I hope that my engagement in the project will encourage new connections and a greater understanding of the precarious importance of our native trees in town and country.

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