Plantlife Scotland

The global voice for wild plants and fungi

Twinflower Restoration

A Strategy for Twinflower Translocation and Habitat Recovery in Scotland to 2040 and Beyond

Sam Jones (Plantlife Scotland), Andy Scobie (NatureScot)

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Foreword

Robbie Blackhall-Miles FLS (Plantlife Cymru and The Royal Society)

Twinflower falls into a group of species that can only be described as botanical 'big game' – species of plants that garner the attention of those interested in the same way as Elephants, Tigers, Bison or Koalas do. If a botanist finds themselves in Australia they find themselves wowed by Banksias or Eucalypts, in North America its Giant Sequoias or Seguaro Cacti, for South East Asia its Slipper Orchids or Titan Arums and in South Africa the focus would be Proteas or Ericas. Here in Northern Europe the botanical highlights list our ground orchids and our diversity of alpines, but the focus of this strategy stands out above all others.

Even the greatest botanists in the world will stop and take a photograph of themselves with Linnaea borealis. What makes it stand out? Well, its beauty cannot be denied - its pink, its delicate and its certainly symmetrical. It is, however, its links to a particular human that really make people show interest in it. The clue is literally in its name. It is the only plant that was named by its author for themselves. Carl Linnaeus is the father of the binomial nomenclature system that governs the way we now name all life on earth. His place in the history of natural history is central and since the publication of his Species Plantarum in 1753 it is sealed. It is this association that places Linnaea on top of the list of plant species that the world's botanists want to see one day.

It is, like many other members of the 'big game' list, threatened with extinction here at the edge of its world range. That threat of extinction in the UK should be a red flag for all other areas of the world where twinflower exists. The lessons we are learning here are lessons that will be valuable globally as the combined impacts of the planetary emergency take hold. So, it is my pleasure, both as a member of staff at Plantlife but also as a fellow of the Linnean Society of London (the world's oldest society for the study of Natural History), to see this strategy come into being. The impact of this strategy will not just be to protect Twinflower in the UK but also act as a benchmark for the joined-up conservation of species worldwide. Its publication acts to conserve not just a species but also a piece of cultural heritage. The conservation of this species has the attention of the world's botanical community. This strategy's publication has a reach so much wider than the consortium of wonderful organisations directly working together to ensure that Twinflower does not become extinct.

I am very proud to have been able to play my small part in it.

1 Summary

Vision - It is 2040 and we are on the path to creating: "within Scotland an ecologically and evolutionarily dynamic population of Twinflower, capable of producing outcrossed seed of high fitness, and able through this seed production to recruit new outcrossed clones locally, disperse seed to neighbouring patches, and establish new populations at suitable sites via natural colonisation" [1]. Many more Twinflower patches are known to be thriving in Scotland, with hundreds producing viable seed in abundance, and seedlings widely establishing. Connectivity is at the heart of this, with corridors planned within and between pinewoods, providing optimal habitat for Twinflower to thrive, and a long-term view recognising the need to adapt in a changing landscape. All practitioners and land managers are engaged with the Strategy, can see the change, and are stakeholders in this vision.

Rationale - In Scotland, Twinflower is currently known from fewer than 500 patches. These are relicts of a once more widespread population which has declined due to historical loss, fragmentation and degradation of native pinewoods. Remaining Twinflower patches are isolated both spatially and genetically, they are rarely able to cross-pollinate and set seed, and when they are, populations of only a few genetic individuals are reproducing. Translocation at carefully selected sites has been adopted as the main method to reverse the decline. Several distinct Twinflower clones are planted together to create a new population with increased genetic diversity and potential for cross-pollination and seed production. Since 2011, 116 translocations have been carried out. However, more action is needed, and no Scotland wide strategy existed to guide translocation and habitat restoration.

Mission - Plantlife's Mission is to support a dynamic, Scotland-wide strategy for Twinflower recovery, informed by research and consistent data, effectively coordinated and communicated across current and future restoration work. By 2040 the Twinflower restoration community will:

1. **Carry out 250 new Twinflower translocations.**
2. **Target the adoption of habitat connectivity plans in key Twinflower areas.**
3. **Be able to show successful seedling establishment around translocation sites.**
4. **Ensure all work is based on evidence and habitat modelling, including seed dispersal, woodland restoration, and climate change, with data made available to all partners.**

While securing Twinflower at all sites is desirable, given limited resources, action must be focused on reproducing patches. Land managers who support Twinflower will be engaged and supported where possible, with a focus on reproducing and key translocation sites. 13 key actions are highlighted which guide restoration.

2 Actions

Action Type	Action	Timescale	Responsible	Accountability
Governance A clear and effective system of communication among all practitioners.	1. Biennial Twinflower conferences.	Next in 2027	- Plantlife - CNPA	Conference reviews
	2. Establish and run Twinflower steering group, meeting quarterly.	Established in 2026	- Plantlife	Minutes circulated to wider group.
	3. Develop Twinflower spatial data resource and online hub.	2027	- Plantlife - BSBI - NatureScot	Reviewed by steering group. Timeline in development.
	4. Fully review Twinflower strategy	2030	- Plantlife	Review in 2030
Research and Knowledge A coordinated programme of research and surveys to inform the ongoing strategy and provide advice to practitioners.	5. Research partnership programme modelling Twinflower habitat connectivity spatially.	2026	- Research Partner - Plantlife	Supervisory involvement. Results circulated.
	6. Research partnership programme modelling and studying long-term changes to landscapes and habitat suitability.	2027	- Research Partner - Plantlife	Supervisory involvement. Results circulated.
	7. Continue to survey wild Twinflower patches and look for new patches.	Ongoing	- All	Site database targeting when needing survey
	8. Survey wild patches to identify reproducing sites and bring together with translocations to produce a list. Identify seedling establishment. Plan repeat surveys of reproducing sites.	Start in 2026	- Plantlife - All	Surveys of reproducing sites based on database. Seedling survey method.
Translocation Programme Collection and planting of cutting at both existing and new sites, and provision of resources to support this translocation work.	9. Continue to propose sites for and carry out translocations, based on land manager engagement, surveys, and modelling when available.	From now, update in 2027	- Plantlife - Key regional partners - All	Priorities and impetus guided by steering group.
	10. Support/joint lead with land managers to start Twinflower translocation in new areas or to continue translocation, based on modelling when available.	From 2026	-Plantlife - Key regional partners	Translocation occurring in new project areas.
	11. Maintain and where possible expand the provision of Twinflower from nurseries.	Ongoing	-RSPB -Balmoral Estate -Forest Research -Plantlife	All Twinflower cutting sourced from nurseries by 2040.
Land Management Advice Provide targeted support for land managers.	12. Support both engaged and unengaged land managers in Twinflower site management with guidance, training, outreach, and site visits.	From 2026	-Plantlife -CNPA	Resources available, staff engagement ongoing.
	13. Develop a Twinflower connectivity plan in partnership with land managers for key woodland blocks in core Twinflower habitat.	2035	-Plantlife -Key regional partners	Propose to key land managers in core areas by 2030.

3 Background and Evidence

This document is intended for an experienced audience, and if further background is necessary, the Twinflower Restoration Handbook, the Plantlife Managing Pinewoods Guide, or the Twinflower Leaflet should be consulted, all found on the Managing Twinflower page.

3.1 Twinflower

Twinflower Linnaea borealis is a perennial evergreen dwarf-shrub distributed across the boreal regions of North America, Europe, and Asia. In Britain it is rare, with remaining populations restricted to Scots Pine woodland in Northern Scotland, particularly Strathspey and Deeside 1. It will be reassigned as vulnerable on the UK red list by 2026. Twinflower favours moderately shaded pine woodlands, struggling to survive or flower in dense woods, but becoming swamped and outcompeted by taller growing shrubs such as Heather in more open habitat or undisturbed woodland. Habitat fragmentation has resulted in a serious Twinflower decline in the last few centuries. Clear fell and single-age structure pine woods negatively impact Scotland's Twinflower, with remaining sites heavily reduced and in nearly all cases, unable to cross-pollinate [2].

Twinflower Habitat, Glen Tanar

3.2 Current Status of Twinflower Patches in Scotland

In total, 438 unique patches of Twinflower have been recorded in Scotland since 2000, but 'new', previously unrecorded sites continue to be discovered each year. Taking account of these undiscovered patches, we may reasonably assume that ~500 total patches exist in the wild in Scotland. A slow but persistent decline of known patches has been recorded, with some patches reducing in size and density due to competition with dwarf-shrubs and changes in land-use (e.g. felling), and others disappearing.

Most remaining Twinflower patches in Scotland only contain one genetic individual (genet), which, when combined with isolation of patches, means they are unable to reproduce. The pollinators of Twinflower do not travel far, distances of as little as 30m can provide a barrier to frequent pollen exchange, meaning almost no patches in the wild are close enough for cross-pollination [3]. Twinflower is known to self-pollinate only very rarely. This means very little recruitment from seed can take place in the wild in Scotland, leaving remaining patches unable to disperse and recover, despite significant pine woodland restoration work. Twinflower translocation has been widely proposed to reverse this decline [2,3]. As the plant spreads vegetatively seemingly indefinitely with shallow roots, existing healthy patches can provide a source of cuttings for translocation to new sites, and they can be planted straight into the soil with reasonable success when habitat is suitable. Twinflower can also be collected and propagated in nurseries/clone banks (where it grows well) to protect genetic resources of rare patches, to ease the burden on wild patches for Twinflower cuttings, and to minimise collection effort. Practical guidance for delivering translocation work has been documented in the restoration handbook [1].

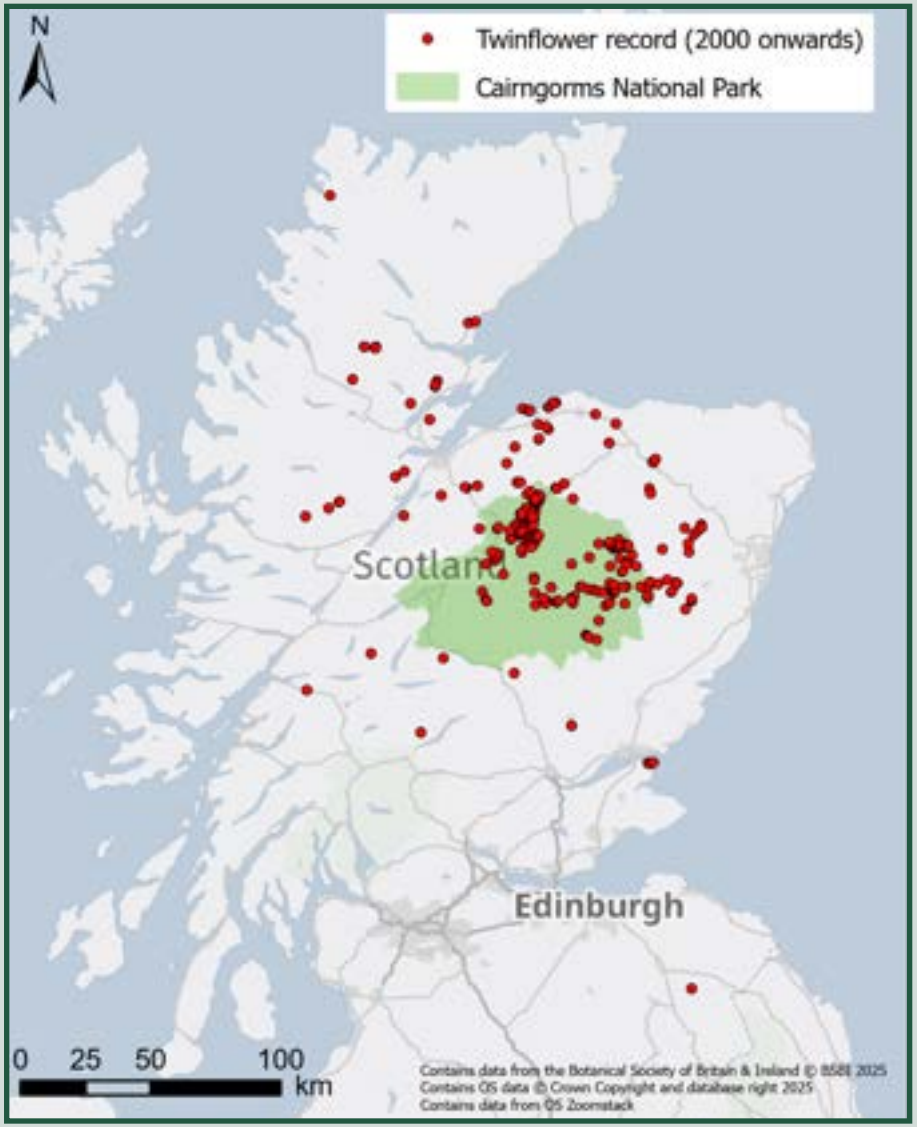

Figure 1: All known Twinflower patches in Scotland

3.3 Reproduction and Connectivity

In a genetic study of 123 Twinflower patches, 179 unique genets were recorded (an average of 1.45 genets per patch), and ~80% of patches contained just a single genet. Only 16% were expected to be able to produce seed, with only 6% within the optimal distance for pollination (<6m to a distinct genet) in Strathspey and Deeside [2,3]. Assuming remaining patches in Scotland (~500) support a similar rate of patches to genets as those analysed in Strathspey and Deeside, we can estimate that 725 genets are likely to remain in Scotland. At most, 5% of these genets are expected to experience cross-pollination and to produce seed. This status may have slightly improved through recent translocation effort, but is unlikely to significantly vary, and may serve as a baseline threshold from which to work from. However, in addition to the absence of cross-pollination, many wild patches persist in unfavourable conditions and are not flowering.

The production of viable seed alone will not ensure the recovery of Twinflower in Scotland. It requires suitable habitat in the vicinity of seed producing patches in which to germinate and thrive. Competition from understory woody species, such as Blaeberry Vaccinium myrtilus and Heather Calluna vulgaris, and a need for disturbance and bare ground for establishment, are thought to be the main limiting factors of seedling success. While mature Twinflower can compete, although not thrive, among denser understory species, seedlings cannot. Prior to anthropogenic changes, abundant Twinflower seed production would have been able to find niches without competition among young pine trees, or bare ground created by herbivores, in which to establish. Modern landscapes offer less of these niches. There is limited data on seedling establishment available, but it is expected that current seedling establishment across Scotland is extremely minimal.

Twinflower Seed, Abernethy

Even if we reach a point where widespread Twinflower recruitment is recorded, we cannot assume long-term sustainability. Minimum viable population is the concept of a minimum number of genets required to allow reliable persistence long term. This persistence includes adaptation to a changing world, which is particularly important given the climate crisis. Minimum viable population is extremely challenging to assess in plants, but somewhere between 2000-15,000 individuals may be needed for a healthy breeding population [4,5]. Currently, the largest breeding Twinflower population known in the UK supports 8 genets [2]. Widespread seedling establishment at individual translocation sites alone will not result in a minimum viable population in Scotland. We need a broader view of potential connectivity between sites, including widespread pollen exchange and seed dispersal. Scotland supports a reduced population of approximately 725 genets or less making them all genetically vital.

This strategy is based on reproducing sites. Reproducing sites are defined as patches of Twinflower which are known to, or have the potential to, produce significant quantities of viable seed. We expect all translocation patches to be reproducing sites given time, unless recorded as a failure, while only a few wild patches are reproducing sites (i.e. multi-clonal patches or 'clusters' with potential for seed production)

Twinflower Flowering, Dell Woods

3.4 Research and Knowledge Gaps

There are key knowledge and data gaps which limit our ability to effectively strategise Twinflower restoration. Existing translocation sites are being monitored according to methods set out in the Restoration Handbook, and a similar approach must be taken at new translocation sites [1]. Assessing where the next translocations should be sited within and between populations or where restoration should occur to improve connectivity across the landscape requires modelling and site survey data. Defining areas of priority for habitat restoration needs concerted effort.

Twinflower Seed Head, Heather Hall

Data Gaps	Current Status	Prioitised Need
Location and current status of Twinflower sites	Data mostly available.	1. High Priority: Improved data visibility and curation. 2. Medium Priority: Continued survey to find undiscovered patches.
Info on flowering and seed production	Data available from translocation patches, mostly lacking from wild patches.	1. High priority: Information on which wild patches are reproducing sites. 2. Low priority: Information on flowering of all patches.
Seedling establishment around sites	Minimal data available, key measure of success.	High priority: Information on the establishment of seedlings at reproducing sites.
Genetics of Twinflower sites	2016 study provides baseline data.	Low priority: Further evidence not needed for continued conservation effort but may be helpful, particularly in Twinflower nurseries[2]. Also, value in assessing minimum viable population.
Habitat suitability and woodland management around sites	Localised site-specific data available in certain circumstances.	High priority: Detailed survey data at and around reproducing sites, including patch threats and condition, land management, and habitat connectivity.
Wider habitat suitability and connectivity modelling across Scotland	None thus far.	High priority: Modelling or Scotland wide strategic planning is an important part of continued translocation and habitat restoration.
Modelling of habitat change in future	None thus far.	Medium priority: Expanded modelling and mapping work to futureproof Twinflower work.
Soil and mycorrhizal study	None specific to Twinflower thus far.	Medium priority: Further research on local soil preferences and associates to aid understanding of translocation failure.

Spatial modelling of Twinflower habitat suitability across Scotland will guide development of strategy targets over time. Where habitat suitable for Twinflower seed is well connected, translocation work can be prioritised. Where seed is being produced but potential habitat connectivity is lower, woodland restoration can be prioritised. Assignment of woodland blocks, Twinflower core area, and connectivity plans will be based on modelling research.

Ennos et al., 2016 effectively summarise the genetic plight of Twinflower and indicate the problems likely facing the entire UK population [2]. Knowing the number of genets in each patch is valuable, and further genetic study of Twinflower in Scotland would be beneficial, particularly when selecting cuttings for translocation. However, this work is specialist and can be costly, and its absence does not present a barrier to translocation or other conservation work. Production of viable seed in significant quantities is used as a proxy for the genetic diversity of patches, given Twinflower does not reliably self-fertilise. Where cutting collection is planned, all guidelines of the Twinflower handbook should be followed, with distance between patches sufficient evidence of genetic difference [1]. Where possible, all clones being kept in Twinflower nurseries should be genotyped.

We expect the Scottish landscape to change significantly over the next century. Where Twinflower restoration is occurring, futureproofing is vital. Establishing a fully functional Twinflower population via translocation, or restoring pine woodland, will take many decades. Climate change has implications for all species and land management as extremes of wet, dry, and hot become more commonplace. A prediction of Twinflower site suitability to 2080 in the Cairngorms under different emission scenarios does not suggest modification to the current understanding of site suitability [6]. We also expect, given the shift in land management priorities over the last few decades, that significant expansion of pine woodland may occur across Scotland in the next century. Amphlett, 2022 shows this will significantly increase opportunities for vascular plants including Twinflower in the Cairngorms Connect area, and a similar pattern should occur across Scotland [7]. Ongoing consideration for climate change, woodland expansion, and other long-term shifts in the Scottish landscape is key to an effective strategy.

Beautiful Twinflower Patch, Nethy Bridge

3.5 Conservation

Translocation aims to increase the frequency of sexual reproduction of Twinflower. Whether a translocation is a reintroduction (planting at a new site) or a reinforcement (planting around an existing wild patch/patches), sites where translocation is planned, being done, or complete, are considered reproducing sites (unless monitoring evidence suggests otherwise at a later point). If translocation is well planned and maintained, we expect it to result in seed production within about a decade. Ideally sufficient material will be provided for most/all translocation in the long term by Twinflower nurseries.

Figure 2: Left: A typical Twinflower cutting of ~40cm with root and leaf nodes. Right: A planted Twinflower cutting.

The first rigorous and officially monitored translocations of Twinflower in Scotland were carried out in 2011 as part of the Cairngorms Rare Plants Project. The earliest translocation site, near Nethy Bridge, is now thriving (4 of 6 clones surviving), flowering prolifically, and producing seed in abundance. Since then, a total of 116 reintroductions and reinforcements have been successfully carried out in 7 different projects across the Cairngorms and north central Highlands (Table 2, Fig. 4 and 5). Follow up monitoring from the oldest of these translocations has shown most of the clones planted at each site have survived and continue to expand, and within about a decade seed starts to be produced in abundance.

In the Cairngorms Nature Action Plan (2019-2024) species recovery curve, Twinflower is recorded as being at stage T2 (trial management underway but not yet clear evidence that it can deliver objectives) and moving into stage T3 (trial management is providing strong indication that it will deliver objectives). As reassessed in this strategy, Twinflower is past this phase of action. Restoration work is well studied and established, and translocation action since at least 2020 has been implementing solutions (the R stages). It is unlikely however, that Twinflower will move beyond R3 (Solutions enable achievement against population/ range targets but only with continued conservation intervention) for many decades.

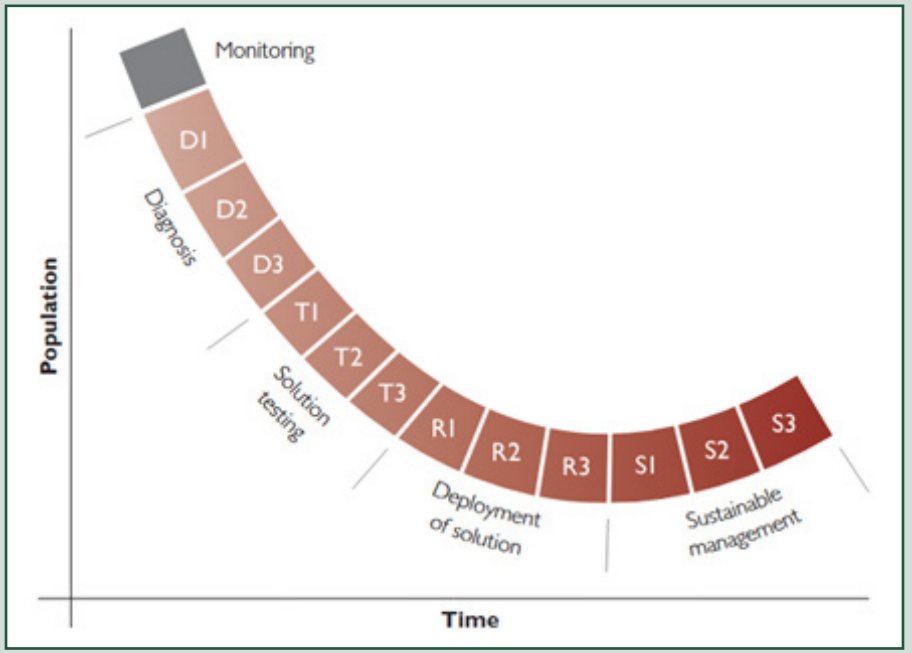

Figure 3: The species recovery curve, taken from the Cairngorms Nature Action Plan 4

Project	Type	Planting date	No of sites/ blocks
Cairngorms Rare Plants Project	reinforcement reintroduction	2012 - 2014 2011 - 2014	4 11
Cairngorms Rare Plants Project + Cairngorms Connect	reinforcement	2014 + 2019	3
North Highland Twinflower Project	clone bank reintroduction	2018 2018 - 2022	1 49
	reintroduction	2018 - 2022	49
Cairngorms Connect	reintroduction	2020	10
NTS Mar Lodge Estate	reinforcement reintroduction	2021 - 2022 2019 - 2024	2 11
RSPB Crannach Reserve	reintroduction	2022	2
Balmoral Estate	reinforcement reintroduction	2022 - 2024 2022 - 2023	7 6
Plantlife	reintroduction	2023	10
Total			116

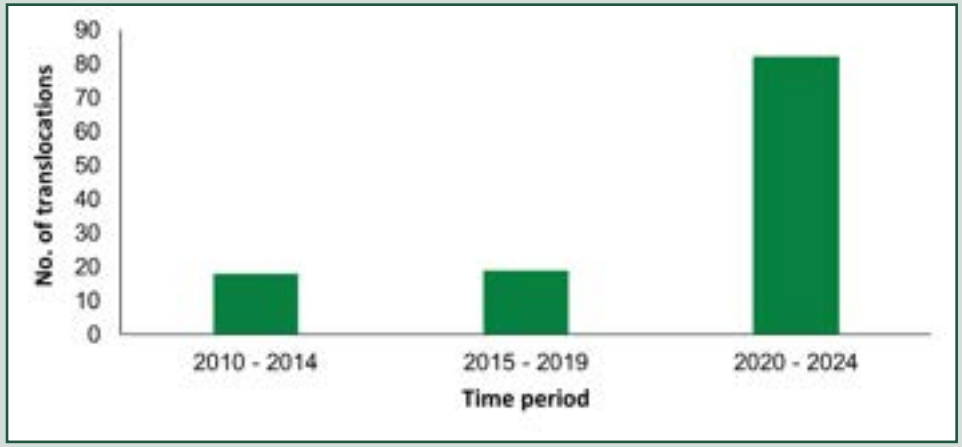

Figure 4: Number of twinflower translocations implemented within three-time periods.

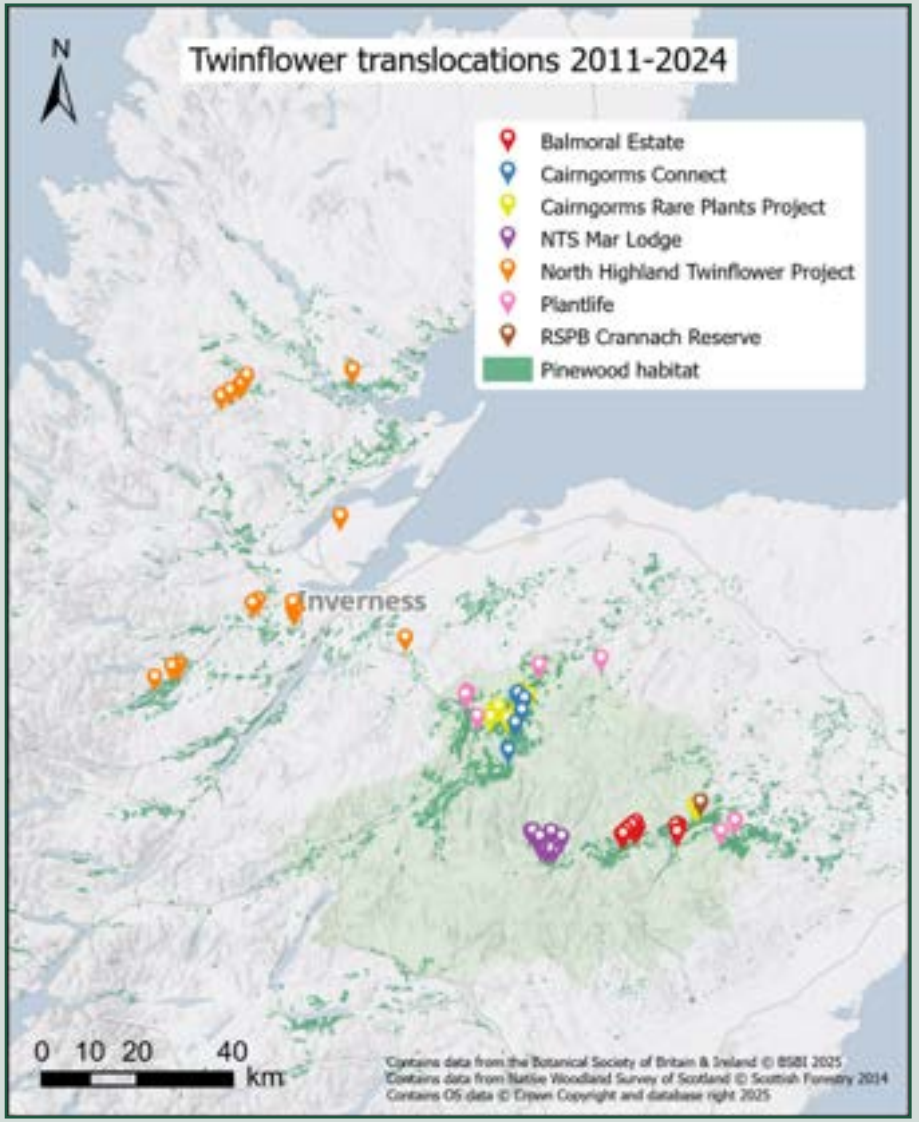

Figure 5: Twinflower translocation sites in Scotland

4 Strategy Details

Based on a Twinflower conference in 2023, and another in 2025 attended by nearly 50 participants representing a wide variety of stakeholders, this strategy has been produced. It is a 1st version for Scotland, and we are seeking ongoing input from all stakeholders. Plantlife have led on the strategy document and will coordinate delivery of actions where appropriate. Thirteen key actions are summarised in Section 2 to implement this strategy. These fall under four main headings, governance and research in support of conservation action, and translocation and habitat work. Note that responsible organisations listed in the table do not indicate any confirmation or guarantee of responsibilities taken on by partners, or Plantlife. This indicates potential for future project partnership and work and will be consulted on further.

Twinflower Junior Ranger Repotting, Drumin Wood

Twinflower Site Prep, Anagach Wood

Governance: It has been proposed that alongside a biennial Twinflower conference open to all stakeholders including newly interested partners, a core Twinflower steering group is established. This group may meet quarterly online or in person and, among other responsibilities, update upon strategy progress. This strategy will be reviewed and maintained as a consensus, enacted by all Twinflower stakeholders. Twinflower data access needs have also been discussed, and there is expected to be on going consultation on exactly what format this may take. It was agreed after the 2025 Twinflower conference however, that conservation practitioners would like to have access to and aid in the maintenance of a Twinflower database.

Research and Knowledge: A master's proposal has been drawn up to model Twinflower habitat suitability and potential woodland connectivity in Scotland. It is hoped a student will start work on this in Autumn 2025, with supervisory support from Plantlife. Further research investigating long-term habitat changes, climate change, and Twinflower dispersal has also been proposed. Key to this strategy implementation is reliable data gathering at reproducing patches (including all translocation sites), focused on flowering, seed production, and when relevant, seedling establishment. However, non-reproducing sites should not be ignored. Wild patches may be producing seed without our knowledge. Where Twinflower sites come under imminent threat, for example, if a site is clear-felled, the patch should also be monitored. The ongoing method of survey for reproducing sites is to be developed, but will be based on the translocation monitoring method, with surveys ~every 5 years after the initial (more intensive) 10 year monitoring period has ended [1]. Ensuring this information is widely available to all practitioners is also key.

Translocation: Plantlife and other key partners will continue to enact, promote, and support translocation across suitable habitats in Scotland. Expanded translocation work is required to hit the target of a further 250 translocations by 2040. While all translocations can be impactful, precisely how and where they occur, and how land is managed on and around these sites, will cause huge variation in restoration outcomes. Ensuring landscape-scale connectivity between populations across different landholdings, considering long-term seed distribution, and planning for climate change, are a few examples of the considerations which should be made collectively rather than individually. Sites with optimal habitat and management but no reproducing populations will be prioritised, particularly in key areas which may connect populations. Ensuring support is available for a larger coalition of stakeholders to enact their own translocations will also help us reach this target, with aid in licensing, planning, site management, and the provision of Twinflower cuttings via nurseries. Thus far, translocation has been carried out by 7 partners, and it is hoped that with additional support, this number will increase. There is need for more translocation everywhere to connect non-reproducing patches. However, some core pinewood areas have not yet fallen under project focus, namely the Moray coast, NE and SW Strathspey, Donside, and eastern Deeside regions.

Land Management Advice: Most land managers are not expected to take a direct approach to Twinflower restoration, and those that do will still need guidance on how and where to manage pinewoods optimally. Enhancing landscape scale connectivity of Twinflower populations is the long-term goal of this work. Based on spatial modelling, woodland within the core Twinflower range can be categorised into woodland blocks. These are areas of woodland which may, in the not-too distant future, support interconnected multi-clonal populations of Twinflower. For example, the Glen Tanar, Craigendinnie, Ballogie woodland block, or the Abernethy-Craigmore-Revack woodland block. Within these landscapes there should be ambitious goals, alongside increased translocation, to create corridors of suitable seedling habitat connecting reproducing populations. Site connectivity plans within these woodland blocks could be developed in partnership with land managers to facilitate this work.

5 Implementation

To all partners and stakeholders, please read the actions in Section 2 and carefully consider how they may be implemented by you. If you are mentioned in the responsible section, Plantlife will be in touch in time to plan potential partnership work. Otherwise, of note for all partners are actions 7, 8, and 9.

Site selection and translocation activity should be based on the protocol set out in the Twinflower Restoration Handbook. Any site where Twinflower is currently present, habitat is suitable, and management is secure long-term, is worth consideration for translocation. Where no Twinflower is present near a proposed site (within a few kilometres), but habitat is suitable and secure, any potential translocation work should be discussed with experts prior to implementation. Distance to extant patches and the presence of historic records of Twinflower on site will inform site selection.

Anyone who is planning to implement a Twinflower translocation must complete a Translocation Project Proposal Form and submit this to the Licencing Team at NatureScot, who will assess the proposal and issue a licence where appropriate. Search for the Scottish Code for Conservation Translocations for details. Plantlife may be able to support and is aiming to provide resources on the Twinflower hub online to assist with license applications.

Biosecurity must always be considered when translocating species. Biosecurity risks will be assessed as part of the proposal form submitted to NatureScot and should be taken seriously. Twinflower translocation is a relatively low risk activity however, as cuttings are typically transferred locally and are bare rooted. Where cuttings are taken from a nursery, risk may be greater and additional measures should be taken, as pests and diseases tend to gather in these settings. See the Plant Health Centre Biosecurity best practice for conservation guidelines for details.

Plantlife manage a group of volunteers who are keen and engaged in Twinflower work. This resource is available to any partners seeking to perform surveys, habitat restoration work, or translocation. Volunteers will also assist in the maintenance of Twinflower nurseries. Assigning Twinflower patches to volunteers for regular surveying is a practical method to get up to date information about all ~500 patches present in Scotland.

Plantlife has and will continue to work to ease the barriers to Twinflower translocation, but nonetheless it is expected most land managers will not be able to lead on Twinflower translocation. Where land managers cannot take the lead, but translocation is desired (e.g. modelling has identified this is a key area for restoration) Plantlife (and other lead partners) will aim to work in partnership with land managers. This will involve sharing responsibilities for planning sites, organising translocation licenses, collecting Twinflower material, and monitoring wherever possible. This approach will ideally encourage, further engagement from land managers in Twinflower conservation, secure sites long term, and allow more translocation to be carried out.

Meaningful improvements to habitat connectivity will be achieved by engaging and working with land managers. This work relies on maintaining positive relationships with all those who support Twinflower on their land as there are currently no direct financial incentives for positive Twinflower action. Modification we seek to aid Twinflower habitat connectivity may be significant, require time and investment from landowners, and need to take precedence over other land use choices. Producing and implementing a Twinflower connectivity plan, alongside maintaining existing Twinflower patches, will require significantly more commitment. However, plans committed to Twinflower connectivity will improve habitat for a wide range of pinewood species (e.g. controlling Heather benefits Capercaillie and Twinflower), aligning with ecologically minded landowners' objectives.

Twinflower Cutting Flowering, Seafield Wood

5.1 Partnership and Funding

Most translocation work to date has been undertaken within the Cairngorms National Park, and its conservation is a key part of the Cairngorms Nature Action Plan. The protection of Twinflower contributes to the Scottish Biodiversity Strategy, the Highlands Biodiversity Action Plan, and the Global Strategy for Plant Conservation, as although Twinflower is not red listed in the UK, it is under threat, in need of intervention, and a Biodiversity Action Plan species. Planning and implementation based on this document may also provide a model for the protection of other species. Nature Networks and 30x30 led by Nature Scot work well alongside the needs of Twinflower and this strategy, with the restoration and connectivity of pinewoods key to success. It is also crucial that this work connects with the burgeoning Caledonian Pinewood Partnership, and that other opportunities for partnership are taken up when available. Where any stakeholders in Twinflower are involved with partnerships which may be relevant, please reach out on behalf of the Twinflower community and, where relevant, inform Plantlife or other lead partners.

Where managers apply for a Forestry Grant Scheme to support an existing woodland, the presence of Twinflower, and a survey/assessment of the population and status, will aid an application. If work needs to be done on a site to improve the status of a Twinflower patch (such as thinning or removal of non-natives), a Forestry Grant Scheme application may offset costs. Forestry Grant Scheme applications for the creation of new woodland may aid long-term connectivity and can be mentioned as part of a landscape scale plan. Plantlife and other partners are planning to maintain funded project support for Twinflower work, with a particular focus on supporting translocation. This will focus on supporting nurseries, providing resources, and driving impetus, but there will also be time and resources for surveys, advice, and groundwork available. Volunteer support is also available.

5.2 Monitoring

Monitoring of Twinflower translocation on the ground should be carried out according to the Twinflower restoration handbook 1. This section discusses monitoring outcomes of this document.

There are three main ecological outputs targeted in this strategy:

1. **250 new Twinflower translocations completed by 2040.**
2. **Habitat connectivity plans created and implementation commencing by 2040.**
3. **A validated method for identifying successful seedling establishment around translocation sites in use and giving positive results by 2040.**

These three guiding outputs need framing in evidence. We cannot inform our work, justify the need for resources, or celebrate success without understanding impact and learning from failures. Detailed monitoring methods for these key ecological outputs will be developed as project work continues.

Actions recommended to enable these outputs are listed in Section 2, and each action includes a brief mention of accountability. Expanding on these proposals:

1	Biennial Twinflower conferences provide a public and open forum to discuss and feedback on progress towards Twinflower restoration.
2	Quarterly Twinflower steering group meetings will plan implementation and feedback to wider group as necessary.
3	Twinflower data hub to be proposed in future project work.
4	This strategy to be fully reviewed in 2030.
5&6	Research partnership managed via supervisory support with results circulated as relevant.
7	A Twinflower data resource identifying gaps in data to direct surveys.
8	As point 7 with a focus on reproducing sites and a validated seedling establishment survey method.
9	A Twinflower translocation review and action plan to be produced by the steering group as part of future project work
10	As above, including provision and maintenance of support for translocation.
11	Maintenance and expansion of nurseries in Strathspey (RSPB Abernethy), Deeside (Balmoral and Forest Research), North Highlands (Alladale), and elsewhere as necessary to provide all material for Twinflower translocation by 2040.
12	All land managers who support Twinflower have been contacted, given opportunity to be involved, and are provided with the resources needed to answer questions and aid in conservation.
13	All key land managers in core Twinflower areas are engaged about connectivity plans by 2030. The completion and commencing implementation of more than one of these plans by 2040.

6 Strategic Partners

Plantlife
The global voice for wild plants and fungi

savills

NATIONAL TRUST *for* SCOTLAND

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SCOTTISH WOODLANDS

Cairngorms Connect

Forestry and Land Scotland
Coilltearachd agus Fearann Alba

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