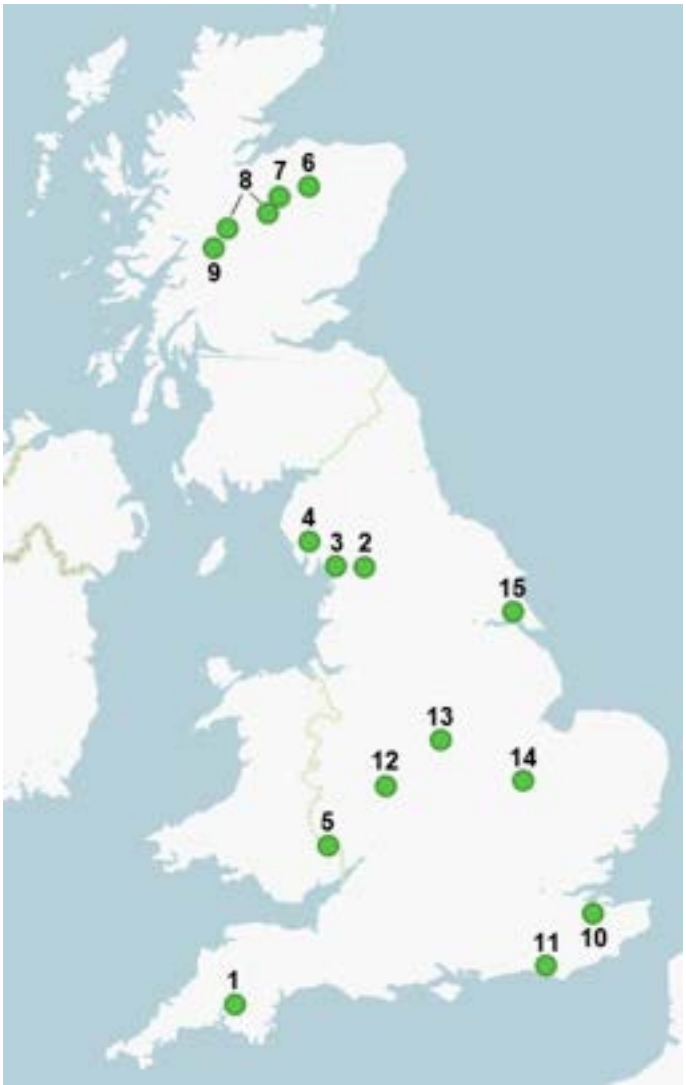
Factsheet: Case studies of woodland creation through natural colonisation

Natural colonisation: what to expect?

Natural colonisation has the potential to create biodiverse, locally-adapted woodlands, and help expand tree and woodland cover across the UK, but the outcomes of the resulting habitat are uncertain. These fifteen case studies provide an overview of some of the timescales and outcomes of creating woodland through natural colonisation in a range of habitats across Britain. The natural colonisation across the case studies spans 0.5 – 1000+ ha and 2 – 70 years, and cover both upland areas (Case Studies 1 – 9) and lowland areas (Case Studies 10-15). In lowland England, the timeframe for naturally-colonised woodland to resemble mature woodland varies from within 50 years (Monks Wood, Case Study 14) to much longer (e.g. very low tree cover after 30 years at Noddle Hill, Case Study 15). In the Scottish Highlands, young woodland can form within 30-40 years under intense deer management, but this is also highly variable (Case Studies 6,7,8).

As the case studies were collected from different sources, it was not possible to provide the same level of detail for every site. Some case studies are too recent to provide information on tree establishment, but are included to show the breadth of examples where natural colonisation is being used across Britain.



Map of case studies

Why use natural colonisation?

Biodiversity restoration is a key aim in the vast majority of the case studies. Many site managers view the longer time taken to form a structurally diverse woodland, with locally-adapted seedlings, as strong benefits of using natural processes over tree planting. However, **half of the case studies also had areas of tree planting**, to help meet site goals such as habitat restoration, through planting of species that were not present in mature form as seed source, or to ensure the development of some closed-canopy woodland within a shorter timeframe.

Some key lessons learned

Deer management is key to success in the uplands, but exactly what density of deer young woodland can support is still uncertain.

Proximity to a seed source is also crucial for colonisation of diverse seedling species. All case studies had some mature native trees or woodland nearby as seed sources.

There are many remaining key knowledge gaps, such as whether to intervene when young woodland is dominated by a small number of colonising species, how best to manage the variable outcomes of natural processes, and understanding the roles of soils and mycorrhizae.

Uplands - Case study 1
Dartmoor Atlantic Oak Woodlands (Merrivale)

Case study provided by Thomas Murphy, University of Plymouth

Publicly accessible
Grid ref. SX551741

Aims of the natural colonisation: The natural colonisation is unplanned with no dedicated planning, however, lower density and mixed growth forms of seedlings might support movement/ expansion of epiphyte lichen species from adjacent ancient oak woodland habitat.

Site description: Upland landscape of west Dartmoor, dominated by grassland and scrub habitat, bordering Sampford Spiney SSSI. The dominant land uses are grazing livestock (sheep and cattle) with some existing oak woodland. There are large granite boulders and the soils are podsols.

Area set aside for natural colonisation: ~1 ha

Year that natural colonisation began: 2010 – 2015

Young oaks (Thomas Murphy)

Seed sources for natural colonisation: Nearby oak woodland

Preparation actions prior to the natural colonisation: None

Maintenance during establishment of natural colonisation: None

"Both natural colonisation and tree planting have a role to play in creating resilient woodlands – the choice depends on the context.

Natural colonisation does not always create better woodlands – some natural colonisation is species poor and will be for a long time."

Which species have successfully colonised, and where? What is the resulting woodland structure? Relatively low species diversity and slow colonisation: oak has colonised up to 10m from the existing woodland edge, with rowan, holly and hawthorn 50 to 100m away. The site is a long way from closed-canopy woodland. Some saplings old and very small, others tall – site has high vertical diversity.

Dominant drivers of natural colonisation: Both granite clitter and bracken can protect seedlings from grazing livestock and provide shelter. Acorns are mostly wind-dispersed here, so oaks only establish 10m from the seed source. Sheep browsing, exposure and competition from the grass sward limit seedling establishment.

Lessons learned: Natural colonisation is complicated - in particular areas, it's not simply a matter of removing animal grazers – expansion site might need a helping hand to kick start the process.

Key challenges: Particularly in upland landscapes, lack of existing trees as a seed source nearby and dispersal agents means it is not always true that natural colonisation produces species diverse woodlands. The species mix and speed of natural colonisation are unpredictable, which puts us at risk of failing to achieve desired outcomes. This also makes planning very difficult as management of naturally colonised sites will look different in each location.

Advice for others: Supporting natural colonisation will involve different approaches at different sites, depending on the context and landscape. Consider the woodland objectives. Natural colonisation alone won't always provide all of these. Think about the suitability of conditions for trees through time and adapt management accordingly.

Knowledge gaps:
Role of natural colonisation in supporting movement of key taxa from upland refugia sites? Landscape constraints to natural colonisation and role of natural colonisation in supporting wider resilience and functioning compared to planting approaches? How might planting support improved natural colonisation outcomes? Influence of herbivore behaviour on natural colonisation processes?

Also see Murphy *et al.* 2022 https://doi.org/10.1002/2688-8319.12126 and 2024 https://doi.org/10.1016/j.foreco.2024.121895

Uplands - Case study 2

Wild Ingleborough, Yorkshire Dales

Case study provided by George Porton, University of Leeds

Publicly accessible

Grid ref. SD742758

Aims of the natural colonisation: Nature restoration and conservation

Site description: Upland limestone pavement landscape in the Yorkshire Dales. Entire site area is 1195 ha, covering approx. 300-650m elevation, with habitats of limestone grassland, acid grassland, blanket bog and fragments of remaining woodland. In the past the entire area was grazed by sheep. Over the years different areas of land have switched to no grazing or cattle grazing, following the removal of sheep.

Area set aside for natural colonisation: Sheep are slowly being removed from site although this process is not yet complete. Extensive cattle grazing and livestock exclusion used to promote colonisation. Total site area is 1195 ha, with a 31 ha area forming the most successful colonisation site, and saplings establishing at a lower density across a much wider area.

New woodland on limestone pavement after 40 years of natural colonisation (Dominick Spracklen)

Year that natural colonisation began: 1977 onwards, varying across the site.

Other methods of woodland creation: None

"A closed canopy woodland has not developed after 40+ years. However, that may be due to the limestone pavement creating open areas, slow growth in uplands , limited seed source and the main canopy tree of Ash suffering from die back"

Seed sources for natural colonisation: Existing woodland fragments that make up less than 3% of the habitat at the site (distance from these to our survey plots ranges 0 – 2000 m)

Which species have successfully colonised? Mainly ash, rowan, hawthorn, juniper and hazel. Trees such as Oak and Birch uncommon in colonising trees, suggesting planting needed for diverse woodlands.

Timeframe for natural colonisation: From modelling the process based on recent patterns of tree establishment, we predict a density of 1000 stems per hectare 90 m from woodland, 30 years after sheep are removed. There is a lot of uncertainty around this estimate currently, but we hope to improve our understanding of this through further data collection. Cattle grazing across the site means that trees are establishing slowly, but mostly still a long way from forming a closed-canopy woodland.

Dominant drivers of natural colonisation: Grazing by sheep significantly hindered natural colonisation. Natural colonisation also more effective closer to existing woodland and on areas of limestone soil (possibly because the limestone pavement protects seedlings), rather than peat. Natural colonisation was possible on areas extensively grazed by cattle and areas where livestock were excluded altogether.

Key challenges: Lack of existing seed sources and land ownership/influence over grazing management.

Key knowledge gaps: How different grazing regimes affects natural colonisation (e.g. species, intensity, timing); the dispersal/colonisation abilities of different tree species; how soil type and existing ground vegetation affects natural colonisation. and how those interact with grazing type. How does natural colonisation affect soil carbon?

See Porton *et al.* (2024) Ecological Solutions and Evidence 5(2): https://doi.org/10.1002/2688-8319.12338

Uplands – Case study 3

Gait Barrows NNR, North Lancashire

Publicly accessible
Grid ref. SD478768

Case study provided by Jim Turner, Natural England and Bill Grayson, Morecambe Bay Grazing Company

Aims of the natural colonisation: Woodland creation is not a primary objective of the management of the site, but blurring ecotones (supporting transitional areas between habitats) to positively impact biodiversity is a part of the management plan. This has led to natural regeneration of scrub and some woodland species in areas of semi-improved grassland.

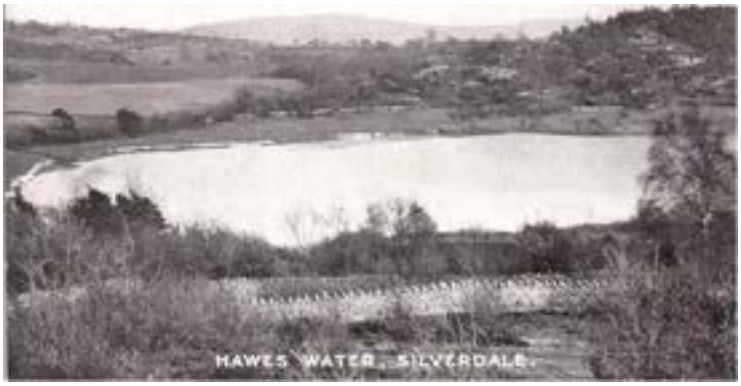
Site description: 122 ha nature reserve, predominantly calcareous grassland, with alkaline fen, woodland, and limestone pavements.

Year that natural colonisation began: 2020

Other methods of woodland creation: None

"There is a risk in the form of reducing the diversity of vascular plants in the meadows due to the shift in grazing, scrub colonisation and ranker sward."

Seed sources for natural colonisation: Nearby established woodland of hawthorn, blackthorn, hazel, ash, oak, sycamore, yew and other species. The site includes ancient woodland and mature hedgerows.



Preparation actions prior to the natural colonisation: None

Maintenance during establishment of natural colonisation: Deer management across the site, and winter cattle grazing.

Which species have successfully colonised? Blackthorn and hawthorn are frequent pioneers with seedlings/saplings of oak and hazel also often found

Is natural colonisation proceeding in line with expectations? Scrub colonisation has occurred faster than anticipated but is broadly in line with expectations.

Dominant drivers of natural colonisation: The grazing pattern of the cattle are the dominant pressures. The natural colonisation is largely due to shifting from late summer grazing to winter grazing and has enabled the blurred ecotones and scrubby regeneration.

Successes and reasons behind them: Given the close seed sources and switch to winter grazing, scrub establishes easily, starting the process of transition to woodland.

Failures and reasons behind them: For this site it may be that we are losing too much of the species rich grassland habitat to scrub and may need to revise grazing patterns/management to take this into account.

Images - Top: Gait Barrows at around 1900, looking Southwest from an area that has now formed closed-canopy woodland through natural colonisation; middle: view of scrub/pasture looking North to South (Bill Grayson); bottom: reverse view looking South to North, showing mature woodland following ~100 years of natural colonisation (background) and pastures kept open prior to the switch to winter grazing in 2020 (foreground; Jim Turner).

Uplands - Case study 4

Hardknott Forest, Cumbria

Case study provided by Dominick Spracklen, University of Leeds

Publicly accessible
Grid ref. SD235995

Aims of the natural colonisation: Nature restoration

Site description: Upland site of 630 ha, spanning ~100-500 m above sea-level. Habitats are primarily ex-conifer plantation (previously moorland or improved farmland), unplanted moorland, and unimproved farmland, and some native woodland.

Area set aside for natural colonisation: 300 ha

Year that natural colonisation began: Around 1998

Other methods of woodland creation: None

"Natural colonisation provides a varied mosaic of sapling densities, but there is anecdotal evidence that sapling density is lower in wet peaty soils."

Seed sources for natural colonisation: Fragments of mixed native woodland, including oaks, birches, rowan, holly and willows

Preparation actions prior to the natural colonisation: Clear felling of conifer forestry close to native woodland, which facilitated natural colonisation in those areas. Some natural colonisation has also taken place on unplanted moorland and unimproved farmland.

20 years of natural colonisation (D. Spracklen)

Maintenance during establishment of natural colonisation: Removal of non-native conifers, deer culling, maintenance of stock-proof boundary fence and exclusion of sheep.

Which species have successfully colonised? 13 species dominated by birch, rowan and willow, at an average density of 3000 saplings/ha. Rowan was the initial coloniser in the first 2-3 years after clear felling, after which the other species increasingly colonised.

Colonisation distance and timeframe: Closed-canopy woodland has developed in 15 years in some areas. Saplings have established up to 2000 m from the nearest seed source, but the vast majority are within 100 m

Successes and reasons behind them: Near to native woodland remnants, clear felling conifer plantation results in conditions favourable for natural colonisation – the soil disturbance enhances the density of native saplings. However, controlling conifer regeneration is crucial for the development of native broadleaf woodland, as are removing sheep and managing deer, and maintaining the boundary fence. Colonisation is generally most effective in free-draining areas rather than wet, peaty soils.

Also see Spracklen *et al.* (2013) 'Regeneration of native broadleaved species on clearfelled conifer plantations in upland Britain' https://doi.org/10.1016/j.foreco.2013.08.001

Uplands - Case study 5

Dunkard, Cross Ash, Monmouthshire

Case study provided by Jenny Knight and Kate Beavan, Stump up for Trees

Not publicly accessible

Monitoring young planted trees (Jenny Knight)

"We are examining whether including seed source of a wider variety of native species will encourage further development, as part of a 12-year monitoring programme that we have just started"

Aims of the natural colonisation: Restoring a previous woodland site (pre 1970s), water management, creation of biodiversity corridors, ecological restoration, stock improvements.

Site description: Pasture to natural colonisation. The surrounding landscape is also mostly permanent pasture. Site area: 4.05 ha

Area set aside for natural colonisation: 0.5 ha

Year that natural colonisation began: 2022

Other methods of woodland creation: Various woody habitat created by planting (various densities and species mixes): dispersed scrub woodland, 5m wide hedgerow, wood pasture, medium density native broadleaf, wet woodland

Seed sources for natural colonisation: Adjacent woodland and hedgerows

Preparation actions prior to the natural colonisation: The site is enclosed by stock fencing (not deer-proof).

Maintenance during establishment of natural colonisation: We are currently reviewing the need for fencing/tree guards as protection from livestock. So far, we haven't used any plastic guards at this site, and will continue to do so as long as survival rates remain high. Planted trees are now fairly tall, which helps withstand browsing damage.

Which species have successfully colonised? Mostly goat willow so far – but very little time has lapsed since the area was set-aside for natural colonisation. So far, planted saplings are establishing much faster than natural colonisation.

Is natural colonisation proceeding in line with expectations? In summer 2024, monitoring revealed increased prevalence of deer in the area, evident in losses in the corner nearest to the old woodland. This may also explain a lack of diversity in the natural colonisation at this early stage. Survival rates in planted trees across the site are otherwise good at a live rate average of 77 per 100.

Planting with volunteers (Jenny Knight)

Publicly accessible
Grid ref. NJ230257

Uplands - Case study 6

Tomnavoulin and other woodland grant scheme sites, Scottish Highlands

Case study provided by Richard Thompson, Forestry and Land Scotland (at Forest Research when this privately owned site was studied)

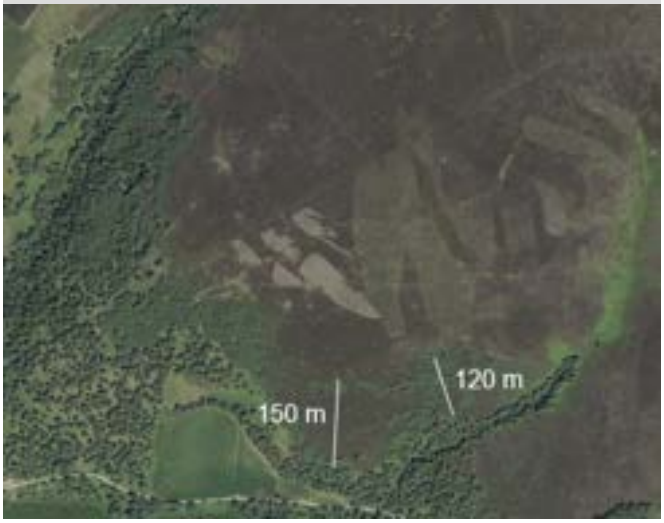
Aims of the natural colonisation: Native woodland restoration

Site description: Upland dry heath with 20 ha of mature upland birchwood at the base of the hill

Area of natural colonisation: 6 ha now established

Year that natural colonisation began: 1987, after a large, intense fire

Other methods of woodland creation: None



Tomnavoulin in 2021, with distances of newly colonised woodland from the seed source (Richard Thompson)

"A disturbance event can deliver lots of naturally colonised trees if seedlings are then protected. However, fire in particular causes considerable loss of biological diversity."

Tomnavoulin in 2001 (Richard Thompson)

Seed sources for natural colonisation: Existing birchwood

Preparation actions prior to the natural colonisation: Intense fire in mid 1980s.

Maintenance during establishment of natural colonisation: Ongoing deer management.

Which species have successfully colonised? Very limited diversity – almost entirely birch.

Colonisation distance and timeframe: At Tomnavoulin, young woodland has formed up to 120-150 m from the existing woodland edge in ~35 years, with some saplings at a distance of 600 m. In general in the Highlands, 90% of seed falls within 60 m of the nearest canopy edge; and colonising birch can close canopy after 10 years in favourable conditions.

Successes and reasons behind them: At Tomnavoulin, the lack of vegetation competition after the fire and infertile, free draining podsolic soils have supported natural colonisation of windblown birch seeds. The colonised area is also downwind of the existing woodland.

Dominant drivers of natural colonisation: From multiple sites in the Highlands, we know that removal of deer or sheep facilitates rapid colonisation and/or growth of existing but heavily browsed seedlings. Seed source (extent and proximity) and competing vegetation (particularly for small-seeded species) are also key. In general, drier, infertile sites appear best suited to forming closed-canopy woodland. Colonisation is most likely to fail where burning or sheep grazing recommence, or deer culling is reduced. Selective browsing by deer can greatly reduce the species diversity of established woodland: animal dispersed species such as rowan, holly, oak and hazel are all very palatable to deer and these rarely get chance to successfully establish, even in suitable sites with a seed source nearby.

What are the main knowledge gaps? What is the role of mycorrhizae? What is the full mechanism of background seed rain – e.g. dispersal distances in well-wooded landscapes compared to against isolated stands? Low-density grazing with cattle to support colonisation appears to be a black art, as they can still preferentially browse palatable species. How to avoid unwanted colonisation of priority habitats (e.g. calcareous grassland).

Also see Thompson (2004) 'Predicting Site Suitability for Natural Colonisation: Upland Birchwoods and Native Pinewoods in Northern Scotland' https://cdn.forestresearch.gov.uk/2022/02/fcin054-1.pdf

Uplands - Case study 7

Cairngorms Connect, Scottish Highlands

Case study provided by Pip Gullett, RSPB

Publicly accessible
Grid ref. NH960163

Aims of the natural colonisation: Landscape-scale nature restoration.

Site description: 60,000 ha mixed upland site: heath, bog, wetlands, montane areas, Caledonian pinewood, and some upland birchwood. Much of the area was historically cleared and heavily grazed.

Area set aside for natural colonisation: ~164 ha establishing annually, over a 6,300 ha regeneration zone.

Year that natural colonisation began: Early – mid 1980s, in line with increased deer culling.

Other methods of woodland creation: There were small areas of planting in locations remote from existing seed sources, to develop seed sources for future natural colonisation.

"Monitoring of comparable areas in SW Norway suggests that natural colonisation supports a fuller suite of species, including habitat for priority species such as black grouse and beaver."

Seed sources for natural colonisation: Existing established mature trees and woodland – mostly birch and pine, with some other broadleaves.

Preparation actions prior to the natural colonisation: Coordinated deer culling across the entire site, with small areas of shrub cutting to increase the niches available for colonisation.

Maintenance during establishment of natural colonisation: Ongoing deer management

Which species have successfully colonised? Mostly Scots pine and some birch, usually within 50m from the nearest seed source, but occasionally several kilometres away. Rowan occasionally colonises remote areas by bird dispersal. On open the open hill, seedlings sometimes colonise downwind of a mature tree, demonstrating that prevailing wind affects dispersal.

Caledonian pinewood colonisation in the Cairngorms: 1973 (above); 2023 (below) (NatureScot)

"There are some surprises, such as successful natural colonisation on one side of a valley but not the other. We don't fully understand the effects of aspect, soils, microclimate etc. in this context."

Successes and reasons behind them: Deer control was key, which led to a sudden 'pulse' of colonisation. Some shrub clearing also reduced competing vegetation. There are also social and wellbeing benefits in restoring woodland to parts of the uplands.

Failures and reasons behind them: Few broadleaves colonise with success, but these are highly palatable, with limited seed sources. Montane willows, dwarf birch and high altitude downy birch are too scarce to provide sufficient seed (and genetic variation) for natural colonisation, making some planting necessary.

Key knowledge gaps: What is the influence of soil and mycorrhizae, especially in long-deforested areas? How can these woodlands make a long-term recovery to a full species assemblage? What are the impacts of climate change and pollinator decline?

Key challenges: There are some conflicting visions for the land, such as preferences for no interventions versus some planting. Similarly, effective reduction of deer numbers in the landscape depends partly on visions and management by neighbouring estates. Demonstrating the link between reduced deer numbers and colonisation has been difficult, because of a lack of coordinated monitoring of deer browsing, but this has now been unified.

Also see Gullett *et al.* 2023 https://doi.org/10.1111/1365-2664.14501

Uplands - Case study 8

Creag Meagaidh (CM) National Nature Reserve, Badenoch, and Invereshie and Inshriach (I&I) National Nature Reserve, Strathspey, Scottish Highlands*

Case study provided by NatureScot

Publicly accessible

Grid refs. NN482872 and NH852012

Aims of the natural colonisation: Landscape-scale nature restoration and conservation

Site description: Mosaic of habitats, mostly dry, wet and montane heaths, with some blanket bog, upland rough grassland and ancient woodland. Site areas: ~4,000 ha (CM) and ~3,500 ha (I&I)

Area set aside for natural colonisation: Over 50 ha (CM) and over 100 ha (I&I) and increasing.

Year that natural colonisation began: Deer management increased in the late 1990s and early 2000s (I&I) and late 1980s (CM).

Other methods of woodland creation: At I&I, some planting of native Scots pine (~40ha total) in the 1960s/70s.

"Through low-intervention management, we can restore habitats at scale by promoting the conditions for woodlands to expand naturally. This requires low capital cost, gives more flexibility (not tied to any grant payments) and potentially offers greater ecosystem benefits."

Invereshie and Inshriach in 1994 (above) and in 2023 (below) (NatureScot)

Creag Meagaidh in 1994 (above) and 2023 (below) (NatureScot)

"Wild deer are part of our native ecosystems, so we accept a certain level of loss of young trees, adding to the structural complexity of the site. Monitoring is essential to ensure that browsing does not reduce tree diversity."

Seed sources for natural colonisation: Nearby ancient woodland: mostly birch, with rowan, willow, alder and some other species (CM); mostly Scots pine (some 'granny pines' in open areas), juniper and birch, with some rowan, willow and aspen (I&I).

Preparation actions prior to the natural colonisation: Sustained wild deer management (no ground preparation).

Maintenance during establishment of natural colonisation: Ongoing deer management. Cattle grazing has also started to encourage natural colonisation at CM.

Which species have successfully colonised? Following seed sources: mostly Scots pine (I&I), birch and alder (CM).

Colonisation distance and timeframe: Seedling numbers initially increased rapidly, then steadily (by 25% between 2017 and 2023, in a survey at I&I). At I&I, Scots pine, juniper and a few broadleaves are colonising sparsely uphill, at 600-800 masl.

Successes and reasons behind them: Significant and sustained efforts in deer management are key, as are good seed sources.

Failures and reasons behind them: The more palatable broadleaves continue to be browsed, in spite of deer control.

Key knowledge gaps: Some areas of ancient woodland that were felled in WWII have not colonised, despite having mature woodland nearby, and trials of cutting and burning. This is not necessarily a 'failure' as the result is a biodiverse habitat mosaic: an advantage of natural colonisation over planting. There is still a lot we don't understand about the process.

See https://storymaps.arcgis.com/stories/6b645896d1d84e45a59adbcea693c994 for additional fixed-point photos

*Invereshie and Inshriach are also part of the wider Cairngorms Connect landscape – see Case Study 7

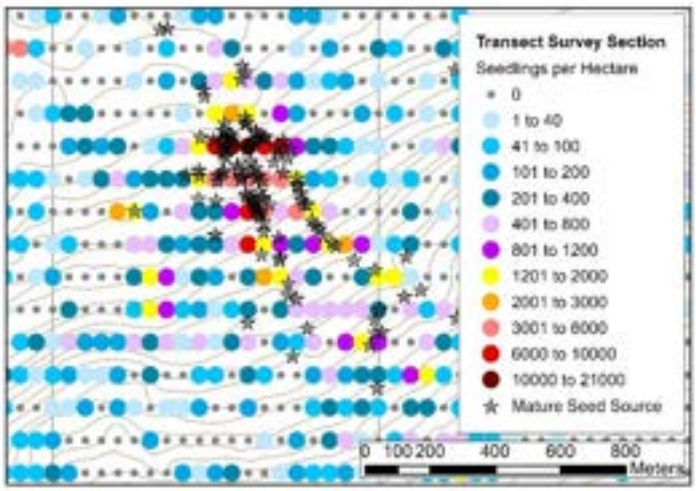
Uplands - Case study 9
Corrour, Lochaber, Scottish Highlands

Case study provided by John Sutherland, Corrour Estate

Publicly accessible, but remote and without road access
Grid ref. NN356692

Aims of the natural colonisation: Nature restoration using self-willed natural processes as far as possible. 1,140 ha have been identified as suitable for natural colonisation across the estate to date, which are being developed first. Overall, there are 11,000 ha with the potential for increased tree cover.

Site description: West Highland estate, spanning 260 – 600 m elevation. Mostly wet and dry heath and acid grassland, with a scatter of mature native woodland trees. Typical glacial landscape of the region - lochs and rivers at the bottom of glens, surrounded by hills up to 1000 m. Sheep grazing ceased in the 1990s, and the only significant browsing pressure is now from deer (mainly red).



Seedling survey results (John Sutherland)

"The hypothesis is that cumulatively, over time, a small proportion of seed can travel great distances."

Area set aside for natural colonisation: Currently 1,140 ha

Year that natural colonisation began: Seedlings were first recorded 2006, but they could be decades old, growing slowly, or failing to establish due to browsing.

Other methods of woodland creation: Some native woodland planting in areas without nearby seed sources, and because some key species are not present (e.g. Scots pine and sessile oak).

Seed sources for natural colonisation: Individuals and small groups of mature native broadleaves are scattered throughout the estate, with a linear woodland following the West Highland railway line.

Preparation actions prior to the natural colonisation: None.

Maintenance during establishment of natural colonisation: Deer management. 180 ha were fenced in 2020, but now plan to increase deer control in target areas to allow seedling establishment.

Which species have successfully colonised? In line with seed sources: downy birch, rowan, willow (eared, goat, grey) and alder are all colonising.

Is natural colonisation proceeding in line with expectations? Birch woodland is establishing as expected. There is potential for pine woodland in some locations but no pine seed sources, so we are considering planting.

Colonisation distance and timeframe: Most seedlings are within 50 - 100m of the seed source, but seedlings do establish at a distance of 500m and up to 1000m. After four years of deer exclusion, vegetation in the 2020 fenced area has a mean density of 800 seedlings per ha and some trees are nearly 2m tall.

"Deer control is fundamental to successful natural colonisation"


Young birch (top) and rowan (bottom) (John Sutherland)

Successes and reasons behind them: Ecological surveys confirmed the potential for natural colonisation and the need for deer control. Seedlings are now establishing and can compete with existing vegetation.

Failures and the reasons behind them: So far, deer control has reduced browsing but not sufficiently to allow new seedling establishment. Lower deer numbers than anticipated are required, so we will focus future increased culling efforts on specific areas to allow seedling establishment.

What are the key knowledge gaps? Assessing natural colonisation potential where there is little or no sign of advance natural regeneration, vegetation management, and timescales required.

Lowlands - Case study 10

Hucking Estate, Hucking, Kent

Case study provided by Clive Steward, Woodland Trust

Publicly accessible

Grid ref. TQ843574

Area of natural colonisation left since 2004, in 2023 (Clive Steward)

Aims of the natural colonisation: Woodland habitat creation as part of a wider nature recovery project across the whole site, including improving habitat connectivity and sequestering carbon.

Site description: Improved grassland and arable prior to natural colonisation, although some areas (including some naturally colonised) were woodland until the mid 20th century. The surrounding landscape is mostly arable farming, with isolated patches of woodland and chalk grassland. Site area: 305 ha

Area set aside for natural colonisation: Approx. 40 ha

Other methods of woodland creation: Tree planting in nearby areas to the natural colonisation

Year that natural colonisation began: Approx. 5 ha set aside in 2004 and 35 ha in 2017

"So far no failures. You have to be patient. You end up with woodland composed of trees which are nearby. If there are species not present which you need then these would need to be introduced through planting or direct seeding if you are brave enough!"

Seed sources for natural colonisation: Nearby woodland of oak, ash, hornbeam and field maple (2004 area); nearby mature individual English oak trees (2017 area)

Preparation actions prior to the natural colonisation: None

Maintenance during establishment of natural colonisation: None

Which species have successfully colonised? Oak, hawthorn, willow, blackthorn, field maple, hazel

Successes and reasons behind them: There are no deer in the area (fallow deer 15 miles away), which has been key to success. Would have used deer control measures if there had been deer present.

Failures and reasons behind them: None so far

Area of natural colonisation left since 2017, in 2022 (Clive Steward)

Also see www.woodlandtrust.org.uk/visiting-woods/woods/hucking-estate

Lowlands - Case study 11

Rickstaddle Farm, Lewes, East Sussex

Not publicly accessible

Case study provided by Robin Williams, Namayasai LLP

Field in 2008, prior to natural colonisation (Robin Williams).

"Natural colonisation is the simplest, cheapest and quickest way to create woodland."

Site description: Rough pasture prior to natural colonisation. The site is adjacent to existing woodland on one side, with arable and horticultural land on the other sides. Many wild deer, hare and rabbits.

Area set aside for natural colonisation: 9 ha

Other methods of woodland creation: Planting ~0.1% of the area with Scots pine and larch (mixed success).

Year that natural colonisation began: 2008

Seed sources for natural colonisation: Nearby semi-ancient woodland and one individual mature oak. In descending order of number of trees: willow (goat, grey & crack), hornbeam, oak, ash, aspen, blackthorn, hawthorn, sycamore, crab apple.

Preparation actions prior to natural colonisation: None.

Maintenance during establishment of natural colonisation: Access around the perimeter maintained by topping a 2-metre wide strip twice a year. Annual cutting of adjacent hedgerows was reduced to a three-year cycle, which may have supported field maple, hawthorn and blackthorn colonisation.

Which species have successfully colonised? In descending order of number of trees: willow (goat, grey & crack), hornbeam, oak, ash, aspen, blackthorn, white birch, hawthorn, field maple, sycamore, crab apple.

Colonisation distance and timeframe: The area had formed scrub by 2012 and had a closed canopy in 2020, up to 150 m from the seed source. Canopy height is around 12 m, and the largest trees have ~50-70 cm girth at a height of 60 cm (willow and birch).

Dominant drivers of natural colonisation: A natural process, driven by the pressures for survival of species. Dense willow scrub provided the main initial protection for young oaks and hornbeams, also aided by brambles. Some browsing by deer and hares.

Successes and reasons behind them: Deliberate tree planting totally un-necessary for native woodland and a waste of resources.

Failures and reasons behind them: A small group of Scots pine deliberately planted, also in 2024 hybrid larch. Work in progress.

Key challenges: No/limited funding available for natural colonisation (especially at the time).

Key knowledge gaps: Learning what flora and fauna are present and what else is going on out of sight; how do seeds of different species disperse over different distances and timescales?

Right: naturally colonised woodland in 2024 (Robin Williams).

Lowlands - Case study 12

Fairfield Forest, Worcestershire

Case study provided by Vanessa Burton, Woodland Trust

Publicly accessible

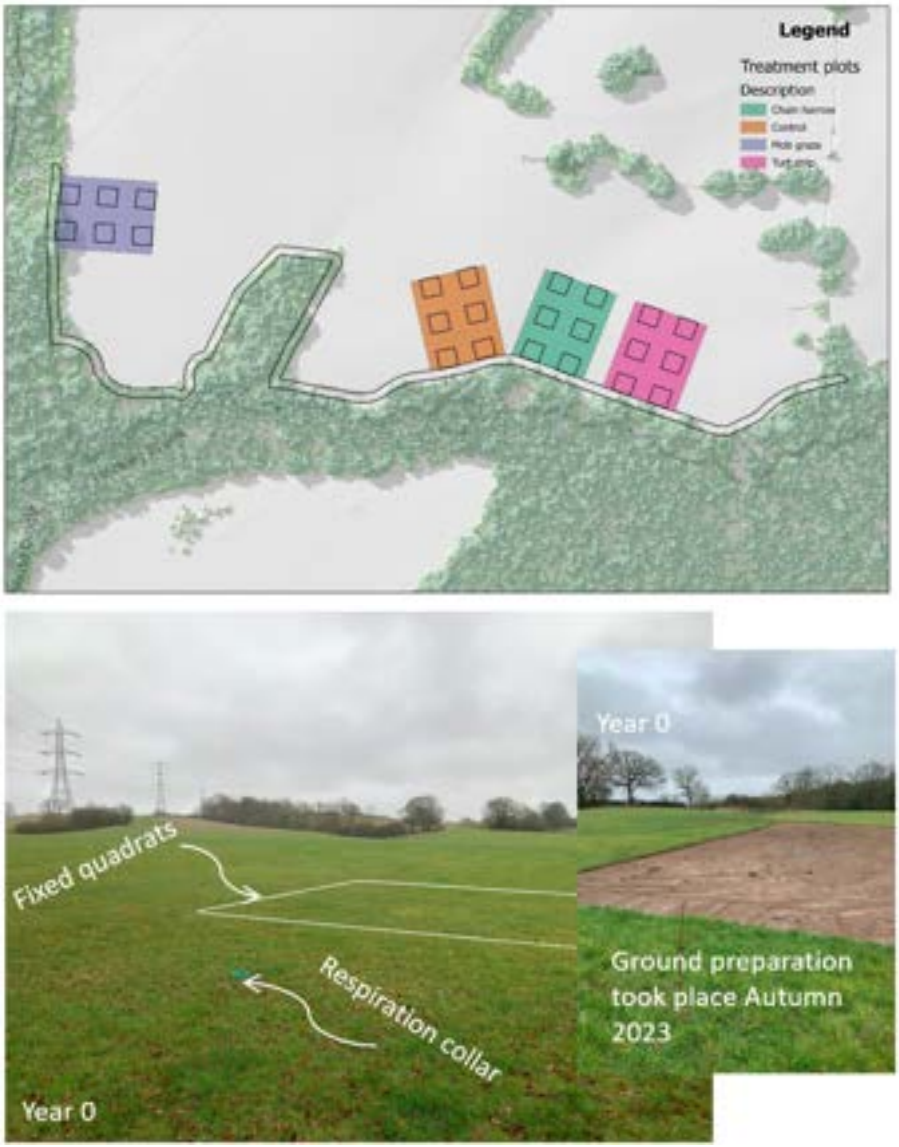
Grid ref. SO938744

Aims of the natural colonisation: Experimental site to examine the impacts of different techniques for ground preparation – does it help or hinder natural colonisation; do any negative impacts (e.g. soil disturbance) outweigh any potential benefits? Soil sampling is also taking place across the site, to understand the impacts of ground preparation and natural colonisation on soils.

Site description: 51 ha lowland site woodland creation site on former agricultural land (Fairfield Forest) adjacent to an existing ancient woodland, Pepper Wood,

Area set aside for natural colonisation: 6.3 ha

Other methods of woodland creation: Tree planting (native broadleaves)



Experimental design of the natural colonisation area (Woodland Trust)

Year that natural colonisation began: Following ground preparation in Autumn 2023.

Seed sources for natural colonisation: Adjacent ancient woodland (Pepper Wood).

Preparation actions prior to the natural colonisation: Experimental ground preparation techniques for the natural colonisation took place in Autumn 2023 (chain harrowing, mob grazing with sheep, turf stripping, and a control without any intervention).

Maintenance during establishment of natural colonisation: There are deer in the area but deer management is ongoing.

Success, failures and lessons learned: Integrating experiments into conservation action is tricky - the 'ideal' experiment design wasn't possible, so concessions were made to ensure that plots lined up with management units to ensure longevity of plots. The main success is a large and varied creation site which combines planting, natural colonisation and direct seeding, alongside a collaborative monitoring project.

"Key challenges around creating woodland through natural colonisation include ensuring competitive & long term funding to make it an attractive option, and managing herbivores at scale. Also, communicating the benefits to the public is important, so they understand successional stages and the benefits of scrubby open woodland."

Lowlands - Case study 13

Swannymote Wood, Whitwick, Leicestershire

Case study provided by Simon Greenhouse, National Forest Company

Publicly accessible
Grid ref. SK443168

Image to left: Time-series 1, from top to bottom: 2008, 2012, 2013, 2020 (Simon Greenhouse)

Aims of the natural colonisation: Capitalising on circumstances to create woodland, as natural colonisation was already taking place in certain areas. Also enhancing biodiversity, providing recreation and increasing landscape forest cover

Site description: Pasture to natural colonisation. The surrounding landscape is mostly pasture with some woodland. Site area: 22.7 ha

Area set aside for natural colonisation: 2.5 ha

Year that natural colonisation began: 2007

Other methods of woodland creation: Tree planting in other areas of site

Seed sources for natural colonisation: Adjacent oak/birch SSSI woodland

"We saw evidence of natural colonisation during the woodland creation planning, and assessed which areas might be most suitable, to capitalise on circumstances."

Preparation actions prior to the natural colonisation: Initial site design included a number of shallow scrapes to create wetter habitat patches. However, these colonised with tree seedlings, inspiring the use of that part of the site for further natural colonisation. Grass was mown to create the coupe boundary.

Maintenance during establishment of natural colonisation: Small amount of respacing in year 5

Which species have successfully colonised? Silver and downy birch, willow, oak, Scots pine

Successes and reasons behind them: We chose areas where there was already evidence of natural colonisation during woodland planning

Failures and reasons behind them: Oak seedlings were numerous, but then out-competed by faster growing species. Squirrel damage heavily impacted willow and birch, seemingly more in areas of natural colonisation than planting, possibly due to the difference in species mixture.

Time-series 2, from top to bottom: 2007, 2008 showing mown coupe boundary, 2012, 2016, 2020 (Simon Greenhouse)

Lowlands - Case study 14

Monks Wood, Woodwalton, Cambridgeshire

Publicly accessible
(1961 area of colonisation)
Grid ref. TL201796

Case study provided by Emma Dear, Natural England and Richard Broughton, UK Centre for Ecology & Hydrology

Aims of the natural colonisation: Restore biodiversity, and scientific research into the process of natural colonisation

Site description: Monks Wood NNR is an ancient woodland, with species-rich rides. Surrounding landscape is mixed farmland (pasture and arable) with woodland pockets.

Area set aside for natural colonisation: Two fields adjacent to the ancient woodland were set aside: a 4 ha barley field (abandoned after a final harvest & ploughing), and 2 ha of unimproved grassland (6 ha in total).

Year that natural colonisation began: 1961 (4 ha barley field) and 1996 (2 ha grassland)

Other methods of woodland creation: None

Aerial view of shrubland in blossom, after 24 years of natural colonisation in the grassland (Richard Broughton, 2020)

Seed sources for natural colonisation: Adjacent ancient woodland, dominated by oak, ash and field maple, with hawthorn and hazel understory (some. wild service and birch in the interior). The barley field is surrounded on 3 sides by woodland, and the grassland on one side only, but is bounded by hedges with some hedgerow trees.

Preparation actions prior to the natural colonisation: The barley field was abandoned after ploughing, and the grassland after mowing.

Maintenance during establishment of natural colonisation: Some deer management in adjacent ancient woodland from late 1990s but none in the areas of natural colonisation

Grassland after 27 years of natural colonisation (Emma Dear, 2023)

"Natural colonisation establishes slowly. Ecologically and in biodiversity terms this should be viewed as a positive. This is a low cost way of establishing semi-natural woodland."

62 years of natural colonisation of the barley field (Richard Broughton, 2023)

Which species have successfully colonised? Mostly oak, ash, field maple, hawthorn and blackthorn. Animal-dispersed species are more abundant than in the adjacent ancient woodland, particularly in the more recently colonised site (2 ha grassland). Wind-dispersed and suckering species (ash, elm, willow, field maple) are near seed sources.

Resulting woodland structure: The older (barley field) site became wildlife-rich shrubland after 10-15 years and closed-canopy broadleaved woodland after 40-50 years, with densities of 390 trees/ha after 59 years (132/ha after 25 years in grassland).

Successes and reasons behind them: The transitional shrubland (scrub) habitat has high biodiversity value, particularly for invertebrates, and the woodland that followed is structurally diverse, created at low cost. The young woodland was resilient to drought periods. Protective thicket of thorn scrub meant that herbivory was not an issue for larger trees to colonise, in spite of presence of brown hares, rabbits, grey squirrels, roe and muntjac deer.

Also see Broughton *et al.* 2021 https://doi.org/10.1371/journal.pone.0252466 **and** www.ceh.ac.uk/press/passive-rewilding-can-rapidly-expand-uk-woodland-no-cost

Lowlands - Case study 15

Noddle Hill, Bransholme, Hull

Case study provided by Richard Broughton, UK Centre for Ecology & Hydrology

Publicly accessible
Grid ref. TA108348

"Although closed-canopy woodland remained a distant prospect even after 33 years, the habitat mosaic of shrubland, grassland and wetland could be considered a valuable outcome."

33 years of natural colonisation: shrusbland and grassland mosaic (above); reedbed wetland (below) (Richard Broughton, 2022)

Aims of the natural colonisation: Expanding woodland cover and restoring biodiversity

Site description: Noddle Hill Nature Reserve is a 48 ha estuarine floodplain site, with 'rewilded' areas, a recreational fishing pond, tree planting, and permitted pony grazing. The site was previously farmland, and is currently surrounded by arable farming, pasture, amenity sports fields and residential housing. Low-lying land, with high groundwater and shallow seasonal flooding.

Area set aside for natural colonisation: 25 ha left to 'rewild passively' across seven contiguous fields

Year that natural colonisation began: 1988

"Blossom- and berry-rich thorny shrubs could provide important ecosystem services of enhanced biodiversity, pollinator resources and cultural services for many decades before any closed-canopy woodland develops."

Other methods of woodland creation: None within the 25 ha, although adjacent fields were planted with trees in 2000

Seed sources for natural colonisation: Far: the nearest mature woodland is 1.5 km away. In 1988, the site included 2.7km of hawthorn-dominated hedgerow, one mature crack willow, and only 1% mature woodland cover with a 1 km radius of the site. Trees planted in adjacent fields in 2000 have not yet matured.

Preparation actions prior to the natural colonisation: In 1988, clayey soils were imported and spread over 70% of the site at a depth of ~1m, intended for future development. The initial ground surface was a patchwork of bare soil, seasonally wet grassland/ex-arable, and existing hedges and ditches.

Maintenance during establishment of natural colonisation: None (herbivores generally scarce)

Which species have successfully colonised? Predominantly bramble, with hawthorn and dog/field roses, followed by elder, crack willow, ash, oak, some silver birch, grey willow and blackthorn.

Successes and failures: After 33 years, trees remained scarce! Thorny scrub thickets covered 53% of the site (average woody vegetation height 2.1 m). This has supported high diversity and abundance of songbirds but is not woodland creation as such (yet). The lack of tree colonisation is in spite of large areas of bare soil available for colonisation, and probably due to combined lack of seed sources and animal dispersers.

Also see Broughton *et al.* (2022) PLOS ONE 17(11): e0277545

TreE PlaNat

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About this document

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www.naturalcolonisation.co.uk

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