Forests for the future

Mike Charkow

Biodiversity and soil health are two of the most important factors to consider in our efforts against climate change. They enable natural resilience and lead to increased carbon sequestration by forests.

It is widely recognised that it is better to retain existing old-growth forests than to plant new ones. However, in many parts of the world, old-growth forests have largely disappeared and suitable sites for planting new ones can be very limited.

The engineered forest regeneration method developed by the Japanese ecologist and botanist Professor Akira Miyawaki in the 1970s allows the planting of biodiverse, resilient forests on tiny sites and on degraded soils, opening up the scope for urban and post-industrial planting schemes. The method is not limited to these sites and indeed it has been used – especially in the tropics – to regenerate rainforests.

Planting by the Miyawaki Method can be cheap, quick and easy. It is perhaps one of the simplest and most impactful ways that communities and individuals can do something to help in the fight against climate change and species loss. Projects have been studied over the last 50 years and results show that they can rapidly create quasi-natural forests with a high amount of biodiversity.

The UK and Scottish Governments have announced goals for Biodiversity Net Gain (BNG), meaning that new developments will have to demonstrate an increase in biodiversity on or near development sites.[1] My view is that Miyawaki forests present an excellent option for developers to meet their BNG targets.

What is a forest?

When you think of a forest, what comes to mind? Trees will feature heavily, of course, but a natural forest is not just a collection of trees. It is comprised of a range of ecosystems across all layers, from soil to canopy, containing trees, shrubs, ferns, lichens, mosses, flowers, decaying old stumps, fungi, insects, birds, reptiles and mammals. And a healthy forest is a resilient forest.

Only around 18% of remaining forests are ancient woodlands.[2] These are the most ecologically beneficial types of woodland, as they are far more biodiverse than plantations. Biodiversity – defined as 'the variability among living organisms from all sources including … diversity within species, between species and of ecosystems'[3] – is important for countering climate change because the more plants a forest can support, the more carbon it will sequester. Lack of disturbance is also important as carbon is not just stored in wood; most of the carbon stored in forests is in the soil.[4]

Until maturity, plantation forests are much less biodiverse than naturally regenerated ones. According to classical ecological succession theory, the re-establishment of mature ecological systems in planted temperate forests can take between 100 and 200 years.[5] This is especially true when they contain non-indigenous tree species.[6] It takes time for fungi and flora to colonise these plantations, especially ancient woodland indicator plants.[7] If we want to plant forests that will help mitigate climate change, rather than just meeting some arbitrary target, shouldn't we be looking to methods that mimic nature?

In addition, non-indigenous forests have been shown to be less resilient than natural forests, both in terms of pest-resistance[8] and anchorage.[9] I recently witnessed the resilience of native forests on a trip through Moray and Aberdeenshire. In January 2022, storms Malik and Corrie brought gusts of over 90mph, with the north-east of Scotland encountering the brunt of these winds. Many forests were devastated. It was evident that semi-natural native woodlands (mainly birch and Scots pine) largely survived, whereas non-indigenous woodlands – mainly monoculture stands – did not. At a time when forests are under increasing stresses, it makes sense to follow a planting method that resembles natural restoration.

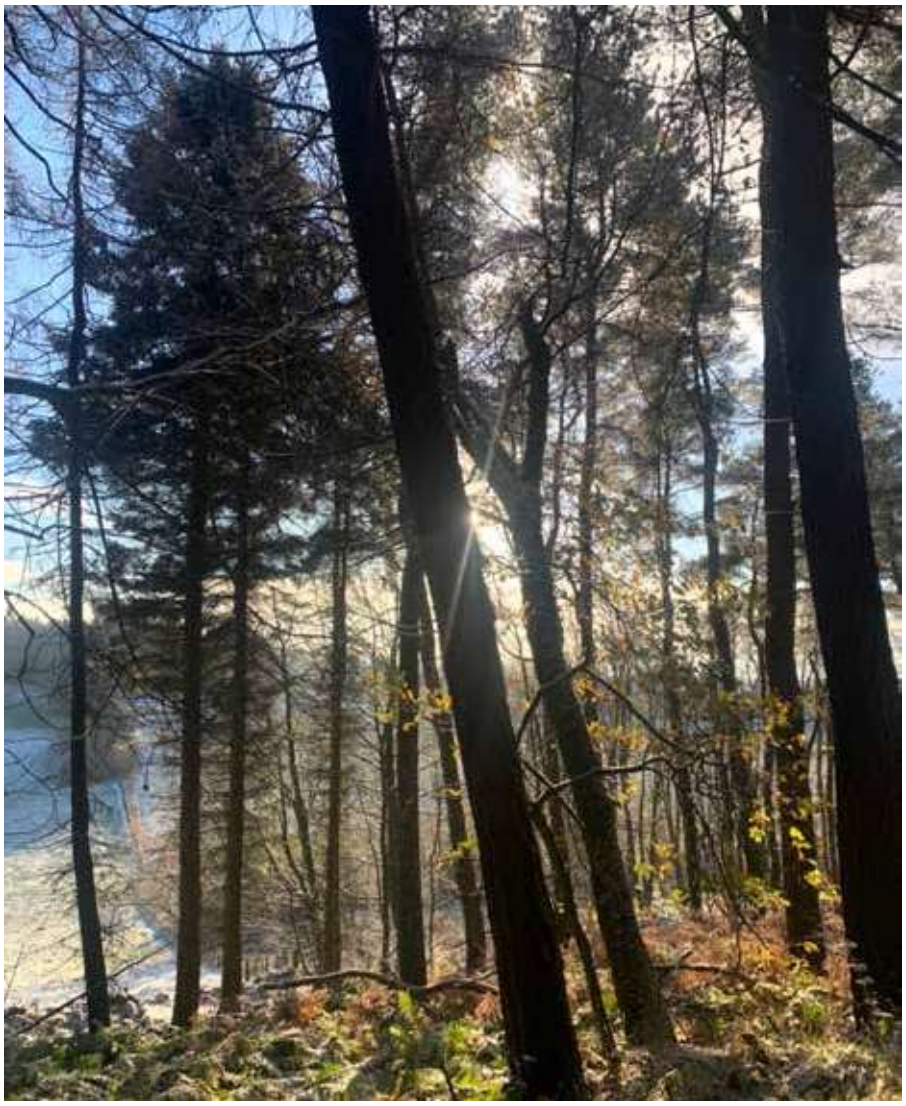
The Miyawaki Method

Around 50 years ago, Professor Miyawaki devised a method of forest restoration that mimics natural regeneration. The aims were primarily to promote forest resilience and to combat climate change. Indigenous forest ecosystems are more biodiverse and therefore healthier, can sequester more carbon and can better resist pests and diseases. Miyawaki had also observed that indigenous forests in Japan tended to remain standing after earthquakes and even a tsunami, while non-native forests did not.

The first application of the Miyawaki Method was a planting at Yokohama University in 1976. This has since become an established, species-rich forest,[10] and in 2006, Professor Miyawaki was awarded the prestigious Blue Planet Prize for his work. In his acceptance message, Miyawaki said, 'The planting should center on the primary trees of the location, and following the laws of the natural forest…'.[11]

Essentially, the initial planting included the key ingredients that ensure a forest can establish quickly and thrive: indigenous trees, shrubs and other plants that are suited to the climate and soil were closely planted in soil that had been ameliorated by humus and mycorrhizae. This method results in a diverse forest consisting of different

Akira Miyawaki. (from: calloftheforest.ca/people/professor-akira-miyawaki)



Traditionally planted forests lack species diversity. Miyawaki forests begin with all of the forest layers and so have increased biodiversity. (Mike Charkow)

layers, composed of plants that should be optimally resilient in that environment.

Miyawaki's method is based on knowledge of the potential natural vegetation (PNV) of a site and any necessary site preparation (mainly to ameliorate the soil). PNV has been described as 'the vegetation that would finally develop in a given habitat if all human influences on the site and its immediate surroundings would stop at once and if the terminal stage would be reached at once'.[12] A planting density of two to three plants per square metre should be followed. This is based on PNV and the potential capacity of the land.[13]

A traditional planting with only trees (especially monocultures) may take many decades to develop the herb and shrub layers.[14] The Miyawaki Method starts with plants that will occupy all of the layers and can result in a quasi-natural forest with rich soil fauna after only 20–30 years.[15]

The method has been used to create very small urban forests in spaces of only a few square metres. The benefits of these tiny urban forests are clear. First, Miyawaki forests are easy to establish, self-sustaining and require very little maintenance. Traditional urban planting is normally associated with low biodiversity (a narrow range of tree selection) and numerous difficulties for tree establishment.[16] Second, high-biodiversity planting with species suited to a site means that the trees will be more resilient.[17] Higher resilience means better health and the consequent benefit of an increase in ecosystem services, such as cooling and a reduction in air pollution. Third, such forests require almost no management. Finally, high-density planting of street trees has been shown to have a positive effect on mental wellbeing.[18]

Tiny forests

Shubhendu Sharma, an Indian student of Miyawaki, first adopted the Miyawaki Method in 2009, in order to create 'Tiny Forests' of around 100–150 square metres.[19] This tiny scale seems to be due to planting constraints: many of Sharma's forests have been planted in constricted urban sites on degraded land. Budgetary constraints may also have limited the scope in some cases.

Sharma has consulted on tiny forests across much of the world, but they have only recently made an appearance in Europe. His approach states that if it is feasible to do so, the plants should be grown from seed; these should all be indigenous species to the site (according to PNV). Otherwise, small plants – for instance cell-grown transplants – should be used. Small, containerised plants and seeds are also possibilities. Depending on the site, there may be a need for some soil amelioration, which might include the addition of topsoil or compost.

As with any new planting scheme, the site is assessed for climate, soil and natural vegetation. The main difference is that as well as trees, other native species from the ground, shrub and canopy layers are also planted. At least 25 plant species are recommended, but up to around 40 could be chosen. The plants are densely planted, at around 3–5 per square metre.

There is some competition – due to the planting density – and this increases the forest growth rate. Natural competition will ensure that the strongest and best-suited plants will survive in any particular location within the forest. However, it is also important to choose species that are shade-tolerant, so as to allow the different forest layers to develop. This is in comparison to a traditionally planted forest in which the trees are all competing for light, and creating only one or two layers. As the forest is multi-layered, there is space for several plants to grow in close proximity, meaning that the forest retains much of its density.

The evidence

Miyawaki forests have been scientifically monitored since they were first planted and there is a wealth of data available. This research has been collated by Urban Forests Company.[20] It shows that biodiversity is higher in Miyawaki forests. In a comparison of traditionally planted and Miyawaki forests in the Mediterranean, plant growth and forest biodiversity were significantly higher when the latter method was adopted.[21] These findings have been replicated in other countries.[22]

The soil is a key component in the establishment of a healthy forest. Soil biodiversity is essential for most of the ecosystem services provided by soils. Soil stores more carbon than the atmosphere and all vegetation combined. Within a forest, around 75% of the carbon is contained within the soil, so it is clear we need to look after it.[23] One way of doing that is to plant more forests. Crop-forests are only a short-term solution: much of the soil-carbon is lost when the soil is disturbed during harvesting. Also, plantations take much longer to establish a healthy soil. The Miyawaki Method offers accelerated development of ecologically diverse forests that consist of healthy and resilient populations of flora, fauna and funga.

Management of these forests is minimal, with weeding only necessary for the first few years. Forest debris (leaves, dead branches and trees etc.) is left to be recycled by fungi and microorganisms. Nutrients are freed up and ready to be utilised again by the plants, and carbon is fixed by the processing of plant

Zandaam Tiny Forest in 2016 (left) and 2021. (© IVN Natuureducatie)

Zandaam Tiny Forest, 2021. (© IVN Natuureducatie)

and animal detritus. Therefore, after planting there is almost no further carbon input, and as the forests are relatively unmanaged, there is very little soil disturbance.

A 2017 study of a tiny forest in the Netherlands found that within two years, the levels of soil bacteria and fungi were comparable to those found in a mature forest. Biodiversity was also found to be high in terms of fauna and soil fauna. Across two sites (of around 250 square metres each) 176 fauna species in 30 groups were observed.[24] As of April 2022, 934 different plant and animal species were recorded across 11 sites.[25]

A video produced by Instituut Voor Natuureducatie (IVN) shows the growth of a newly planted Miyawaki Forest in Zaandam, Netherlands.[26] The plants grew from sub-metre cell-grown plugs to around 7m in height between 2016 and 2021. Another tiny forest planted in Beeldenboek in December 2015 grew to around 10m height in five and a half years.

To some in the UK and Europe, this may appear to be a new and untested method. Miyawaki forests have only made an appearance in Europe in the last seven years, and the first UK Miyawaki forest was planted just two years ago. However, the method is well established and has been implemented across much of the world over the last five decades. It has been used to restore tropical rainforest, to establish forests on degraded land, to stabilise soil and beaches and to control pollution. It has been extensively researched and validated.

A similar approach was developed by Martin Crawford in the UK and known as 'Forest Gardening'. A forest garden is a natural woodland that contains 'large trees, small trees, shrubs, herbaceous perennials, annuals, root crops and climbers, all planted in such a way as to maximise positive interactions and minimise negative interactions, with fertility maintained largely or wholly by the plants themselves'.[27]

Spreading out

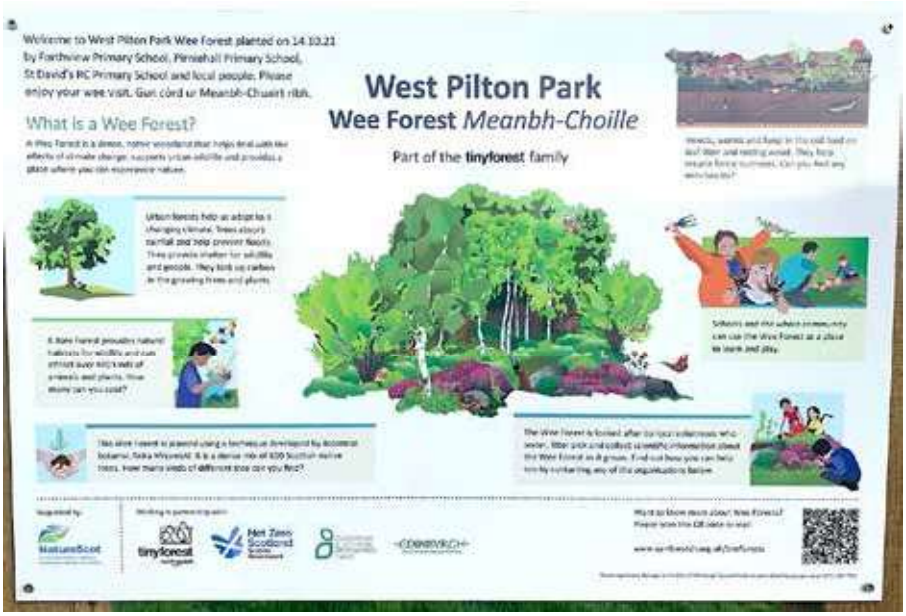
As of 2011, around 1700 Miyawaki forests had been planted across the world, especially in Japan, China, Borneo, Kenya and Amazonia. There are now Miyawaki forests in India, Pakistan, Australia, USA, Chile, Nicaragua, the Middle East and throughout Europe, especially in the Netherlands where over 200 'tiny forests' have been established since 2015 by IVN.

The UK has been relatively slow to get involved, with the first one planted in Witney near Oxford in 2020; however, more were planted in 2021 and others are planned. The citizen science charity Earthwatch has been heavily involved in community planting of Miyawaki forests in the UK and a map is available on its website; it is carrying out long-term environmental monitoring of its tiny forests.[28] IVN and Earthwatch follow the tiny forest principles laid out by Shubhendu Sharma of Afforestt.

2021 also saw a number of 'Wee Forests' planted in Scotland. These projects have been tied to community and educational goals and will be a valuable resource for local people to learn about nature.

Political leaders are noticing the effectiveness and importance of these forests and are

West Pilton Wee Forest planting and information board. (Mike Charkow)



supporting their creation. Imran Khan, Pakistan's former Prime Minister, gave financial backing to more Miyawaki forests, as has the city of Chennai in India and the Kerala Forest Department.[29]

Miyawaki forests appear to broadly be in line with the aims of the 2021 'Tree Planting in the UK' briefing paper; part of the strategy for England is to protect and improve woodlands by 'adapting treescapes and woodlands to the future climate and maximising the benefits they can provide to support adaptation measures, such as natural flood management and helping improve the resilience of wildlife'.[30] They also chime with UK Biodiversity Net Gain proposals, which state that new developments should put 'nature and biodiversity gain at the heart of all decision-making and design'.[31] It would be desirable to see the UK governments invest in this planting method, both for meeting new tree planting targets and for urban-greening.

Although many of the Miyawaki Method forests being planted are tiny forests (i.e. around 150 square metres), the size doesn't necessarily have to be constrained. Restrictions on size are generally down to limits on space or finances. Some planting schemes that involve social and educational goals can cost a lot more due to the high levels of planning and staffing required for the additional required input and community interactions. However, private or commercial planting schemes can cost relatively little. The initial cost per hectare may be higher than a traditionally planted forest, but the lack of maintenance required reduces the long-term costs. More importantly, the benefits gained from a Miyawaki forest are proportionally much greater. I recently planted a 500-square-metre Miyawaki-Method forest in a private garden near Glasgow with 1400 trees and shrubs, 100 ferns and 1kg of woodland-wildflower seeds. This method was very cost-effective.

Projects can involve whole communities and planting can be done by almost anyone.

Forests of life

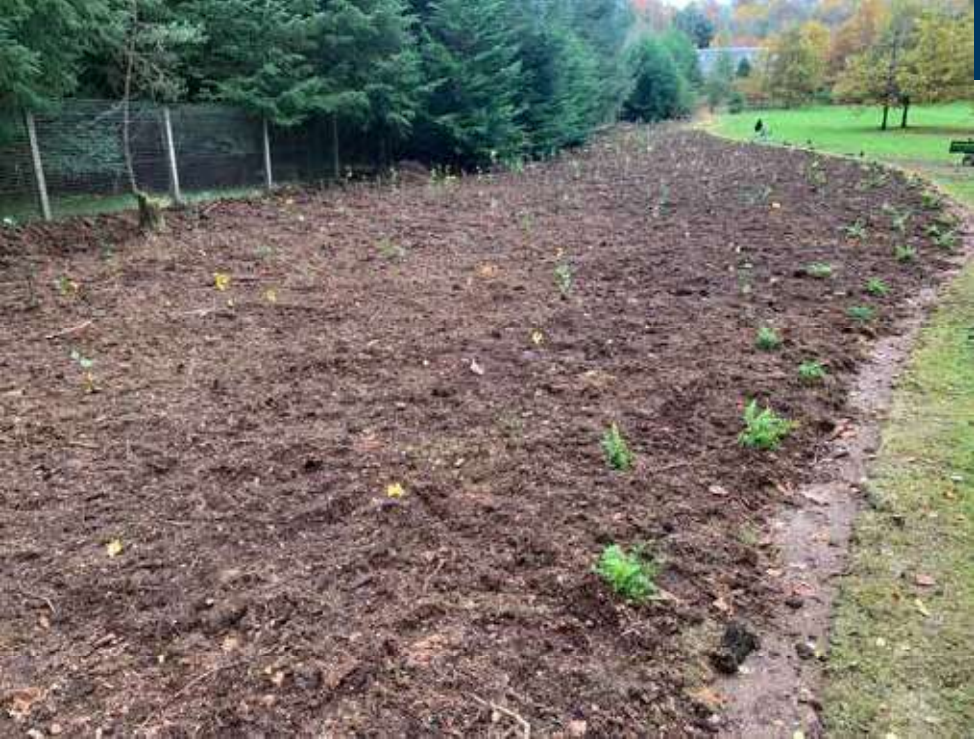
Miyawaki said, 'Forests are life itself. Humans have survived until today supported by forests. ... [Survival] begins with creating true 'forests of life' by planting trees today.'[32]

This is a time when extinction rates are increasing. The abundance of UK priority species has decreased by 60% in the last 50 years. This can be attributed largely to habitat loss.[33] Miyawaki forests achieve high biodiversity within a short space of time; it seems clear that they are one of the best methods for providing refuge to many threatened species and for arresting their decline. These forests have been shown to be havens for a wide range of fauna, even just a few years after planting.

Miyawaki died in July 2021 at the age of 93. His legacy will be enjoyed by many generations to come. Perhaps some of the thousands of Miyawaki forests will become the old-growth forests of the future and will help preserve a wide range of plants, animals and fungi.

Studies have shown that Miyawaki forests truly live up to the name 'Forests of Life'. If we want to be able to establish biodiversity and resilience in new plantings then we could do worse than utilising this method to create more forests of life, no matter how small the space. So, let's all get planting.

Mike Charkow gained a Master's degree in Psychology, then spent some time teaching English in Japan. He was a tree surgeon for 10 years and has been a consultant for 15. He says, 'I have an interest all things concerning trees, including the things they rely on, and things that rely on them. I am always surprised by nature and delighted by its refusal to be neatly defined.'



A recently planted 500-square-metre Miyawaki Method forest in a private garden near Glasgow. (Mike Charkow)

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