Reflections on the **Miyawaki tree planting method**

Jon Heuch and **Peter Thurman**

Planting trees is a key aspect of both arboriculture and forestry. Decisions on tree planting location, species choice, tree size and planting spacing/density have long-term consequences where it is hoped that trees will last for decades if not centuries. Cultural aspects such as site preparation, tree protection and post-planting maintenance are all important components to ensure tree establishment.

For the most part, what constitutes effective and efficient tree planting practice is well known; however, there is also widespread concern that too many planted trees fail to establish – from individual trees to larger-scale planting (see, for example, the Highways England report on A14 planting). There seems to be room for improvement, and when a 'new' method of tree planting is promoted that appears to have some advantages, it is worth examining along with any claims made for it. If significant improvements are shown to be robust, wider adoption of the new method may be appropriate.

The focus of this article is the Miyawaki method which involves planting trees and shrubs together at very high densities, after intensive site preparation, with a view to ecological restoration. It is being promoted and used in the UK by numerous organisations and various claims are being made for its superiority over 'traditional' tree planting methods.

Various publications by Akira Miyawaki himself describe the background to the method, including Miyawaki and Golley (1993) which states: *'It is important to note that this ecological engineering technique is not designed to recreate natural ecosystems. While natural ecosystems may ultimately evolve on an engineered site, the goal of the process is to create dense stands of forest vegetation quickly. These stands serve specific purposes.'*

Whilst the Miyawaki method is not restricted to small sites, this article focuses on its application to very small plots (described as a tennis court or around 0.02 hectares). Some call these 'tiny forests'.

Background

What is the Miyawaki System?

It is a tree and shrub planting methodology named after its inventor Akira Miyawaki (1928–2021), a Japanese botanist and plant ecologist. Wikipedia states he developed, tested, and refined his method of ecological engineering to restore native forests from seeds of species native, historically, to a specific area. The planting focus was on very degraded soils in which organic matter/humus is very low or even non-existent.

In 2006 Miyawaki won the Blue Planet Award – working on protected forest restoration at over 1,300 sites in Japan and various tropical countries, especially in the Pacific region, creating shelterbelts, woodlands, and woodlots, including in urban areas such as ports and industrial zones.

The original concept

As early as the 1970s, Miyawaki advocated the restoration of woodlands using species well adapted to local conditions. His specific concern was the length of time it was then thought necessary to allow in order that native woodlands could be restored on the degraded sites he was working with. Decades if not centuries were considered necessary as pioneer species were replaced over time with late-succession species. He suggested that timeframes for re-establishing these species could be drastically reduced by good ground preparation and dense planting of multiple species. This, he claimed, suppresses weeds and allows the species best adapted to any one site to come to the fore. Rather than guessing, species choice was determined by actual growth at any one site.

Miyawaki considered that the old and traditional tree species that grew around temples, shrines and cemeteries in Japan (such as *Castanea crenata*, *Castanopsis cuspidata* and *Quercus myrsinifolia*) were relics of the primary indigenous forest that only made up 0.06% of contemporary Japanese forests.

He went on to suggest that the tree species that were then dominating Japanese forests – timber trees introduced over centuries by foresters (such as cedar, cypress, pine and larch) – were neither the most suitable candidates to address climate change nor the most resilient vegetation for the geo-bioclimatic conditions of Japan.

He consequently proposed that rapid restoration of forest cover and soil was possible (and needed) by using a selection of pioneer and secondary indigenous species that were very densely planted and provided with mycorrhizae and mulch.

Miyawaki today

The philosophy behind the Miyawaki system and his practices are now being cited as the basis for planting relatively small areas in urban areas. A 2021 *National Geographic* article states that this tiny forest approach spread from Japan to India in 2009 and was promoted in a 2014 TED talk by Shubhendu Sharma.[1] The method is now being promoted globally, especially in many European countries such as the Netherlands and the UK. For example, here in the UK, one organisation has established 219 sites and has a goal of planting 500 by 2030.

The interpretation and implementation of Miyawaki/tiny forests varies from country to country and according to the providing company or charity but generally all or most of the following site operations and stages are involved.

Intensive site preparation which may involve some or all of the following:

1. Stripping of existing vegetation
2. Removal of debris and existing soil – even subsoil up to 1 metre depth
3. Introduction of new soil
4. Mechanical cultivation

Planting of trees and shrubs:

5. Planting (by volunteers) – mainly seedlings (whips) of up to 20 different woody species at from 5 to 12 specimens per square metre with the addition of ameliorants such as mycorrhizal inoculants
6. Surface mulching
7. Fencing (with gated access)

Post-planting maintenance which may involve:

8. Watering
9. Monitoring (such as recording mortality and growth rate and sometimes wildlife)

Different organisations promote their interpretation of the Miyawaki method in different ways. Some plant their own sites and others actively encourage third parties to plant with their help, offering a

1. www.ted.com/talks/shubhendu_sharma_an_engineer_s_vision_for_tiny_forests_everywhere

comprehensive service that includes: a site survey and validation, a written agreement, community engagement and volunteer recruitment, training, advertising, site preparation, species selection and stock procurement, planting supervision, fencing and, once the work is completed, ongoing management and monitoring.

The claims linked to the establishment of tiny forests are varied, but usually they are made in comparison to 'conventional' or 'traditional' tree-planting methods. No one organisation claims all of the points in the list below so it has been compiled from different organisations and the practices they specify:

a. Faster tree growth due to higher competition
b. Ecological succession achieved within 20/30 rather than 100/200 years
c. Greater soil biodiversity
d. Greater plant biodiversity
e. Greater wildlife value
f. Higher levels of carbon sequestration achieved more quickly
g. Real contribution in the fight against climate change
h. Increased resilience, self-sustaining
i. Lower initial costs and lower maintenance costs per established tree
j. Fewer plant losses
k. More community involvement
l. Greater educational value
m. Naturalness
n. Innovative
o. A better way of building forests and one of the most effective tree planting methods

We consider each of these claims below:

a. Faster tree growth

The initial growth of some Miyawaki plots has been visually remarkable but not surprising. It has been known for several decades that good ground preparation can improve tree survival and initial growth and if this is coupled with good weed control, there would be every reason to expect that close to 100% of planted trees can survive initially and grow well (e.g. Davies, 1987).

But dense planting is not necessary to achieve this and will, if successful, inevitability lead to mortality because of competition. The goal is simple – establish a closed canopy between plants to control weeds to ensure establishment. The quicker this is achieved through close planting, the earlier competition will set in, followed by mortality and moribund growth. Alternatively, trees must be removed through thinning to reduce competition and mortality. With mixtures of species the situation is more complex, and it is difficult to predict which will endure – the fast-growing pioneers, the slower-growing shade-tolerant ones, or a mixture of the two. In forestry the unpredictability of mixtures may be problematic; in amenity plantings it can be less so.

Fast upwards growth is reliant on proportionate diameter growth if a tree is to endure and grow to maturity. In dense small plantings there is only space for a few trees to develop to maturity. 0.02 hectares is, after all, barely enough space for one or possibly two mature open-grown oak tree(s). Most planted trees in a Miyawaki planting will be outcompeted and fail to fatten up. Light-demanding species may not tolerate the shade of others and may die; shade-tolerant species may survive but grow slowly. A planting in East Sussex which one of us has been observing since it was planted in the winter of 2014/15 has reached 4/5 metres in height, but annual growth increments have now slowed right down. Some tree species (e.g. *Betula pendula*) in traditional plantings would be taller after nine years.

The claim also suggests that growth following 'conventional' or 'traditional' tree planting is slow. This is simply not true provided good practices are followed in terms of tree stock, planting and weed control. New woodlands planted at the usual spacing of say, 1.5 × 1.5 metres will form a canopy that can be walked under within 10 to 15 years. Wider spacings such as 1,600 stems per hectare (2.5-metre spacing) will also yield similar results with greater attention to weed control over a longer period.

b. Ecological succession within 20/30 years

Ecological succession is the process of species change in an ecological community over time. We have a pretty good idea of what will happen to bare sites if they are left ungrazed and uncut, provided a reasonable supply of seed is available from adjacent and nearby sites. Regeneration of birch, ash, sycamore is common. Seeds of oak, holly, cherry and mistletoe may be introduced by animals. Other species such as willow, poplars and alders may only spread and thrive in wetter sites. The famous long-term plots at Rothamsted Research Station (started in the 1880s) give us first-hand evidence of how succession may or may not develop over time. It is common knowledge that dense, dark stands of trees have little herbaceous understorey and thus coppicing can significantly alter the situation by letting light penetrate onto a woodland floor – but that is human management thwarting the natural process.

It is unclear what the tangible benefits will be if a woodland succession process is artificially speeded up – certainly when viewed over a long period. As almost all tiny forests planted in Europe are only a few years old, this claim remains speculative.

c. Greater soil biodiversity

The Miyawaki method was originally developed to address sites with soil in very poor condition or with no suitable soil. Ground preparation is both disruptive and expensive. In many sites selected for tree planting, the removal of existing soil to replace it with imported soil is not necessary or sustainable and cannot be good for local and natural soil biodiversity. Changes to soil fauna and other microorganisms may be accompanied by changes to the local hydrology. How this is more natural than retaining existing soil with all its sustainable benefits is unclear and left unexplained by its proponents. Protocols for sourcing the replacement soil need scrutiny. In the UK, soil in bulk is available from landscape suppliers, development sites and other workings but data on provenance or history may be lacking.

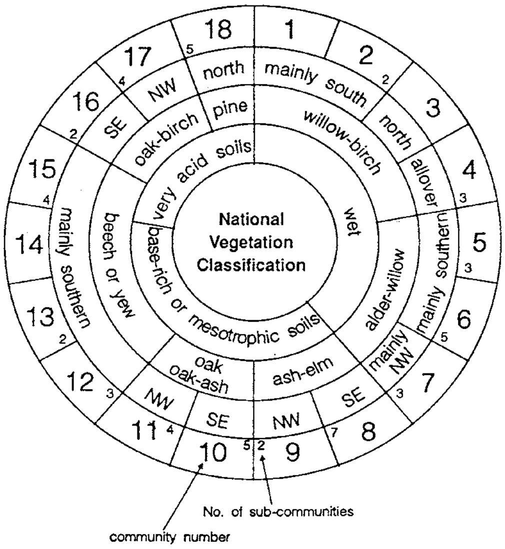
It is generally acknowledged that soils which have had recent plant growth have adequate levels of mycorrhizae. The use of mycorrhizal inoculants is considered by many to be a pointless exercise and expensive wherever it is applied but especially if the soil is compacted and degraded *or* imported and fertilizer has been added.

The application of a mulch in appropriate locations and depth is difficult to criticise. On larger plots the cost may be prohibitive. However, some local sources (e.g. tree surgeons with chippers?) maybe very cheap or free to all tree planters, regardless of the method of planting adopted.

d. Greater plant biodiversity

Tiny forest plantings of up to 20 different woody species (at *up to* 12 plants per square metre) sounds impressive but does this mimic what occurs in the wild? Do natural temperate woodland habitats include that number of species or evolve from that density of natural regeneration?

In Britain, our woodlands are officially classified into 18 different types within the National Vegetation Classification. It is based on over 30 years of surveying and all our habitats are classified. All our woodlands are dominated or co-dominated



National Vegetation Classification showing 18 British woodland types. (Source: https://theoldmanofwytham.com, based on K.J. Kirby, G.R. Saunders and A.M. Whitbread (1991). The National Vegetation Classification in nature conservation surveys. *British Wildlife* 3: 70–80.)

by just a few of our native woody species and are different in makeup mainly due to differences in climate, pH, soil type, etc. Understorey species making up the shrub layer will also be low in diversity – perhaps as few as 3 or 4 different species. Biodiversity is achieved in the wide range of habitats we have; individually most are not very diverse at all, certainly not our 18 British woodland types.

Furthermore, Britain only has about 45 woody plant species (including 10 willows) and relatively few ever meet each other in the wild. The same scenario occurs in most if not all, northern temperate woodlands. It is often publicised by Miyawaki providers that local-provenance plants are sourced for their projects. We find it hard to believe that this is always achievable. Akira Miyawaki himself, however, always collected seeds locally and germinated them over several years at a central nursery in Okayama.

Planting 20 different native species in a tiny forest seems both unnatural and pointless. Even a more relevant mix for urban areas of resilient natives and non-natives is unlikely to warrant that many.

Another significant concern is that such dense tree planting will restrict or even prevent the development of the natural woodland ground and field layers that are home to herbaceous perennials, ferns, grasses, bulbs and even mosses etc. Some types may grow around the edges of the planted area where light penetrates more but that may be considered unsatisfactory and tokenistic.

e. Greater wildlife value

Initial comparisons of the wildlife in Miyawaki plantings with adjacent plantings show greater species records. But useful comparisons must be both fair and robust. If your traditional plantings have failed due to neglect, it is hardly surprising that the Miyawaki plantings record more species. Creation of habitat, even of small areas and at traditional spacing, is just as useful in enhancing wildlife populations. Choice of planted species is also a factor, but an unnaturally wide range will make no difference (see Mata *et al.*, 2023).

Tiny forests appear to be planted mainly as standalone entities surrounded by grass in parks etc. and are developing into dense thickets or wide hedges. These will provide cover for some species – especially birds. But isolated tiny forests will only provide limited connectivity unless there is existing (and possibly much larger) woodland nearby.

It is difficult to understand how tiny forests offer *greater* wildlife benefits than other types of planting. In fact, given more space and light with wider tree spacing, most woody species will produce more flowers, fruit and seed and their production will start earlier in their lives. Conversely, the dense shade and lower temperatures created in a tiny forest are unlikely to attract many invertebrates, such as bees and butterflies, or reptiles that require sunlight and warmth – although these may thrive on the boundaries/edges. Once a tiny forest canopy has closed up and light levels plummet, will the fauna count do so too?

f. Higher levels of carbon sequestration achieved more quickly

Planting small-scale woodlands is carbon intensive, as is soil preparation using machinery. Studies looking at the carbon footprint of tree planting or lifetime assessments of trees show that it may take many years before tree planting starts to sequester and store more carbon than was used during tree establishment (see Luck *et al.*, 2014 and Petri *et al.*, 2016). Overall levels of carbon sequestration are determined by the complex interaction of many factors – such as rate of photosynthesis, canopy cover, leaf volume, species and soil type.

Tree planting that inevitably leads to tree mortality suggests any short-term gains will not be sustained. Does greater early growth lead to higher carbon sequestration in the medium or long term? It is difficult to find data that proves this.

Surely, the quicker growth claimed of tiny forests does not necessarily increase photosynthesis potential because canopy cover and leaf volume are not increased due to the planting density. Aren't taller, thinner specimens formed with little in the way of side branches and foliage below the terminal shoots?

g. Fight against climate change

The small scale of Miyawaki plantings appears to fit into the model of the panacea of tree planting to address climate change. Significant changes to technology and our practices as consumers will be necessary to have any significant effect on carbon emissions and thus climate change. Miyawaki volunteers want to help but tiny-forest-scale plantings of trees are irrelevant to this.

h. Increased resilience, self-reliant, self-sustaining

The reasoning behind this claim is unclear. One provider suggests that after planting, no further inputs are required.

In natural woodlands, dense clusters of successfully germinated seedlings – perhaps regenerating after a halo has formed by a tree falling – will thin themselves out over a period of years according to the availability of resources (light, nutrients, water etc.). They will be the young of the tree and shrub (and herbaceous) species that populate the habitat. The density and makeup of mature natural woodlands can vary greatly according to these factors.

Planting up to 12 *different* young plants per square metre does not mimic this process and will not increase resilience. Stress levels are likely to be higher, resulting in higher losses. Certain species may be smothered and crowded out across the whole planting. How does this increase resilience?

i. Lower initial costs and lower maintenance costs

Comparing professional contractors' costs to volunteer input can be misleading.

The actual costs of tiny forests are not readily available. Figures we have seen suggest that some providers charge significant sums for management, support, back-up and publicity. However, we understand that in the UK and mainland Europe, to plant up an area the size of a tennis court (24 m × 9 m or 216 m^2) – which is 1/50th of a hectare – costs around €25,000 or £21,500 in the UK (1 GBP = 1.16 EUR). This does not include the cost of labour to plant and mulch etc. because this is usually free of charge by volunteers and/or school children. This is equivalent to €1.25 million or £1.075 million per hectare.

By comparison (in the UK), to plant up the same area using traditional planting methods at a spacing of 1.5 m × 1.5 m per tree/shrub, with tree shelters, mulch mats and *including labour*, the overall cost would be less than £2,000 using a garden contractor. An experienced forestry manager has quoted us £15,000–£20,000 to plant 1,600 trees/hectare including deer fencing – less than the cost of one Miyawaki tennis court forest.

Bare soil beneath dense tree planting seen in June 2022. Dense planting clearly has controlled any weed growth to the extent of the soil being completely bare of vegetation. (photo: Jon Heuch)

Tree growth of a tiny forest in June 2022 after planting in March 2020 (almost 3 years' growth seen). The visitors are using a bench installed in a horseshoe-shaped planting design. (photo: Jon Heuch)

If these comparisons are correct, well-implemented and maintained, traditional methods would likely be equally successful for a fraction of the cost.

The *maintenance costs* are unknown but if the work is carried out by volunteers, yes, they will be minimal. But, again, this is not a saving exclusive to tiny forests. Many traditional plantings are also looked after by volunteer groups. The long-term maintenance requirements are unknown and difficult to predict. How will a complex mix of species interact over time? Will there will be high numbers of wasteful failures due to the competition (see j, below).

Descriptions of the tiny forest process are varied in whether trees are watered post-planting. Traditional planting of whips does run the risk of failure as extensive watering is difficult on uneven terrain and simply too expensive relative to beating up/replanting the next year. Watering of small-scale plantings close to a (metered?) water supply may be possible, but any meaningful comparison of methods needs to clarify differences in technique.

j. Fewer plant losses

Acceptable losses for conventional planting are 5–10% and tiny forest suppliers are claiming the same. This is hard to believe because of the incredible competition created by the high density of planting. For example, Schirone *et al.* (2011) using the Miyawaki method reported 23% mortality after 2 years and 61% after 12 years, with their second site recording 85% mortality after 12 years.

The typical Miyawaki tennis-court-sized planting commonly referred to, covering 216 m^2 and planted at the rate of 5–12 plants per square metre, uses between 1,080 and 2,592 trees and shrubs. With conventional tree planting (1.5 m x 1.5 m spacing), 178 trees would be planted in the same area. So, 10% losses with both techniques will give vastly different numbers!

k. More community involvement

This is very much part of the tiny forest ethos, and this aspect of their administration should be greatly applauded. Promoters and supporters of all tree-planting initiatives should take note and realise that there is an important but still largely untapped desire by the public to get involved in such projects. Developing a sense of ownership over planted trees should also help in protecting and nurturing them post-planting.

There is a further spin-off of community involvement suggested and that is community mobilisation underpinning access and well-being. Tiny forests have been promoted as 'a pleasant and healthy spot for neighbours to come together'.

Some may have an access point, a bench, or some other means to enjoy the surroundings. However, the dense plantings of trees themselves are likely to be impenetrable to people (and other larger mammals). Even if a proportion of the planted trees die through suppression or are thinned out, older tiny forests still appear dark and claustrophobic. People are only able to view these thickets from outside or from paths created that run between the planted clumps. Is this the best way to maximise or improve levels of well-being that the trees should or could provide?

Are tiny forests really a valuable alternative to traditional woodland planting methods? Conventional plantings are not only perfectly acceptable, successful and cheaper, they are also more suited for small urban plots where people will be able to walk and sit in the shade they create.

Let's also not forget that in many regions and countries there are already plenty of (traditional) tree planting programmes involving citizen participation – for all ages – that have nothing whatsoever to do with Miyawaki. And the extent of tree waste that tiny forests may initiate could be highly detrimental to long-term participation as citizen's efforts will not be rewarded. Seeing their plantings struggling, dying, being removed prematurely, or becoming inaccessible would be a massive disappointment and toxic to any attempt at improving well-being.

It seems a little ironic that this Japanese system seems to have forgotten or ignores the many woodland pleasures originally appreciated and described in Japan such as: *Shinrin-yoku* (森林浴) 'Forest Bathing'. They even have a term (*Komorebi* – 木漏れ日) for 'Sunshine filtering through the trees' – something that will be hard to enjoy in a tiny forest that will just remain an impenetrable and soul-less thicket.

l. Greater educational value

Promotional material from one company suggests that their tiny forests will be 'outdoor classrooms' and that, children 'can learn about the native flora and fauna'. This potential could be linked to any tree planting, not just Miyawaki-style plantings. The potential for education associated with tree planting does not appear to be proportionate to tree-planting density or even method. Focusing on a small area may mean the task is manageable for a community gathering for a day or two, but its environmental impact is likely to be small too.

m. Naturalness: Is the Miyawaki method more or less 'natural' than other tree planting methods?

A common theme to the literature on Miyawaki is that in some way it is natural. However, photos on websites of excavators moving soil around for site preparation and the call that sites must be near roads for access suggests that this claim rings hollow. Is the Miyawaki forest only possible near a community and is thus a little luxury, or does it have any lessons for more extensive woodland planting? The rate of carbon sequestration and many of the other stated benefits are only of significance on an extensive scale of thousands of hectares.

n. Innovative

Clearly the Miyawaki method is different from what might be termed traditional or conventional. But is it innovative in that it teaches us something we did not know already? Possibly it just reminds us of what we should already know – we can get very good establishment if we prepare for planting and look after planted trees. Our planting sites are littered with tree shelters and stakes, and weeding of trees (as opposed to the cutting of grass) may be a forgotten skill. Whether the stakes and plastic tubes are removed at the appropriate time depends on the site and operator.

A tiny forest comparison plot with traditional planting adjacent to it in January 2024 after planting in late 2020 or early 2021. The traditional planting within the grass sward had largely failed due to lack of grass control. The Miyawaki planting can be seen on the left with the 'traditional' on the right. (photo: Jon Heuch)

o. A better way of building forests and one of the most effective tree planting methods

For the various reasons explained above, this broad claim is difficult to accept. Both planting and establishment need to be done cost effectively. The Miyawaki method, despite overcoming the issue of weeds and unsightly tubes, is expensive and the long-term tree cover outcomes remain highly speculative.

Summary

The Miyawaki method of tree planting is an alternative method of tree establishment that differs from current methods used in arboriculture and forestry. And tiny forests themselves can vary in how they are 'translated' from the original concept.

Most published and promoted comparisons with traditional methods are done 'in-house' by Miyawaki providers and have not been independently assessed. So too, the post-planting monitoring and data collection. Fuller and fairer peer-reviewed evaluations and trials are much needed.

In our opinion, the benefits claimed for the process appear to be exaggerated, misleading, incorrect and/or extremely speculative. As one example, an adequate response to the threats arising from climate change requires significant changes to the way we live and consume energy and other resources. Planting tiny forests will achieve nothing on the scale required. Flooding control, air quality amelioration and carbon sequestration from these small areas will also be negligible.

There is no doubt, however, that the Miyawaki marketing and promotion methods have excelled in public engagement and raising awareness of the importance of trees. But this is not a benefit of Miyawaki; it is just a sad indictment of our current professional lethargy and blinkeredness.

Conclusions

The Miyawaki system appears to have significant flaws and is not what it is often promoted as – a way of saving the planet. Although better than nothing, it offers very little more or new that traditional tree planting methods don't already offer – with fewer inputs – both in the long and short term.

A great concern is that public money is already starting to be used to fund Miyawaki plantings – seemingly without a full appraisal of their true costs and benefits. Similarly, what could be achieved if the same resources applied to the Miyawaki method were used on more extensive plantings using traditional methods, possibly involving a greater number of communities and people?

If 500 tiny forests, all the size of a tennis court (0.0216 hectares) were established in the UK, they would occupy 10.8 hectares which is just over a twelfth of the size of Kew Gardens (120 hectares) – so a relatively small contribution to any national reafforestation/tree planting effort. More importantly, perhaps, at the current costs known, these 500 dense thickets would cost £11 million in total.

There has been considerable coverage of the Miyawaki system and Miyawaki-influenced projects, including in Mike Charkow's article in *ARB Magazine* 197 (summer 2022) which states the Miyawaki method can be 'cheap, quick and easy' and is one of the simplest ways to do something against 'climate change' and 'species loss'. We are not convinced by these statements but hope our concerns will initiate debate, discussion and clarification in the future.

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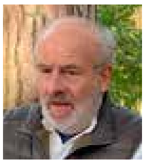
A site in East Sussex planted in winter 2014/15 and photographed in January 2024. The maximum heights reached (as of January 2024) are between 4 metres and 5 metres. Rabbit guards are not usually part of the Miyawaki process these days. (photos: Peter Thurman)

James Newmarch: Landscape Architect/Manager formerly at East Sussex County Council and East Sussex Highways – designing, establishing, and managing tree planting, often involving the voluntary sector; now semi-retired.
Naomi Zurcher: Urban Forester, Consulting Arborist and i-Tree team affiliate member based in Switzerland, specialising in urban forestry, participatory management and Building WITH Trees strategies.

Dr Jon Heuch is a Registered Consultant of both the Association and the Institute of Chartered Foresters. He was a trustee of the Arboricultural Association from 2007 to 2016, serving as Vice Chairman 2008–09 and Chair 2009–10.



Peter Thurman is a Fellow of the Association and a retired arboricultural, horticultural and environmental consultant and landscape designer. He is based in East Sussex.

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