

Carinthia II

Part 3

Nature Tech

Published since 1811
215th Year of Carinthia



Volume 2

Issue 2

2025 Verlag des Naturwissenschaftlichen
Vereins für Kärnten

Establishment of the Miyawaki forest at Carinthia University of Applied Sciences in Villach

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ABSTRACT

The Miyawaki method offers a fast and effective nature-based solution for the restoration of ecosystems, especially in urban areas. Developed by Akira Miyawaki, the approach relies on dense planting of native species to create diverse, multi-layered forest ecosystems, resulting in a so-called Miyawaki Forest (MF). In April 2025, an MF was created on the campus of Carinthia University of Applied Sciences (CUAS) in Villach as part of the Interreg IT-AT project BioBox to promote urban biodiversity, especially for pollinators and birds. Following soil analysis, an area of 91 m² was prepared by plowing and enrichment with straw and compost. Inspired by the species composition of local riparian forests along the Drava River, nearly 300 saplings of native trees and shrubs were planted in three vertical layers by 16 volunteers. The MF at CUAS will serve as an outdoor laboratory for the students to monitor soil, growth and biodiversity. Although they are still rare in Austria, MF — like the CUAS pilot project — demonstrate the potential of small-scale urban forests to increase biodiversity, improve ecosystem services and engage communities. The Miyawaki method offers significant long-term environmental benefits, including better air and soil quality, urban cooling and carbon sequestration.

Anlage eines Miyawaki-Waldes an der Fachhochschule Kärnten in Villach

ZUSAMMENFASSUNG

Die Miyawaki-Methode bietet eine schnelle und effektive, naturorientierte Lösung für die Wiederherstellung von Ökosystemen, insbesondere in städtischen Gebieten. Entwickelt von Akira Miyawaki, basiert der Ansatz auf der dichten Bepflanzung einheimischer Arten, um vielfältige, mehrschichtige Waldökosysteme zu schaffen, die als sogenannte Miyawaki-Wälder (MW) bekannt sind. Im April 2025 wurde auf dem Campus der Fachhochschule Kärnten (FHK) in Villach im Rahmen des Interreg IT-AT-Projekts BioBox ein MW angelegt, um die städtische Biodiversität, insbesondere für Bestäuber und Vögel, zu fördern. Nach einer Bodenanalyse wurde eine Fläche von ca. 91 m² durch Pflügen und Anreicherung mit Stroh und Kompost vorbereitet. Inspiriert von der Artenzusammensetzung lokaler Auwälder entlang der Drau pflanzten 16 Freiwillige ca. 300 Setzlinge einheimischer Bäume und Sträucher in drei vertikalen Schichten. Der MW wird als Freiluftlabor genutzt, in dem Studierende Boden, Wachstum und Biodiversität untersuchen und überwachen. Obwohl Miyawaki-Wälder in Österreich bislang nur vereinzelt realisiert wurden, illustriert das Pilotprojekt der FHK das Potenzial kleinräumiger Stadtwälder zur Förderung der Biodiversität, zur Verbesserung ökologischer Funktionen und zur Einbindung lokaler Gemeinschaften. Die Miyawaki-Methode bietet bedeutende langfristige Umweltvorteile, darunter eine bessere Luft- und Bodenqualität, städtische Kühlung und Kohlenstoffbindung.

INTRODUCTION

A Miyawaki forest (MF), also known as a tiny forest or pocket forest, is derived from a rapid reforestation method developed by the Japanese botanist Akira Miyawaki in the 1970s that has attracted worldwide attention. It represents a paradigm shift in ecological restoration as the Miyawaki method offers a fast and effective approach to establishing native forests in degraded or urban environments. An MF distinguishes itself through its emphasis on indigenous species, dense plantings, and soil preparation, fostering accelerated forest development and an increase in biodiversity [1]. An MF is established through dense planting of native trees and understory plants with application to restore degraded land or make urban areas more attractive and biodiverse. By mimicking natural forest ecosystems, a diverse, multi-layered and resilient plant community is created in which species support each other. This approach can be considered a nature-based solution and provides a fast, effective and sustainable way to restore native ecosystems that have been degraded or altered.

KEYWORDS

- Miyawaki forest
- tiny forest
- potential natural vegetation
- CUAS
- reforestation

The selection of species for MF follows the principle of potential natural vegetation. The MF is intended to develop into a climax vegetation community that could develop and persist under the current climate and soil conditions in an area given there is no human influence, no disturbance, and assuming long-term natural succession [2]. Typically, more than 20 different native tree and shrub species are used, resulting in a multi-layered forest. The MF method accelerates forest development by planting a dense mixture of as many native mid-successional, late-successional, and climax species as possible in richly prepared soils, skipping early successional stages. Species are distributed over several structural levels (canopy, sub-canopy, understory trees, and shrubs) aiming to form a mature canopy within 20–30 years [3].

By design, MFs cover relatively small areas, from less than 100 m² up to several thousand m². These tiny forests are now very popular in urban areas because they fit into areas that are suitable for renaturalization. The planting phase involves a high-density arrangement, typically three to five seedlings per square meter, which encourages intense competition for resources among the plants, driving up growth and accelerating the natural selection process [4].

MF plantings have a high survival rate and grow at an annual rate of at least one vertical meter. After about three years, a completely self-sufficient, natural and indigenous forest will have developed that requires no further maintenance. MFs improve soil quality, prevent erosion, improve groundwater retention, significantly reduce heat and noise, improve air quality, and absorb up to 30 times more CO₂ than conventional monoculture plantations. In addition, they support the local fauna and do not require the use of chemical fertilizers [3], [5].

An MF utilizing the Miyawaki method was established in April 2025 on the Carinthia University of Applied Sciences (CUAS) campus in Villach as an implementation measure of the Interreg IT-AT project BioBox, with the goal of improving biodiversity in urban areas, and with particular focus to increase the diversity of pollinators and birds. The MF will also serve as a polygon for monitoring biodiversity and ecosystem services for CUAS students.

METHODS

When setting up the MF at CUAS, we adhered to the established steps [6]. We installed the MF planting area to the north of the main Villach campus building (46.611856 N, 13.882840 E). The area was configured as two half-circles and covered approximately 90 m². The soil was analysed, plowed and enriched with mature compost.

Since the area of the Drava River near the Villach campus is quite densely populated and the forests have been heavily modified, we were inspired by the nature reserves along the Drava [7] and various publications [8], [9], [10]. Most of the species planted in the CUAS MF can be found along large rivers in mixed riparian forests containing *Quercus robur*, *Ulmus laevis* and *Ulmus minor*, *Fraxinus excelsior* or *Fraxinus angustifolia* in a habitat type referred to as *Ulmion minoris*. We selected several native flowering species of smaller trees and shrubs that attract insects and birds, thus increasing biodiversity and aesthetics.

On 23 April 2025, approximately 300 seedlings of native trees and shrubs were planted (Table 1). The planting was organized in a participatory manner. After planting, a thick mulch layer of wood chips was applied to retain moisture and control weeds. The planned maintenance included summer irrigation in the first year, which will be repeated in summer 2026. A low protective fence will be erected around the forest to prevent damage

to shoots and bark caused by wildlife (primarily rabbits) and to restrict pedestrian access during the early stage of growth.

Tab. 1						
	Scientific name	Common name	Vertical layer	Maximum height (m)	No. of plants surveyed	No. of plants invoiced
1	<i>Cornus mas</i>	Cornelian cherry	1	5	9	10
2	<i>Cornus sanguinea</i>	common dogwood	1	4	14	15
3	<i>Corylus avellana</i>	hazel	1	4	7	5
4	<i>Crataegus monogyna</i>	common hawthorn	1	5	31	30
5	<i>Euonymus europaeus</i>	European spindle tree	1	4	30	30
6	<i>Prunus spinosa</i>	blackthorn	1	5	24	25
7	<i>Rhamnus frangula</i>	alder buckthorn	1	5	34	35
8	<i>Salix purpurea</i>	purple willow	1	3	26	28
9	<i>Sambucus nigra</i>	black elder	1	7	8	10
10	<i>Viburnum lantana</i>	wayfaring tree	1	4	15	15
11	<i>Viburnum opulus</i>	Guelder rose	1	4	17	18
12	<i>Weigela florida</i>	old-fashioned weigela	1	2	1	0
13	<i>Alnus glutinosa</i>	black alder	2	25	5	4
14	<i>Alnus incana</i>	grey alder	2	20	1	2
15	<i>Populus tremula</i>	quaking aspen	2	21	0	2
16	<i>Prunus padus</i>	bird cherry	2	10	22	20
17	<i>Salix alba</i>	white willow	2	25	11	10
18	<i>Taxus media</i> ‘Hicksii’	common yew	2	15	14	15
19	<i>Fraxinus excelsior</i>	European ash	3	30	2	4
20	<i>Populus alba</i> ‘Nivea’	white poplar	3	30	4	3
21	<i>Quercus robur</i>	English oak	3	40	3	3
22	<i>Ulmus laevis</i>	European white elm	3	35	11	12
total					289	296

Table 1:
Species of trees and shrubs in three vertical levels. Layer 1 represents understory species, layer 2 represents sub-canopy species, and layer 3 represents canopy species.

Tabelle 1:
Arten von Bäumen und Sträuchern in drei vertikalen Schichten. Schicht 1 repräsentiert Unterwuchsarten, Schicht 2 repräsentiert Unterkronenarten, und Schicht 3 repräsentiert Kronenarten.

A low-altitude flight was conducted over the MF on 23 September 2025 using an uncrewed aerial vehicle (UAV), generating an orthophoto of the MF following the first growing season. A survey of the surviving plants was made in parallel to the UAV flight. Locations of each plant were approximated using QGIS software by placing color-coded points onto the orthophoto, and the resulting shapefile was exported into ArcGIS (Environmental Systems Research Institute, Inc., Redlands, CA, USA) for visualization.

RESULTS

According to the soil map of Austria, eutric cambisols are present along the Drava River at Villach [11]. The initial analysis of the vertical soil profile indicated a shallow organic horizon (3 cm depth), eutric brown soil (9 cm depth), underlaid by a predominantly sandy soil with clay admixtures, which is most likely a remnant of historical alluvial deposits from the Drava River (Figure 1). After plowing, we enriched the soil with 0.9 m³ of mature compost with straw. With 16 student and staff volunteers (Figure 2), approximately 300 seedlings of 21 native tree and shrub species were planted. Planting took about two hours, after which 5.5 m³ of mulch and wood chips were added (Figure 3). A total of 4,175 € was spent to establish the forest, covering the purchase of seedlings, compost, wood chips for mulching, and gloves. The costs do not include the fence, which will be installed later, or the volunteer work. A representative distribution of the plantings is shown (Figure 4).

**Fig. 1****Fig. 2****Fig. 3**

DISCUSSION

Tiny forests are not yet widespread in Austria. The closest MF to our knowledge is in Maribor in Slovenia, established in 2020. As part of a pilot project “Wiener Wäldchen”, several tiny forests were planted in Vienna in 2022. In this respect, the CUAS MF will also serve to raise awareness among stakeholders about the benefits of urban forests, will increase local biodiversity, and will be a stepping stone between other green habitats in the city. It will also serve as a learning tool for students who will be able to measure and evaluate soil parameters, growth rates and biodiversity of flora and fauna over the years, especially in comparison to other empty or vegetated control plots in the neighborhood. Regular monitoring is planned.

Figure 1:
Soil core sample from
under the planned
CUAS Miyawaki forest
site, pre-planting stage

Abbildung 1:
Bodenkerprobe vom
geplanten Standort des
FHK-Miyawaki-Waldes,
vor der Pflanzphase

Figure 2:
Participatory planting
(photo credit: Elisabeth
Wiegele)

Abbildung 2:
Partizipative Pflanzung
(Foto: Elisabeth
Wiegele)

Figure 3:
Planted CUAS tiny
forest following the
Miyawaki method

Abbildung 3:
Gepflanzter FHK-
Miniwald nach der
Miyawaki-Methode

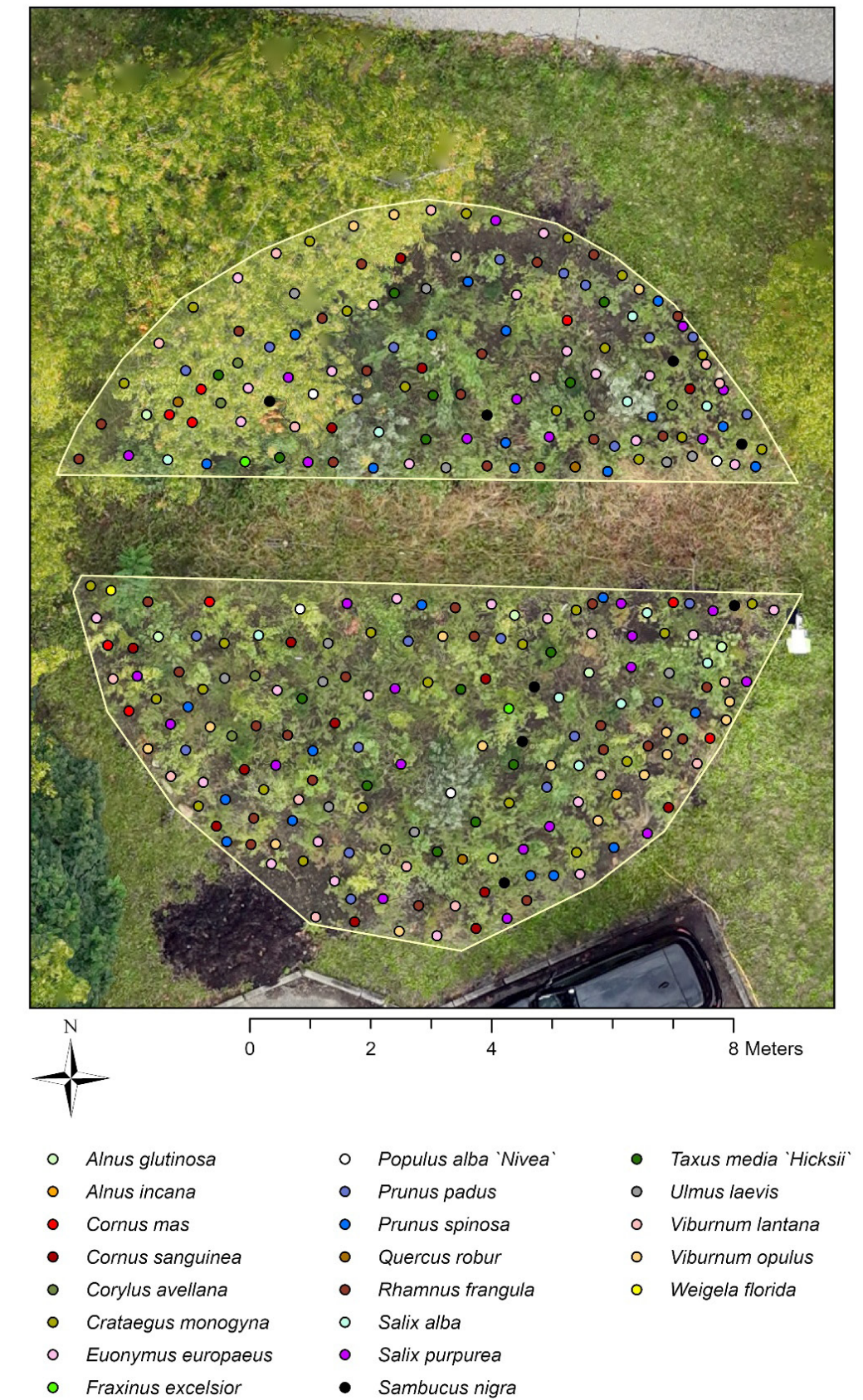


Figure 4:
Visualization of the
Miyawaki Forest
planting from above

Abbildung 4:
Visualisierung
der Miyawaki-
Waldpflanzung
von oben

Fig. 4

Despite some concerns about intensive site preparation, planting density, reduced genetic diversity, management required and low aesthetics in the early stages of forest establishment, the MF method offers numerous advantages. The importance of careful planning of the MF and ongoing research is emphasised to optimise the effectiveness of the tiny forest as a nature-based solution and to ensure its long-term success.

ACKNOWLEDGEMENTS

Funding for the Miyawaki Forest planting was provided through the Interreg IT-AT project BioBox, Project Number ITAT-27-008. We additionally thank the volunteers who conducted the site preparation and field plantings.

REFERENCES

- [1] A. Miyawaki, "Restoration of urban green environments based on the theories of vegetation ecology," *Ecological Engineering*, vol. 11, no. 1-4, pp. 157-165, 1998, doi: 10.1016/S0925-8574(98)00033-0
- [2] A. Chiarucci, M. B. Araújo, G. Decocq, C. Beierkuhnlein, and J. M. Fernández-Palacios, "The concept of potential natural vegetation: an epitaph?," *Journal of Vegetation Science*, vol. 21, no. 6, pp. 1172-1178, 2010, doi: 10.1111/j.1654-1103.2010.01218.x
- [3] L. Butfoy, Miyawaki Method Handbook. Kent: Kent County Council, 2023
- [4] J. C. Rodríguez and C. Sabogal, "Restoring degraded forest land with native tree species: The experience of "Bosques Amazónicos" in Ucayali, Peru," *Forests*, vol. 10, no. 10, p. 851, 2019, doi: 10.3390/f10100851
- [5] M. L. Cárdenas, B. Pudifoot, C. L. Narraway, C. Pilat, V. Beumer, and D. B. Hayhow, "Nature-based solutions building urban resilience for people and the environment: Tiny Forest as a case study," *Quarterly Journal of Forestry*, vol. 116, no. 3, pp. 173-183, 2022
- [6] V. E. Cambria, C. Fratacangeli, G. Fanelli, V. C. Cuccaro, I. Panero, M. De Sanctis, et al., "Testing the Miyawaki method in Mediterranean urban areas through a standardised experimental design," *Botany*, vol. 102, no. 9, pp. 379-386, 2024, doi: 10.1139/cjb-2024-0045
- [7] Drava - Natura 2000. "Riparian oak-ash-elm woodlands along large rivers," 2025, available: <https://drava-natura.si/en/habitats/riparian-oak-ash-elm-woodlands-along-large-rivers> (accessed 13 October, 2025).
- [8] I. Dakskobler, L. Kutnar, and U. Šilc, "Poplavni, močvirni in obrežni gozdovi v Sloveniji: gozdovi vrb, jelš, dolgocepljatega bresta, velikega in ozkolistnega jesena, doba in rdečega bora ob rekah in potokih," 2013, available: https://www.gozdis.si/f/docs/Publikacije/51_Poplavni_gozdovi_Dakskobler_et_al_celotna_2013.pdf
- [9] European Environment Agency, "Riparian mixed forests of *Quercus robur*, *Ulmus laevis* and *Ulmus minor*, *Fraxinus excelsior* or *Fraxinus angustifolia*, along the great rivers (*Ulmion minoris*)," 2025, available: <https://eunis.eea.europa.eu/habitats/10199> (accessed 13 October, 2025).
- [10] M. A. Fischer, K. Oswald, and W. Adler, "Exkursionsflora für Österreich, Liechtenstein, Südtirol," Land Oberösterreich, Biologiezentrum der Oberösterreich. Landesmuseen, 2008
- [11] W. Rieck, "Bodenkarte von Österreich. (Soil map of Austria)," Joint Research Centre, European Soil Data Centre, 1989, available: <https://esdac.jrc.ec.europa.eu/content/bodenkarte-von-osterreich-soil-map-austria> (accessed 13 October, 2025)

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